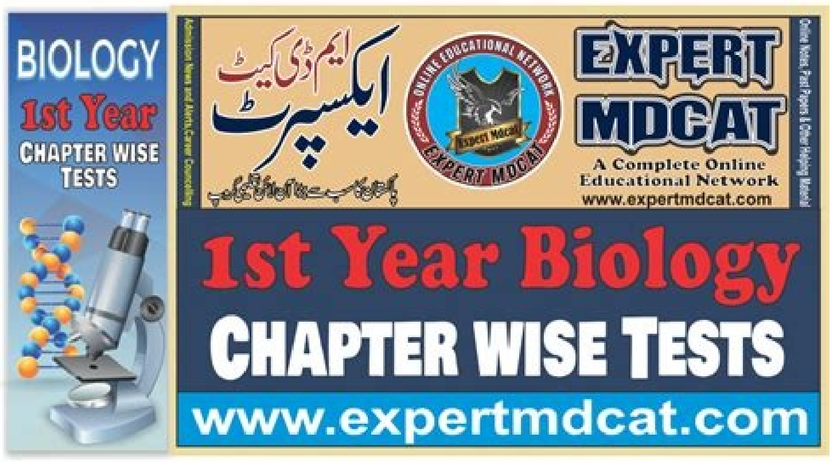
Exploring science hsw edition year 9 answers



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He writes science education materials for most of the major UK publishers (Pearson â€“ including Edexcel, Heinemann & Longman), Nelson Thornes (now part of Oxford University Press), Hodder Education and HarperCollins. He is also the series editor on a number of publications, including Exploring Science and Edexcel 9-1 GCSE Sciences. Exploring Science builds a foundation of science skills while fostering students' natural curiosity about their world. The series combines vibrant print books with online ActiveLearn resources. This course is suitable for students who will go on to study any awarding body's GCSE science specifications. Answers 8A Food and nutrition L6 8 27.2 g sugars, 1.0 g starch 8Aa Nutrients L6 9 starch Student Book 1: 8Aa Food and advertising L4–6 1 Students’ own answers: L4 e.g. for energy, growth and repair, and health L5 because food contains nutrients, such as proteins and carbohydrates, which are used for different activities in the body L6 match some names of nutrients with their uses in the body L4 2 a Chewing (hard foods, walnuts) will strengthen face muscles (and stop sagging faces). L5 b There is no evidence that chewing hard foods stops faces becoming saggy. L5 3 a They contain vitamins/vitamin B1. L5 b They contain a lot of sugar/fat, which can be bad for you/make you fat. L5 4 a the digestive system L6 10 a iodine solution for starch testing (blueblack colour if starch present), rubbing sample on paper (greasy mark left if fat present), Biuret solution for protein testing (purple colour if protein present) b There is also water in the food. Activity Pack 8Aa-1 Nutrients L4 1 what you eat L4 2 one of: keeping warm, moving, thinking, growing, or any other sensible suggestion L5 3 a vitamins, minerals L5 b wheat flour, modified starch, sugar L5 c milk fat, vegetable oil (cheddar cheese or cream are other options) L5 d 6 g L5 e 24 g L5 f 100 g L5 b any two from: teeth, food pipe/ oesophagus/gullet, stomach, small intestine/ intestines, large intestine/intestines, rectum, anus, liver, salivary glands (there are others, e.g. pancreas, gall bladder) L6 g fibre (not energy, because energy is not a substance) L6 c description of the function for the organ parts in part b, see page 14 of the Student Book 8Aa-8 Nutrition labels L4 1 Julie has a lot of starch in her diet. L4–5 5 Students’ own answers: L4 eat a lot of fruit and vegetables L5 answer includes a reason, e.g. ‘because they contain lots of vitamins and minerals’ 2: 8Aa Nutrients L4 1 what you eat L5 2 a raw material for your body b energy, growth and repair, health L6 h to help food move through the intestines L6 4 starch L4 2 giving you energy, growing and repairing, keeping you healthy L4 3 a ingredients, nutrition, allergy advice L4 b one of: keeping warm, moving, thinking, growing, or any other sensible suggestion L5 c protein, carbohydrate, fat (completed on the label) L5 d downwards from energy: 1600 kJ, 3 g, 20 g, 7 g, 3 g L6 3 Fibre helps undigested food pass through the intestines by stopping the intestines getting blocked. Water helps to lubricate the food. L5 e fibre (energy is not a substance) L6 4 Students’ own answers, making use of the different ways of using persuasive language from 8Aa Food and advertising L5 b WowPow bars contain energy! L6 5 because you lose water when you sweat and water is very important in your body for dissolving things, acting as a lubricant and filling up cells L5 6 protein, carbohydrates (sugars), fat, sodium L5 7 because some people are allergic to nuts 450 L5 f vitamins or minerals L4 4 a To persuade you to buy the product. L5 c They’re also delicious! 8Aa-9 Super fibre bars L4 1 growth and repair, energy, health L4 2 nuts L5 3 a protein, carbohydrates, (sugar), fats, vitamin B1 © Pearson Food and nutrition b 12 g c 25 – (2 + 15 + 6) = 2 g L5 4 The protein per 100 g should be 8 g and not 6 g and the vitamin B per 100 g should be 5.6 mg and not 0.34 mg. L5 5 a fat, protein, sugar L6 b Drop iodine solution onto the bar and look for blue/black colour; rub the bar onto a piece of paper and hold it up to the light to look for a greasy mark. L6 6 to keep your intestines healthy/stop constipation/help move food through the intestines L6 7 a It implies the bar contains lots of fibre when in fact it contains hardly any. b Students’ own responses. 8Aa-10 Sorghum syrup L5 1 a carbohydrate b fats (oils), proteins, vitamins and minerals L5 2 the lowest of the lines/the non-reducing sugar line L5 3 a 1.8% b 18% L6–7 4 From 70 days after planting until 100 days, the amount of both types of sugar within the plant increases, but the reducing sugars increase more quickly than the non-reducing sugars. The total sugar content reaches a peak after 130 days, after which the levels of both sugars decrease at the same rate. A level 6 answer will indicate the rises and falls of the graphs. A level 7 answer will include details of the rates of increase/decrease. L7 5 a Yellow, because it contains 1–1.5% reducing sugars. b Orange, because now the solution contains both the original reducing sugars and also the reducing sugars convert into non-reducing sugars by boiling in acid. So, the total sugar content is between 1.5% and 2%. L7 6 anywhere between 82 and 92 days L7 7 a After 130 days because this is when the sorghum contains the most sucrose. L6 b Students’ own responses. 8Ab Uses of nutrients Student Book 1: 8Ab Uses of nutrients L5 1 carbohydrates (e.g. starch, sugars), fats/ lipids (e.g. solid fats, oils), proteins, vitamins, minerals L5 2 He has eaten more food than he needs (the energy content of his food is greater than the energy requirement for his daily activities). L6 3 for energy L6 4 as energy, as an energy store and to help stop heat escaping from your body (a heat insulator) © Pearson L4 5 a 1865 kJ L5 b 11–14 year old boys need 10 700 kJ, girls need 9500 kJ. So boys need 10 000/1865 = 5.74 lots of 100 g quantities of the food = 570 g (to two significant figures). By the same reasoning girls need 510 g. Another way of doing this calculation is to work out the energy per gram at the start and divide the amount of energy needed by this figure. L5 c 2 hours of slow walking uses 940 kJ so 940/1865 = 0.5 lots of 100 g = 50 g OR 1865 kJ is provided by 100 g therefore 940 kJ is provided by 100/1865 × 940 = 50 g (to two significant figures) 50 g provides enough energy for 2 hours’ slow walking L4 6 a 15–17 years old L6 b This is a time of very fast growth and changes in the body. L6 7 a Ravi b He has to move around more, which requires more energy than sitting at a desk. L6 8 The carbohydrates she does not need for energy will be turned into fat in the body and stored: this will increase her mass. L4 9 for energy, for growth and repair, for health L5 10 a carbohydrate, e.g. potatoes, bread (starches), sweets, cakes (sugars); proteins, e.g. fish, meat, eggs, nuts; fats/lipids, e.g. milk, butter, cooking oils; vitamins, e.g. fruits, vegetables (or specific examples, e.g. vitamin A from eggs, vitamin B12 from red meat); minerals, e.g. fruits, vegetables (or specific examples, e.g. calcium from milk, iron from spinach) L6 b Nutrient Why nutrient is needed carbohydrates energy fats energy storage (and insulation) proteins growth and repair vitamins and minerals health Some students may say that all nutrients are needed for health. L7 11 not having very much energy or being short of breath (students should link their answers with knowledge that iron is used in red blood cells, which are responsible for carrying oxygen around the body) 2: 8Ab Weighting and bias L4 1 a text B (it is trying to grab attention/make you buy the newspaper) L5 b The scientific paper is accurately reporting a hypothesis about the possible cause of rickets (‘may be responsible’) while the newspaper has used the more definite word ‘causes’ to add weight to its report. 451 8 A Food and nutrition 8 A L5 2 It describes the disease as ‘terribly painful’ and ‘disfiguring’. These adjectives are hard-hitting and emotive. Some students may also point out that the disease is associated with grime and poor living conditions, with the writer making that association in the last sentence. L5 3 a Powerful adjectives are used to add weight to the nouns (e.g. ‘fantastic’, ‘fabulous’, ‘super-strong’, ‘healthy’). It has also used a powerful verb (‘devour’ rather than ‘drink’). L5 b There is no evidence to support the idea that Gamer’s Friend is the ‘best’ for giving superstrong and healthy bones; there is no evidence that Gamer’s Friend will give you super-strong bones rather than bones of a normal strength; there is no calcium in Gamer’s Friend (as far as we can tell) and that is needed for bones. L6 c Students’ own responses, using weighted vocabulary but without making claims about the drink being the best for strong bones. L5 4 Students’ own responses, e.g. ‘contains a great source of vitamin D – a vital vitamin for healthy bones’. L5 5 Adjectives are used to suggest the product has been improved – ‘new’, ‘better’ – and to make it sound mouth-watering – ‘crispy’, ‘crunchy’. L6 6 it has only used the part about rickets being caused by lack of sunlight; it has ignored the word ‘probably’; it has made up the part about video gaming, which was never mentioned in the original scientific paper Activity Pack 8Ab-1 Uses of nutrients L4–5 1 carbohydrate – as a fuel – potatoes protein – for growth and repair – meat fat – for storing energy – butter (or milk) vitamin C – to help hold tissues together – fruits calcium – for strong bones – milk (or butter) 2 a (7 × 180) + (8 × 350) + (2 × 250) + (2 × 400) + (3 × 470) + (2 × 250) = 1260 + 2800 + 500 + 800 + 1410 + 500) = 7270 kJ b more energy c Males need more energy than females. d less energy e Older people need less energy than people in their twenties. f She would become overweight. g Any extra carbohydrate that she does not use up would turn into fat and be stored. 8Ab-3 Matching energy and foods L4–6 Cards are linked thus: 452 Walking slowly for an hour (470 kJ) = 25 g of cornflakes (375 kJ) + 38 g of milk (95 kJ) Cycling slowly for an hour (660 kJ) = 80 g of baked potato (280 kJ) + 12 g of butter (380 kJ) Jogging for 45 minutes (990 kJ) = 70 g of sliced white bread (665 kJ) + 11 g of butter (325 kJ) Ballet dancing for 2 hours (2560 kJ) = 120 g of sponge cake (2280 kJ) + 56 g of custard (280 kJ) Cycling up a hill for 10 minutes (440 kJ) = 100 g of banana (350 kJ) + 45 g of apple (90 kJ) Playing tennis for 90 minutes (2060 kJ) = 100 g of sausage roll (1950 kJ) + 100 g orange juice (110 kJ) Playing volleyball for 45 minutes (570 kJ) = 22 g of chocolate (484 kJ) + 172 g of tea with milk (86 kJ) Rollerblading for an hour (1850 kJ) = 150 g of chicken curry (1500 kJ) + 70 g of rice (350 kJ) Skiing for 2 hours (1640 kJ) = 60 g of samosa (1440 kJ) + 17 g of papadum (200 kJ) 8Ab-4 Take away L4 1 energy, growth and repair, health L4–6 2 a carbohydrate L5 ; as a fuel L4 for energy L6 b protein L5 ; for growth and repair L6 c vitamins/minerals L5 ; for health L6 L5 3 a fat L6 b to store energy/for insulation L5 4 a sugar b turns to fat, or causes tooth decay. L5 5 a no b The food does not contain all the vitamins you need (for example, there is no vitamin D in the foods). L5 6 a Three whole burger meals. This would give him an excess of 2200 kJ per day. L6 b No. If they eat two, they will get just slightly more energy than they need for the day, but this would not be a balanced diet as it lacks other nutrients such as vitamins. 8Ab-7 Foods and energy L4 1 a The amount of energy needed per day increases up to the age of about 15–18 and then starts to slowly decrease again. L4 b men L4 c If the female is very active and the male is not very active. L6 d People continue eating as much as they used to but need less energy as they get older. L5 2 a beef steak – protein; avocado – fat; rice – carbohydrate. b protein – any meat, fish, eggs, nuts; fat – milk, cakes, mayonnaise, oils; carbohydrates – bread, potatoes, sweets c starch © Pearson Food and nutrition L5 3 rice L5 4 football L5 5 a 2200 kJ (must state the units) L6 b It depends how fast you swim. Swimming faster uses more energy than swimming slowly. L6 6 a They may become overweight because they are eating foods with more energy than they need. The extra food is stored as fat by the body. b Beef. It doesn’t contain much fat or carbohydrate, which can be stored or converted by the body into fat stores. L6 7 a avocado (24 mg, compared with 2.5 mg for rice and 20 mg for beef) b beef (67 mg compared with 1 mg for avocado and 4 mg for rice) L6 8 a It dissolves in lipids (fats). b Avocado, because it contains the most fat (lipid). L6 9 Students’ own responses. Possibly using adjectives to add weight, using powerful verbs and not using all of the evidence in the table (for example not mentioning that rice contains much less fibre than avocados). 8Ab-8 The work of food scientists L4 1 a The sugar dissolves into the water. L5 b Filter the mixture, evaporate the solution and measure the mass of the solid sugar formed. L4 2 a 63 g L5 b The food also contains water. L5 3 a 1386 kJ/100 g L5 b 100 g × 4.4 °C × 4.2 = 18 480 J L4 c higher L5 d The fibre will also burn and release energy but humans cannot digest this. L6 4 It allows people to keep watch on how much energy their food contains and not eat foods containing more energy than they will use (which will make them overweight). L6 5 a age, gender and activity levels b Up to the age 15–18 you need increasing amounts of energy, but after this age the amount required goes down slowly. Males need more energy than females. People who are more active need more energy. L6 6 a It dissolves in lipids. L7 b In the fat because fat is a lipid. L7 c Vitamin A is needed for healthy skin and eyes. L7 d Calcium, which is used to help make bones. L6 7 Students’ own responses. Possibly using adjectives to add weight, using powerful verbs and not using all of the evidence in the table (for example, not mentioning the amount of fat that’s in the bar). © Pearson 8Ac Balanced diets Student Book 1: 8Ac Balanced diets L4 1 a diet that contains a wide variety of foods and all the different nutrients you need in the right amounts L5 2 They have too much of one or more nutrients in their diet and so their diet is not balanced. L6 3 a B – kwashiorkor because the child has a large belly, C – rickets because the leg bones are poorly formed b eating more fresh fruit and vegetables L5 4 They only eat enough energy-containing foods for their needs. L5 5 a obesity L5 b too much to eat/too much sugar and/or fat in the diet L6 c heart disease and high blood pressure are the expected answers but some students may include diabetes (Type 2) L6 6 a reference intake = 8400 kJ 920 kJ is provided by 100 g therefore 8400 kJ is provided by 100/920 × 8400 = 900 g b It doesn’t contain all the vitamins you need (e.g. vitamin A and vitamin C). c It adds vitamin A to the diet. Activity Pack 8Ac-1 Balanced diets L4 1 a foods containing lots of starch – bread, breakfast cereal; egg; dairy – milk, cheese; fatty and sugary foods – sweets; foods containing lots of protein – bacon, egg; fruit and vegetables – lettuce, orange b A balanced diet. L5 2 a group B L5 b Group B contains a wide variety of foods that contain all the different nutrients. L6 c Groups A and C are both missing fibre and the vitamins and minerals found in fruits and vegetables. L6 d per day L5–6 3 night blindness – poor eyesight in dim light – lack of vitamin A obesity – very overweight – too much food rickets – poorly formed bones – lack of calcium scurvy – bleeding gums – lack of vitamin C starvation – very thin – lack of food L6 4 any one of: high blood pressure, heart disease, poor circulation, Type 2 diabetes 453 8 A Food and nutrition 8 A 8Ac-2 Meal matching L5 Menu A 1200 Grilled fish 890 Baked potato 400 Small amount of butter 230 Carrots 280 Apple 0 Water Menu B 800 2 slices of brown bread 990 Egg salad 800 Yoghurt 10 2 lettuce leaves 400 Small amount of butter 0 Water Menu C 400 Grilled chicken 120 Green beans 130 Courgettes 1450 Vanilla ice cream 700 Rice 200 Apple juice with water Menu D 1200 3 sausages 650 Mashed potato 100 Gravy 90 Spinach 430 Banana 530 Milk Menu E 900 Lamb chop 400 Broccoli 1000 Boiled potatoes (with skins) 150 Mushrooms 420 Fresh fruit salad 130 Tea with milk (no sugar) Menu F 780 3 fish fingers 400 Oven chips 300 Peas 230 Custard 1100 Apple crumble 190 Orange juice and water drink 454 Menu F is the least well balanced because it contains a lot of sugar (in apple crumble, custard). 8Ac-3 Scurvy and beriberi L4 1 Your legs swell up, your joints become painful, your gums bleed and your teeth fall out. L5 2 a Scurvy is caused by something missing in the diet. L4 b The sailor who ate grass and his scurvy was cured. L4 c He gave sailors different additions to their diets and monitored their progress. L4 d fruit L6 3 a vitamin C L5 b deficiency diseases L6 4 a vitamin B1 b pain, paralysis, swelling in the limbs c Rice contained a poison (that was neutralised by the outer layer of rice). d Beriberi was caused by the lack of a nutrient/vitamin/‘accessory food factor’. 8Ac-4 Traffic lights L5 1 a 6% L5 b 18 g L6 c 90 g (5% of the reference intake is 4.5 g, so 1% is 4.5 ÷ 5 = 0.9 g, so 100% is 0.9 × 100 = 90 g) L5 2 FAT (green), SATURATES (green), SUGARS (green), SALT (green) L6 3 Breakfast cereal label (top of page): FAT 2.8 g per 100 g is low (green) SATURATES 0.4 g per 100 g is low (green) SUGARS 18 g per 100 g is high (red) SALT 0.8 g per 100 g is medium (orange) Label A: FAT 1.5 g per 100 g is low (green) SATURATES 0.5 g per 100 g is low (green) SUGARS 16 g per 100 g is high (red) SALT 1 g per 100 g is medium (orange) Label B: FAT 1.9 g per 100 g is low (green) SATURATES 1.1 g per 100 g is low (green) SUGARS 2.5 g per 100 g is low (green) SALT 0.1 g per 100 g is low (green) Label C: FAT 8.4 g per 100 g is medium (orange) SATURATES 8.4 g per 100 g is high (red) SUGARS 20 g per 100 g is high (red) SALT 0.1 g per 100 g is low (green) © Pearson Food and nutrition Label D: FAT 1.1 g per 100 g is low (green) SATURATES 0.2 g per 100 g is low (green) SUGARS 3.1 g per 100 g is low (green) SALT 1.6 g per 100 g is high (red) 8Ac-5 Balanced meals L4 1 a Eating a wide range of different foods to get the right amounts of nutrients. This means eating more of foods containing starch, fruits and vegetables and less of foods containing proteins, sugars, fats and oils, dairy products. L5 b If you don’t eat a balanced diet you may start to suffer from malnutrition and feel unwell. L5 2 a the ‘Pasta special’ L6 b some fruit L5 3 a & b Problem Too Too little of How the much of something problem something can be prevented obesity ✓ eat less (especially fats and sugars) starvation ✓ eat more scurvy ✓ eat foods rich in vitamin C rickets ✓ eat foods rich in calcium 8Ac-6 Fizzy drinks tax L4 1 a 163 litres b 112 000 000 × 163 = 18 256 000 000 litres (over 18 billion litres) L5 2 a obesity L4 b People are drinking too many fizzy drinks. L4 3 a He doesn’t think it will make any difference – people will continue to buy fizzy drinks. L5 b The fact that people continue to buy cigarettes despite taxes pushing prices up. L5 4 Patricia Varelas saying ‘It’s more expensive to buy a bottle of water than a soda’. OR Alejandro Calvillo saying ‘International studies show taxes are effective when the tax is high and consumption is high’. L5 5 Katherine Durán saying that the tax on fizzy drinks is ‘evil’; Katherine Durán saying she’d ‘buy it [fizzy drinks] whatever the price’. OR Victoria Cadena saying ‘But I do agree with the soda tax so we get educated and give up sweets, now’. L5 6 Students’ own responses. © Pearson L5–6 7 L5 It will raise money for the government. Or It will put people off buying fizzy drinks. L6 It will stop people buying so many fizzy drinks so obesity will be less of a problem and cost the government less in health care. L6 8 either diabetes (Type 2) or heart disease or high blood pressure. 8Ac-7 Food and health L5–6 1 a He eats too much L5 . His food contains more energy than he needs for his activity in a day and so this extra

energy is stored in fat L6 . L6 b heart disease or high blood pressure, but also diabetes (Type 2) L5–6 c Cut down on the amount he eats L5 . By cutting out foods that contain the most fats and carbohydrates since these contain a lot of energy (for example, the boiled sweets, chocolate, ice cream and cake) L6 . L5 d exercise more L5–6 e He doesn't eat enough food L5 . His food does not contain enough energy for his activity in a day L6 . L5–6 f any two of: protein, a wide range of vitamins and minerals L5 . Protein and a named vitamin, such as vitamin C which is only present in small quantities in this diet L6 . L5–6 g A deficiency disease L5 . A level 6 answer would make reference to particular deficiency diseases (e.g. kwashiorkor due to lack of protein and scurvy due to lack of vitamin C). L6 h Rickets because there is milk in his diet and milk is a good source of calcium. L6 2 a The recommended amount of a nutrient needed per day. b 34 sprouts c night blindness/problems seeing in dim light 8Ac-8 Diabetes and diet L5 1 a by eating too much (fatty and/or sugary food) b lack of exercise and getting older c the graph shows that as obesity rates have increased so have the rates of Type 2 diabetes. L6 2 When the pancreas was removed the urine contained sugars. L6 3 Topic sentence should be short, state the main point of the paragraph and be engaging. Supporting sentences should describe the findings of each doctor/scientist. The summary sentence should restate the main point, linking it back to the supporting sentences. For example: It took thousands of years from the first clues about the cause of diabetes until the discovery of insulin. In about 1500 BC an Indian doctor, called Susruta, 455 8 A Food and nutrition 8 A knew that diabetic urine was sweet. Matthew Dobson then showed in 1776 that diabetic urine contained sugar. Just over a hundred years later, Oscar Minkowski linked diabetes to a problem with the pancreas. Then in 1921 Banting and Best finally isolated insulin from the pancreas. Today we understand the role of insulin on blood sugar levels and we use insulin to control diabetes. L7 4 The glucose goes into the blood, insulin is produced but the cells don't respond to it and so glucose stays in the blood. OR the glucose goes into the blood, but very little insulin is produced and so only a small amount of glucose is taken into the cells. L7 5 They can cause blood glucose levels to rise quickly. L7 6 There is so much glucose in the blood that it gets into the urine. OR The body puts it in the urine to get rid of it. L7 7 Exercise increases the rate of respiration and so increases the rate at which glucose is taken out of the blood to provide energy. If there is less glucose in the blood, then less insulin will be needed. 8Ad Digestion Student Book 1: 8Ad Digestion L4 1 a breaks large/insoluble food molecules down into smaller ones L5 b many food molecules are too big for the body to use L5–6 2 L5 flow chart showing organs in the correct order and L6 a brief summary of the function for each: mouth (chews food and adds saliva), gullet/foodpipe/oesophagus (takes food to stomach), stomach (adds acid and digestive juices, churns food), small intestine (adds more digestive juices and absorbs food), large intestine (removes water from undigested food), rectum (stores faeces), anus (egests faeces) L6 3 ingestion is the taking of food into the mouth/gut; egestion is expelling undigested food from the anus/gut L6 4 The muscles in the wall of the gut behind a piece of food contract and squeeze the food along. L6 5 benefit – they can digest some foods that the body can't; drawback – they make you fart, some of them are harmful L6 6 a They contain enzymes, which break up big molecules into smaller ones. L7 b Scissors cut through paper and can make a large piece of paper into many smaller pieces of paper. Enzymes act in a similar way, turning large molecules into many smaller ones. 456 Activity Pack 8Ad-1 Digestion L5–6 1 The breakdown of food into smaller soluble substances is called – digestion. Large molecules such as starch and fats are broken down into smaller ones by – enzymes. Large molecules need to be broken down so that they can be – absorbed. Food is pushed through the gut by the contraction of – muscles. The food is churned up and mixed with acid in the – stomach. Food that cannot be digested has water removed in the – large intestine. After food is broken down it is taken into the body in the – small intestine. The intestines hold about 1 kg of microorganisms called – bacteria. When undigested food is pushed out through the anus it is said to be – egested. The tube that carries food into the stomach is called the – oesophagus. L6 2 The drawing on the right should show six separate squares. 8Ad-5 Digestive system parts L5–6 rectum – picture 6 – Faeces are stored here. salivary glands – picture 8 – They produce a digestive juice. anus – picture 7 – Egestion occurs here. oesophagus – picture 5 – Food is pushed down this tube into the stomach. mouth – picture 4 – The food is ground up by hard surfaces and mixed with a digestive juice. stomach – picture 1 – This organ churns up food with enzymes and acid. large intestine – picture 3 – Water is taken out of undigested food. small intestine – picture 2 – Most digestion occurs here. Small molecules are absorbed. 8Ad-7 Human digestion L4 1 i mouth; ii gullet; iii stomach; iv small intestine; v large intestine; vi rectum; vii anus L4 2 Digestion starts in the mouth. During digestion, digestive juices are added to the food and these contain enzymes that break the food down into smaller pieces. L5 3 Credit should be given for using complex and/or compound sentences with appropriate conjunctions. Credit should also be given for using scientific words such as: digest, molecule, © Pearson Food and nutrition absorption, small intestine. A good explanation will include the fact that food molecules are too big to be absorbed into the body in the small intestine and so they need to be broken down into smaller pieces. L6 4 a one of: some of them make vitamins; they help to digest food that we cannot b some can make us ill L6 5 a one of: teeth in the mouth break up food into smaller pieces; food is mixed with saliva in order to start digesting it; food is mixed with saliva in order to make it easier to swallow b one of: food is digested by enzymes in the small intestine; small molecules/pieces of food are absorbed into the body/blood in the small intestine 8Ad-8 Enzymes and digestion L5 1 a mouth, gullet/foodpipe/oesophagus, stomach, small intestine, large intestine, rectum, anus L6 b small intestine (absorption of food), anus (egestion), mouth (ingestion) L5 2 a in the mouth L6 b small intestine – more different enzymes are found there L6 c Bread – ticks in mouth, gullet and small intestine Butter – ticks in small intestine Celery – mainly fibre, so either no ticks or one tick in the small intestine Ham – ticks in stomach and small intestine L6 d pH 1-3 because the stomach contains strong acid. L6 3 For example: Muscles in the wall of the gut behind the food contract, and this squeezes the food forward inside the gut. L7 4 credit should be given for: the enzyme in the diagram being labelled 'amylase', the diagram showing the lines between the hexagons being cut by the enzyme, the enzyme looking the same after it has finished its job 8Ad-9 Enzyme action L6 1 a Enzymes break down large molecules into smaller ones. b Large molecules cannot be absorbed into the blood/body by the small intestine. OR The body cannot use large molecules. L7 2 a It shows that large molecules are split into smaller ones; it shows that the enzymes don't get used up; it shows that enzymes change shape as they work; it shows that links/bonds are broken in the molecules by enzymes. b It doesn't show that the enzyme only works on a specific molecule. © Pearson L7 3 a It shows that large molecules are split into smaller ones; it shows that the enzymes don't get used up; it shows that the enzyme works on a specific molecule. b It doesn't show that enzymes change shape as they work; it doesn't show that the links/ bonds are broken. L7 4 Each enzyme will only work on a specific type of molecule. L7 5 a The spanner model works better to explain this. The action of heat on the spanner will change its shape slightly, so there will be an optimum temperature for each spanner. b Students' model should take account of: • enzymes do not get used up as they carry out their tasks • enzymes change shape as they work • each enzyme only works on one particular type of molecule • digestive enzymes break links (bonds) between atoms in larger molecules • digestive enzymes change shape with temperature. 8Ae Absorption Student Book 1: 8Ae Surface area L4 1 100 × 45 = 4500 m2 L6 2 2 × (10 × 15) = 300 µm2; 2 × (10 × 20) = 400 µm2; 2 × (15 × 20) = 600 µm2 300 + 400 + 600 = 1300 µm2 L6 3 a 2 × (8 × 4) = 64 cm2; 2 × (8 × 6) = 96 cm2; 2 × (4 × 6) = 48 cm2 64 + 96 + 48 = 208 cm2 b 2 × (4 × 4) = 32 cm2; 2 × (4 × 6) = 48 cm2; 2 × (4 × 6) = 48 cm2 For each block 32 + 48 + 48 = 128 cm2 but we have two blocks now, so the total of both is 2 × 128 = 256 cm2. L6 4 The granules have a greater surface area for the water to reach the sugar and dissolve it. L7 5 The smaller the food pieces are, the greater surface area they have and there is a larger area over which enzymes can break down the food. This means that smaller pieces of food will be digested faster; teeth help in this process by grinding up food into smaller pieces. 2: 8Ae Absorption L5 1 a small intestine L6 b the sugars/glucose (not the enzyme or starch), because they are small enough to be absorbed 457 8 A Food and nutrition 8 A L6 2 sugars (glucose), because the enzymes break down the starch into sugars which are then small enough to diffuse through the Visking tubing L4 3 a to release energy from food L5 b plasma carries glucose; red blood cells carry oxygen L5–6 4 L5 the overall movement of particles from an area where there are a lot of particles to an area where there are fewer particles L6 until a balance is reached L6 5 Molecules move in all directions, so by chance some will move in one direction and others will move in the opposite direction. L7 6 Small soluble molecules can pass through the wall of the small intestine. So, there is an overall movement of these soluble molecules through the wall of the small intestine into the blood because there are more soluble molecules in the small intestine than there are in the blood. Insoluble molecules are too big to go through the wall of the small intestine. L7 7 It is long and so has a large surface area. Its surface area is increased by folds, villi and microvilli. The walls of the villi are only one cell thick, making it easier for molecules to diffuse. L5 8 a Fewer digestive enzymes are released into the small intestine. L6 b Fewer of the insoluble food molecules will be digested into soluble ones that can be absorbed. L7 c They will digest less food, due to less digestive enzymes; the villi shrink in size and so are not able to absorb as many of the nutrients as before. L7 9 The calculation does not take into account the effects of the folds, the villi or the microvilli. 3: 8Ae Packaging and the law L4 1 a to add weight to their products/make their products sound the best so they can sell more L5 b to add weight to the health message and make their products sound as though they can be eaten and not cause weight gain L5 2 a fat, carbohydrates (sugars), salt L6 b fats store energy and provide insulation, carbohydrates provide energy, salt is needed for health L6 c Only the ones which cause the most problems for health if overeaten are included. L6 3 Bacteria can make useful substances (e.g. vitamins) and can help digest foods but some can also cause diseases. L5–6 4 L5 flow chart showing starch being digested L6 by enzymes L6 into glucose, 458 L5 which is soluble and L6 so can easily diffuse L5 through the wall of the small intestine and into the blood plasma; L5 cells take it out of the blood plasma Activity Pack 8Ae-1 Absorption L5 1 a inside the small intestine L5 b blood L6 c Substance Inside tubing at the start enzymes ✓ starch ✓ sugars water ✓ Inside tubing after 30 min ✓ ✓ ✓ ✓ Outside Outside tubing tubing at start after 30 min ✓ ✓ ✓ L6 2 large surface area and wall is only one cell thick L6 3 plasma L6 4 Diagram completed to show that there are an equal number of small food molecules (white circles) and water molecules on each side but that the grey squares have stayed where they are. 8Ae-4 The small intestine L5 1 a absorption L6 b squares drawn around the two types of smaller circles L6 c They are small enough to fit through the wall of the small intestine (villi). L5 d diffusion L5 e plasma L4 2 a to release energy L5 b glucose L6 3 a one of: by having a folded wall, by having microvilli b They can't absorb digested nutrients so quickly and so may not absorb enough, which may result in malnutrition or a deficiency disorder. 8Ae-5 Calculating surface area L6 1 2 × (8 × 4) = 64 cm2; 2 × (6 × 4) = 48 cm2; 2 × (6 × 8) = 96 cm2. So, 96 + 48 + 64 = 208 cm2. L4 2 24 L6 3 6 × (2 × 2) = 24 cm2 L6 4 24 × 24 = 576 cm2 L7 5 The smaller the food pieces are, the greater surface area they have and there is a larger area over which enzymes can break down the food. This © Pearson Plants and their reproduction means that smaller pieces of food will be digested faster and teeth help in this process by grinding up food into smaller pieces. L6 6 a 0.51 × 20 × 20 = 204 m2 L7 b A larger surface area allows more space for digested nutrients to be absorbed and so digested nutrients are absorbed more quickly. L7 c The small intestine wall is folded, which also increases the surface area. L6 d 21/6.5 = 3.2 So, the elephant's small intestine is more than three times longer than a human's. 3.2 × 204 = 653 m2 (to the nearest m2) L7 e Assumed that elephants also have villi and microvilli to increase their surface area, and their small intestine is of a similar width. 8Ae-6 Absorbing digested food L6 1 a X L7 b It has a greater surface area of absorbent fibres. L6 2 a small intestine b villus c capillary d microvillus e starch molecule f glucose molecule L7 3 It is a long, thin tube so has a large surface area. Its surface area is increased firstly by folds and then by villi. The villi themselves are covered in microvilli that greatly increase the surface area further. The walls of the villi are only one cell thick, making it easier for molecules to diffuse through and there are many blood vessels to absorb the molecules. L6 4 a It will increase. L7 b Molecules are randomly moving. Some will move into the blood. There will be an overall movement of particles from where there are more of them (the small intestine) to where there are fewer of them (the blood). Until there is a balance between them. L7 c The wall of the small intestine is very thin (one cell thick) and has a very large surface area. L7 d If the soluble products of digestion are removed then the blood will always have fewer molecules than the small intestine. As there will never be a balance, the small molecules will continue to diffuse out of the small intestine. 8Ae-7 More digestive enzymes L5 1 a starch, maltose, glucose b 2 – salivary amylase, pancreatic amylase and maltase L6 2 Labelled diagram to show enzymes cutting up a protein into smaller units (peptides) and then a different enzyme cutting up the peptides into amino acids, which are then absorbed in the small intestine. © Pearson L7 3 a Molecules are randomly moving. Some will move into the blood. There will be an overall movement of particles from where there are more of them (the small intestine) to where there are fewer of them (the blood). This continues until there is a balance between them. A better answer will explain how the flowing of the blood helps to maintain the imbalance and so the overall diffusion of soluble molecules from the small intestine into the blood will be maintained. b It has a large surface area caused by having folds, villi and microvilli. It also has very thin walls and many blood vessels. L7 4 a pH from 6–8 or 9. It needs to neutralise the highly acidic stomach contents, but a pH of over about 9 may be dangerous. L8 b Answer should explain that bile forms an emulsion in which the fat/lipid droplets are broken down into smaller droplets. This allows a greater surface area for enzymes (like steapsin) to act on and so the fat/lipid is broken down more quickly. This can be illustrated by calculating the surface area of the large cube in the diagram (150 mm2) and comparing that value with the total surface area of the 125 smaller cubes that the large cube can be cut up into (750 mm2). 8B Plants and their reproduction 8Ba Classification and biodiversity Student Book 1: 8Ba Useful plants L4 1 one of: animal, fungus, protoctist, prokaryote ('animal' is the expected answer) L4 2 rough calculation of the value of something L4 3 a They transfer pollen from one flower to another. L5 b scent (given in text), flower colour (hinted at in the caption to photo A), nectar L6 c the pollen grain and the egg cell/two gametes/sex cells fuse L5 d one of: edible fruits, wind, fruits that stick to animals, explosions L6 4 example of a scientific name: Gossypium hirsutum; examples of a common name: flax, cotton, indigo, lavender, willow, foxglove, maple, spruce, rape, rubber tree 2: 8Ba Classification and biodiversity L4 1 a Animal cells have no cell wall and animals cannot make their own food. b protoctists, prokaryotes, fungi 459 8 B Plants and their reproduction 8 B L5 2 a they both have leaves, they both have roots, they both have xylem tissue (some students may include similarities from figure A, e.g. their cells have cell walls) b conifers have cones, flowering plants have flowers; conifers have needle-shaped leaves, flowering plants have large, flat leaves L6 3 four L5 4 Helianthus annuus L5 5 a Hyacinthoides non-scripta b Mertensia L6 6 Both words are in italics and the first word (genus) has a capital but the second word (species) does not. (Note: instead of writing a scientific name in italics, you can underline it instead.) L6 7 tropical rain forest, many more species live there L6 8 preserves ecosystems (since organisms depend on one another), preserves a source of undiscovered substances for human use, allows a habitat to recover faster if disaster strikes L7 9 You need to be able to identify and name all the different organisms in an area if you are going to be able to work out how many different species there are. 3: 8Ba Accuracy and estimates L5 1 a balance Z (the scientific balance) b balance X (the bathroom scales), it has the fewest significant figures L6 2 50 ÷ 5 = 10, 10 × 24 = 240 sweets L6 3 The exact number of sweets has not been determined. We have assumed that there are 24 sweets in each 5 cm of the jar. L6 4 a 250 ÷ 10 = 25, 25 × 15 = 375 plants b The exact number of daisies has not been determined. We have assumed that there are 15 daisy plants in each 10 m2 of the lawn. c You would get a more accurate estimate. d It would take longer. Activity Pack 8Ba-1 Classification and biodiversity L4 1 Characteristics Name of kingdom make their own food (using photosynthesis) plants cells have a nucleus but no cell wall animals organisms only have one cell, which has a nucleus protists/protoctists cell walls contain chitin fungi cells do not have nuclei prokaryotes L5 2 Characteristics Name of plant group do not have xylem tissue mosses make cones conifers have flowers flowering plants do not have flowers or cones ferns or mosses L6 3 a Monstera deliciosa b so that scientists all over the world know what plant someone is talking about L6 4 a X b one of: we get useful products from organisms; organisms depend on one another; enriches our lives; more biodiverse areas are better at disaster recovery 8Ba-4 Sorting plants L4–6 A possible classification system is given below but there will be many variations on this. plants on worksheet broad leaves strap-shaped leaves leaves without notches blue flowers harebell clustered bellflower flowers without petals yellow flowers primrose brown flowers pendulous sedge oxlip green flowers sniddel reed sweet-grass orchard grass leaves with notches white and yellow flowers ox-eye daisy 460 feverfew flowers with petals yellow flowers tansy corn marigold flowers without petals around a tube bluebell grape hyacinth flowers with petals around a tube poet's narcissus wild daffodil © Pearson Plants and their reproduction 8Ba-5 Kingdoms and keys L4 1 a X is common ash, Y is horse chestnut L5 b The leaves do not grow in opposite pairs along a stalk, the leaves do not have lobes, but they do have smooth edges. L5 c two trees (field maple, English oak) L4 2 a two of: animal; fungi; prokaryote (accept 'bacteria'); protist (or protoctist) b one of: they can make their own food; their cells contain chloroplasts/chlorophyll; their cells have cell walls. c classification L5 3 a conifers b sensible suggestions, such as: shape of leaves; colour of flowers; shape of flowers L5 4 Rainforests have greater biodiversity because they contain the greater number of different species. 8Ba-6 Paper quadrats L4 1 Neatly drawn table, identifying each square sampled with a two-letter code (e.g. a g). There should be a column for the square codes. The numbers of the different species for each plant should be clearly shown. Extra credit should be awarded if space has been left to allow totals and/ or means to be added. L4–6 2–4 Credit should be given for all working shown, even if the answers are incorrect. L6 5 a There are six thistle plants (followed by comparison to the student's estimate). b by taking more samples c It takes longer to do the analysis. 8Ba-7 Biodiversity of species L4 1 a animals, plants, fungi L4 b one of: plant cells have a nucleus/cell walls made of cellulose/organisms made of many cells/make their own food (using photosynthesis); or animal cells have a nucleus/no cell walls/organisms made of many cells/feed on other organisms; or fungi cells have a nucleus/cell walls contain chitin/ organisms made of many cells/live on rotting organisms and their wastes L6 c controls the cell's activities L4 2 a animal kingdom L5 b sensible suggestion such as: they have feathers; have beaks; or they lay eggs with hard shells. 'They fly' is a less good suggestion because some mammals (e.g. bats) fly and some birds (e.g. penguins) don't. L5 c sensible suggestion such as: length of beak; or colour; or type of food they eat. L6 d reed bunting and yellowhammer because the scientific name shows that they are in the same © Pearson genus, which is the second to last group that you get to in the classification system. L6 e It allows scientists all over the world to know exactly which organism is being talked about. L6 f Auriparus (give extra credit for a capital at the start of the word, and the word being in italics). L5 g X, because it has a greater total number of birds, even though both areas have the same number of different species. L6 h one of: we get useful products from organisms; organisms depend on one another; enriches our lives; more biodiverse areas are better at disaster recovery 8Ba-8 Monitoring biodiversity L6 1 a Glyceria (give extra credit for a capital at the start of the word, and the word being in italics). b It allows scientists all over the world to know exactly which organism is being talked about. L5 2 a Students' own answers based on observation of the three drawings (e.g. flower type). b So that different species can be accurately identified. If you can't tell the difference between different species you cannot come up with an accurate number of the different species in an area. L5 3 a (award extra credit for showing working) Dactylis glomerata Area A: 1267 Carex pendula Area A: 367 Glyceria maxima Area A: 2833 Dactylis glomerata Area B: 1500 Carex pendula Area B: 967 Glyceria maxima Area B: 767 L7 b (award extra credit for showing working) Area A = 0.0007 Area B = 0.0009 L7 c Area B is more biodiverse because it has the greater biodiversity index. L7 d Take more species into account. L6 e To make sure that biodiveristy is being preserved. 8Bb Types of reproduction Student Book 1: 8Bb Types of reproduction L4 1 two organisms/a male and a female/two parents L5 2 a plumcot L6 b because it is a hybrid and hybrids cannot reproduce/are not fertile L5 3 a one of: shape, size b skin and flesh colour L5 4 flower colour L6 5 a sperm cells 461 8 B Plants and their reproduction 8 B b egg cells L6 b All its cells come from the original plant. L6 6 Each sperm cell from a man contains slightly different instructions for characteristics and so does each egg cell from a woman. Therefore, all the offspring from two parents (apart from identical twins) have slightly different sets of instructions for characteristics and look slightly different. 8Bb-2 Variation and reproduction L5 There are seven plants that are identical to Parent Y (A, C, D, G, J, K & M) so have been produced by asexual reproduction. There are seven plants that have been produced by sexual reproduction between X and Y (B, E, F, H, I, L & N). Award additional credit to students who have not included the two parents in either pile (since we cannot tell how they were produced). L5 7 a flowers/pollen grains and egg cells/gametes b runners L6 8 The tubers are produced by asexual reproduction and come from only one plant. The new plants will all have the characteristics of the parent plant. 8Bb-3 Sexual and asexual reproduction L4 1 a They are both the same type of plant. L4 b plant A L5 c It is exactly the same as all the other plants on the left. OR It is attached to the other plants by runners. L5 d inherited L4 2 a asexual reproduction L5 b a stem and leaf L5 3 sexual, gamete, fuse, fertilisation, fertilised, embryo, inherited L5 9 a a plant is being grown from part of the parent plant/a new plant is produced using only one parent b one of: it is quicker, you can be sure what the new plants are going to look like Activity Pack 8Bb-1 Types of reproduction L4 1 a colour L4 b apricots and plums L5 c hybrid L5 d purple fruits L5 e one sensible suggestion, such as: size of fruit, shape of fruit, size of stone/pips, colour of flesh L6 2 correct labels from left to right: sex cell; gamete; fertilisation; fertilised egg cell; growth L6 3 Each time a parent produces a gamete cell it is different. So no two combinations of gametes will give identical results. L4–5 4 sexually and asexually L4 or using flowers and using runners L5 L4 5 a asexual reproduction 8Bb-4 Plant variation L4 1 a the number of petals, number of spots on petals, number of leaves, flower width, plant height L5 b Continuous variation: flower width, plant height. Discontinuous variation: number of petals, number of spots on petals, number of leaves. L5 2 inherited variation (accept inheritance or heredity) L5–6 3 They are all the same type of plants L5 and can reproduce with one another to produce offspring that can also reproduce L6 . L5 4 a Plants Total plant height (cm) Flower width (cm) Number of petals in flower Number of spots on each petal Number of leaves Plant B 1.8 1.0 5 2 3 Plant E 2.0 1.4 7 2 3 Plant F 1.6 0.9 5 2 3 Plant H 1.8 1.1 7 1 2 Plant I 1.7 1.1 7 1 2 Plant L 2.1 1.4 7 1 2 Plant N 2.2 1.5 5 2 3 Parent X 1.5 0.9 7 2 3 Parent Y 2.2 1.5 5 1 2 (Note that plants A, C, D, G, J, K & M are identical to Plant Y.) 462 © Pearson Plants and their reproduction Width of flower (cm) L5 b How the width of a flower depends on plant height 1.6 1.4 1.2 1.0 0.8 0.6 0.4 0.2 0 1.0 L5 2 They use flowers to reproduce sexually and they use runners to reproduce asexually. L5 3 a They are made using plants from two different species. b F. virginiana X F. chiloensis. Give additional credit if students have used italics for the scientific names. 1.2 1.4 1.6 1.8 2.0 2.2 2.4 Total plant height (cm) L6 c Yes. As the height of the plant increases, so does the width of the flower. Award additional credit if students have described this as a positive correlation. L7 d see graph from part b L6 5 a Students' own responses, showing an understanding that sexual reproduction needs two parents (asexual reproduction needs only one) and that sexual reproduction produces variety (asexual reproduction does not). b Students explain that, in sexual reproduction, a parent makes gametes that contain the instructions for characteristics but each gamete has a slightly different set of instructions. When gametes fuse in fertilisation, the instructions are combined and so the offspring end up with different sets of instructions. (Students may add that, in asexual reproduction, all the cells come from one parent and so all contain the same instructions as the parent.) 8Bb-5 Plant reproduction L6 1 a 3 L4 b both trials L6 c second trial L5 d height L5 2 a red colour of fruits L6 b They are hybrids, so they are infertile (because they are hybrids). L5 c Take a cutting of a tayberry plant (e.g. stem, leaf) and plant it. L6 d They have come from exactly the same cells as the parent plant. L5 e two of: plumpness/size of fruits, colour of fruits, size/number of thorns. L6 f Students explain that, in sexual reproduction, a parent makes gametes that contain the instructions for characteristics but each gamete has a slightly different set of instructions. When gametes fuse in fertilisation, the instructions are combined and so the offspring end up with different sets of instructions. © Pearson 8Bb-6 Strawberries L4 1 two parents L7 4 a From F. virginiana they have inherited bright red colour of fruits, salt intolerance. From F. chiloensis they have inherited large fruits, ability to grow in full sunshine. b Students explain that, in sexual reproduction, a parent makes gametes that contain the instructions for characteristics but each gamete has a slightly different set of instructions. When gametes fuse in fertilisation, the instructions are combined and so the offspring end up with different sets of instructions. L7 5 a F. vesca X F. chiloensis, F. vesca and F. chiloensis. Give additional credit if students have used italics for the scientific names. L6 b They cannot reproduce sexually. L6 c It can reproduce asexually, using runners. L8 d F. vesca X F. chiloensis because they are all identical. Sexual reproduction can still occur between different F. vesca and between different F. chiloensis plants, allowing variety. Some of those offspring may be more resistant to the disease. L8 e It is faster, or all the offspring will be suited to growing in that area (because it's the same area as where the parent is growing). 8Bc Pollination Student Book 1: 8Bc Pollination L5 1 a stamen b anther, filament L4 2 Pollen is transferred from an anther to a stigma. L6 3 one of: nucleus, cytoplasm, cell surface membrane, mitochondria, cell wall L6 4 a to trap pollen grains L7 b it is sticky L5 5 three from: flower is brightly coloured, flower has a scent, flower produces nectar, flower has large and sticky pollen grains, flower has a sticky stigma L5 6 figure H because the pollen grains are bigger and have spikes on them to stick to insects L7 7 They are small and light so that they are easily carried by the wind. 463 8 B Plants and their reproduction 8 B L6 8 a Pollen is transferred from the anthers of one plant to the stigma of another (of the same species). size and presence of petals influences the attraction of insects to Hibiscus flowers. L7 b because cross-pollination means the offspring have a mixture of characteristics from two different plants L5 d Petals are essential for attracting insects, and the bigger the flower, the more insects visited. Activity Pack 8Bc-1 Pollination L4–5 1 a style – supports the stigma; ovule – contains the female gamete; stigma – receives pollen; anther – makes pollen grains L5 f They were attracted by the nectar. (Not scent, because the petals produce scent.) L5 b Insects – because it does not have feathery stigmas like a wind-pollinated plant would have. There are other possible answers including the fact that it has petals or that its male and female parts are sheltered from the wind by petals. L5–7 g Pollen B is from Hibiscus. It is large and spiky, like pollen grains from other insect-pollinated plants L5 . It has spikes that allow it to stick to the outer coverings of visiting animals L7 . L6 3 The male gamete is found inside the pollen grain and the female gamete is found inside the ovule. L5–6 4 to stop pollen falling onto the stigmas from the anthers L5 to prevent self-pollination L6 . L5 2 a insects L6 b to provide food for bees L6 3 pollen grain L6 4 produce pollen L6 5 To prevent self-pollination. The wind blows the pollen off the flowers at the top and away from the female flowers below. 8Bc-5 Inside a flower L5 4 The sepals protect the flower in bud. L4 b correct labels L5 c stigma L4 2 a Plant X is pollinated by the wind. Plant Y is pollinated by insects. L5 b Plant X produces lots of light pollen ✓ L7 5 It means that there should be some varieties that can cope with a change in conditions, such as a disease, increased rainfall and decrease in temperatures. 8Bc-8 Pollinators and pollination L5 1 a to attract pollinators L5 b There are no pollinators for red campions around at night. 8Bc-6 Flowers L4 1 a Drawing of a cross-section through the flower, clearly showing three stamens in the centres of three petals and surrounding a central carpel, in which the ovary is wider than the stigma. Y produces nectar ✓ produces a scent ✓ produces large, spikey pollen ✓ 8Bc-7 Hibiscus flowers L4 1 a W stigma, X style, Y anther, Z filament L5 b to collect/receive pollen L6 c It has a brush-like structure to collect pollen off visiting insects. L5 2 a To attract animals to pollinate them, or to protect the parts inside. L5 b They produce scent, they are brightly coloured. L5 c Scientist were trying to establish how the 464 L5 e Bombus preferred Hibiscus but Ptilothrix preferred a different type of flower. Or There were more Bombus than Ptilothrix in the area. L6 c The amount of sugar in male flowers is greater than that in female flowers in the afternoon, until between 5 pm and 7 pm when it suddenly falls and there is an increase in the amount of sugar in the female flowers at the same time. L7 d During the day, more insects are attracted to the male flowers because there is more nectar/ sugar available. This means that they get a lot of pollen on them. Then later in the afternoon, the plants need to make sure that the pollen that has been taken from the male flowers gets to the female flowers and so the male flowers become less attractive by producing less nectar and the female flowers become more attractive by producing more nectar. L6 2 a self-pollination L7 b In all but one case, insect pollination creates pods with more seeds in them. It is the seeds that are wanted because they contain the oil. L7 c sensible suggestions include: that it was too small/the wrong shape to rub against the stigma to transfer the pollen; or that the insect's covering did not pick up much pollen in the first place L7 d Both of the Apis species (Apis dorsata and Apis florae) because although they cause fewer seeds to form in pods than Halicatus species, they are more active in the mornings when the plant produces most of its pollen and they also visit more flowers and spends less time transferring pollen. © Pearson Plants and their reproduction 8Bd Fertilisation and dispersal L5–6 6 L5 a (ordering the sentences), Student Book L6 b (identifying the pronouns); 1: 8Bd Fertilisation and dispersal L6 1 a A pollen grain grows a pollen tube down to the ovule, in which the egg cell is found. The male gamete is carried in the pollen tube to the egg cell in the ovule. b fertilised egg cell or zygote c fertilisation L6 2 eight cells L6 3 an embryo L5 4 food store L6 5 ovary L5 6 a Cocklebur fruits have hooks that trap the fruits in animal fur and so animals carry the fruits away. b Dandelion fruits float in the wind, carrying the seeds away from the parent. c Coconut fruits float on water and carry the seeds to new places by water currents. d Himalayan balsam spreads its seeds using fruits that explode and fling the seeds away from the parent plant. L5 7 a The fruits are eaten and when the seeds are egested from the animal they will be in a different place. L6 b seed coat L6 c to stop the seeds being digested in the digestive system L6 8 so that the new plants are not in competition with the parents and so that the plant species can spread to new areas 2: 8Bd Structuring paragraphs L5 1 Coffea arabica L5 2 flesh is left to dry in the sun, fermented or digested by Paradoxurus hermaphroditus/the kopi luwak method L5 3 Students' own answers, a short title need not be a full sentence but it should contain key words, which are usually found in the topic sentence, e.g. Coffee bean flesh removal, Removing flesh from Coffea arabica fruits L5 4 a Coffea arabica fruits b fermenting the fruits c the kopi luwak process L5 5 a drying in the sun L5 b fermenting L5 c digestion by Paradoxurus hermaphroditus/the kopi luwak method L6 d no, the summary sentence tells us that the method used depends on the available resources and so what is 'best' in one area may not be 'best' in another © Pearson The kopi luwak process is an unusual and timeconsuming way of removing the red flesh from Coffea arabica. Each of the red fruits of a coffee plant contains a seed (commonly known as a coffee bean). (pronoun – 'each', referring to fruits) In the first instance, farmers feed these to Asian palm civets, which are small mammals with the scientific name Paradoxurus hermaphroditus. (pronoun – 'these', referring to beans; pronoun – 'which', referring to civets) Farmers then collect the animals' droppings, which contain the seeds. (pronoun – 'which', referring to droppings) Finally, the coffee is processed in the normal way, by roasting and grinding it. (pronoun – 'it', referring to coffee) This is why kopi luwak coffee can cost up to £500 per kilogram. L6 c 'kopi luwak', 'remove' 'flesh' and 'Coffea arabica' describe a main point; the pronoun referring to beans only makes sense in the correct order; 'In the first instance' and 'Finally' identify the order of sentences describing the process; 'droppings' happen after 'Feeding'; 'This is why' implies a summary and 'kopi luwak' is mentioned again. Activity Pack 8Bd-1 Fertilisation and seed dispersal L5 1 1 pollen release, 2 pollination, 3 pollen tube growth, 4 fertilisation, 5 embryo development, 6 seed dispersal L6 2 cell division L5 3 a eaten by animals (strawberry); b wind (sycamore maple); c wind (dandelion); d explosion (hairy bittercress) L4–6 4 tiny root – absorbs water; tiny shoot – grows leaves; food store – an energy source; seed coat – protects the seed. Label lines also need to be drawn to the correct places on the diagram. L6 5 so that the new plants do not compete with the parents 8Bd-5 Comparing reproduction Humans: The male gamete can swim. The male gamete is found in a liquid called semen. Fertilisation occurs inside an oviduct. Flowering plants: The male gamete is found in a pollen grain. Pollination occurs before fertilisation. The embryo contains a tiny root. Fertilisation occurs inside an ovule. Requires a pollinator. It only happens at a certain time of year. 465 8 B Plants and their reproduction 8 B Both: Two gametes fuse. The zygote uses cell division to become an embryo. Male and female gametes are required. The egg cell is the female gamete. The offspring show variation between one another. The egg cell has a cell membrane. The nuclei from the male and female gametes fuse. The male gamete has a nucleus. A fertilised egg cell (or zygote) is formed. 8Bd-6 Developing seeds and dispersal 1 Correct order: B, C, G, A, E, D, F, Summary. Exemplar answer: First, a pollen grain reaches a stigma of the same species, where it grows a pollen tube. This now grows down the style and into the ovary, until it reaches an ovule. The male gamete then fuses with the female gamete, and this is called fertilisation, which produces a zygote. Next, the zygote divides and this forms an embryo. It then grows and develops a tiny root and a tiny shoot. At the same time, the ovule forms a seed around the embryo. The ovary forms a fruit, which finally disperses the seeds. This is the process through which plants create and disperse seeds. Words to denote time order are in italics. Pronouns are underlined. 8Bd-7 Making and dispersing seeds L4 1 four of: seed coat, food store, tiny shoot and/or embryo, tiny root and/or embryo L5 2 a wind b explosion c animal fur d eaten L6 3 a pollen tube drawn down the style and into the ovule in the ovary b correctly labelled diagram L6 4 a in the pollen grain b egg cell c fertilisation L6 5 cell division removed to prevent self-pollination; a plastic bag is used to cover the flower head to stop other pollinators pollinating the plant. L6 b The pollen grain grows a pollen tube from the stigma and down through the style into an ovule in an ovary. Award additional credit for the use of words in italics. L6 c The nucleus from the male gamete fuses with the nucleus from the egg cell. Award additional credit for the use of words in italics. L4 d small local bee L6 e suggestions might include: it was able to carry more pollen; it was of a better size/shape to rub against the stigma; it spent longer visiting the flowers L5 f The results for Osmia because this is the result that contains the fewest readings used to calculate the mean. Some students may have included Xylocopa here, which should also be seen as correct since both these results contain many fewer repeat readings than the others. L5 2 a Animals eating it and then moving away from the parent before dispersing the seeds; it has fleshy fruit and a bright red colour. L6 b Flesh is from the ovary, seed is from the ovule, embryo is from the zygote/fertilised egg cell, tuft is the remains of the style/stigma. L6 c So that offspring do not compete with their parents and/or so that a plant species can spread to a new area. L4–6 d Major parts L4 with functions L6 . Tiny root to absorb water; tiny shoot to support leaves; food store to provide energy; seed coat to protect the seed. Award extra credit for answers presented as paragraphs, demonstrating good overall structure together with unity, coherence, cohesion and order. For example, the order could be to look at the different parts of the seed starting in the centre and working outwards. 8Bd-10 Evaluating seed dispersal Award extra credit for answers written as paragraphs, if students have been asked to do this. 8Bd-8 Comparing sexual reproduction L6 Similarities may include: requires a male and female; produces variety; mixes characteristics; involves gametes; produces embryos. L6 1 a Baccaurea racemosa is dispersed by animals, which move off in all directions scattering fruits and seeds as they go, either discarding them or egesting seeds in their faeces. Differences may include: in humans it usually requires people finding and getting close to one another (this does not happen in plants); the structures of the male gametes are different; the plant male gamete is not mobile. Shorea leprosula has seeds with wings that flutter. A lot of the seeds land quite close to the parents (as shown by the clumps) but if there is a wind in a certain direction they can be moved further away. There is evidence on the map of lines, possibly showing the direction of the wind. See also the answers to Worksheet 8Bd-5. 8Bd-9 Seed dispersal L6 1 a The filaments and anthers have been 466 Neobalanocarpus heimii has fruits that fall to the ground and are then disturbed by animals (or by rolling down slopes), as shown by the more regular © Pearson Plants and their reproduction shaped circular concentrations of fruits, formed by fruits dropping in a regular fashion from all around the tree. Croton argyratus has seeds that are expelled by the forces unleashed in a drying seed pod. The seeds do not travel very far. b Students make an argument for one of the types of dispersal being best (for example Baccaurea racemosa because the seeds get carried a long way and in an even distribution. Or Croton argyratus because a lot of the seeds land fairly near the parent, where conditions for its growth are likely to be good and it doesn't waste seeds landing up in unsuitable areas). c Large fruits taken from the plant by animals as these had the largest clusters. d Any habitat in which there are few animals or a habitat in which there is a lot of wind/ water. L6 2 a The pollen grain grows a pollen tube from the stigma and down through the style into an ovule in an ovary. The nucleus from the male gamete fuses with the nucleus from the egg cell. Award additional credit for the use of words in italics. L7 b Suggestions could include that the fused gametes do not form a cell that can survive, or that the zygote cannot divide. However, the male gamete has entered the ovule and so fruit formation is triggered. 8Be Germination and growth Student Book 1: 8Be Germination and growth L3 1 when a seed starts to grow L3 2 at least three of the following and in this order: the seed absorbs water, the root emerges, the shoot emerges, the first leaves open L4 3 a oxygen, glucose b carbon dioxide, water (not energy, because energy is not a substance) L4 4 water, oxygen, warmth L5 5 to ensure that at least some fruits survive and carry the seeds away from the parent L5–6 6 L6 The cells in the embryo use cell division. L5 The energy for this process comes from respiration. L6 The glucose for respiration comes from the food store in the seed. L5 7 The food store is being used up. L5 8 a, b oxygen (for respiration), carbon dioxide (for photosynthesis) L5 9 a, b carbon dioxide (for photosynthesis), light (for photosynthesis), mineral salts (for healthy growth) © Pearson L6 10 Plants release oxygen from photosynthesis, which animals depend on for respiration. L6 11 There are fewer pollinators and so some plants may not produce as much fruit or seeds as they used to. L6 12 Seeds only germinate when conditions are right and so when the plant is more likely to survive. 2: 8Be Animals using plants L4 1 Humans, woodpecker finches, insects, bowerbirds, crested rats, flower mantises are in the animal kingdom. Cacti and arrow poison trees are in the plant kingdom. L5 2 so that scientists know exactly what organism is being talked about: there is less chance of confusion L6 3 Lophiomys (award additional credit if a student has used italics) L5 4 flower (for sexual reproduction), tuber (for asexual reproduction), fruit (for seed dispersal), leaf (for making food/photosynthesis) L5 5 Insects come to collect nectar/pollen from the flowers. L5 6 by animals eating it; because it has flesh and can be safely eaten when it is ripe L6 7 The arrow poison tree, bees and humans are all interdependent. The tree relies on bees that visit the flowers and so pollinate them. In turn, the bees rely on the tree for nectar, which they collect for food. Humans rely on the tree for poisons for the arrows, so that they can hunt animals and have meat to eat. Humans also collect and eat arrow poison tree fruit. This helps the tree by spreading its seeds. Humans may collect honey from the bees. Humans will make sure that the trees are not damaged and so the bees will always have a source of its nectar. (Give additional credit for paragraphs that have a sound overall structure and good levels of unity, cohesion, coherence and order.) Activity Pack 8Be-1 Germination and growth L3 1 a A seed starts to grow. L4 b root L4 c water, oxygen, warmth L6 d One of: Water is needed to allow chemical reactions, such as respiration, to occur. Oxygen is needed for respiration. Warmth is needed because chemical reactions, such as respiration, do not happen very quickly when it is cold. L5 2 The raw materials for photosynthesis are carbon dioxide and water. The sugar made by photosynthesis is called glucose. Oxygen gas is also produced. Photosynthesis needs energy transferred by light to make it happen. 467 8 B Breathing and respiration 8 C L5 3 a C bA c respiration d glucose L5 4 a for food/nectar/pollen to eat L5 b for pollination L6 c less seeds/fruits due to less pollination. 8Be-6 Growing from seed L4 1 1 – flowering – The plant makes flowers. 2 – pollination – Pollen grains land on a stigma. 3 – fertilisation – The male gamete joins with the egg cell. 4 – seed dispersal – Fruits are carried away from the parent plant. 5 – germination – The seed starts to grow a tiny shoot and root. 6 – mature plant – The plant is old enough to have flowers. L4 2 oxygen, warmth, water L5 3 The function of part X is to provide raw materials/glucose for respiration (food store). The function of part Y is to protect the seed (seed coat). L5 4 carbon dioxide, water (not energy) L5 5 It needs light for photosynthesis. Photosynthesis is used to make the plant's food. 8Be-7 New plants from seeds L3 1 a March L4 b 3 months (it flowers in June) L5 c Seedlings may appear and be killed off by cold/frost; if the seedlings did survive and flower, there would be no pollinators to pollinate the flowers. L5 d root L5 e anchors the seedlings and absorbs water L6 d They depend on one another. Bumblebees depend on wild primrose flowers for food (nectar/pollen) and the flowers depend on the bumblebees for pollination. 8Be-8 Germination and photosynthesis L5 1 a starch L5 b Using iodine solution. A blue-black colour indicates the presence of starch. L6 c Negative result. The soda lime absorbs the carbon dioxide and so the leaf cannot photosynthesise. L6 2 a Shaded area is only the green central area of the leaf, which should have a straight edge across the top of it where the foil was. b Photosynthesis requires light and chlorophyll. There is no chlorophyll in the white parts of the leaf. Light cannot reach the parts of the leaf covered by the foil. c chloroplasts L5 3 a testa protects the seed; cotyledon is the food store; radicle absorbs water and becomes the root, anchoring the seedling; plumule grows into a shoot to support the leaves L6 b It's the radicle that absorbs water for the embryo to start to grow and develop and so it is closest to the place where water enters the seed. L7 4 a Red light promoted germination at the end of the sequence, whereas far red light at the end of the sequence inhibited germination. L8 b If only far red light is reaching the seeds then there must be plants above them, shading the seeds. If the seeds grew they may not get enough light and would be in competition with the other plants. Therefore, seeds will germinate only when there is nothing that will stop them from growing well above/near them. L4 f water and oxygen (not warmth because that isn't a substance) 8C Breathing and respiration L6 g Water to allow chemical reactions to occur (or to allow cells to swell); oxygen for respiration. 8Ca Aerobic respiration L5 h the food store in the seed L6 2 a It has reduced their populations because they depend on flowers for nectar/pollen to eat. b made it more difficult for some crops, such as fruit trees, to be pollinated and produce fruit because there are fewer pollinators L5 3 glucose + oxygen Æ carbon dioxide + water water + carbon dioxide Æ oxygen + glucose L5 4 a the seed coat L7 b Water soaks into it slowly and softens it. L7 c The seeds will last through the winter so when they germinate conditions will be right for good growth of the seedlings. 468 Student Book 1: 8Ca Water sports and breathing L4 1 a oxygen L4–5 b L4 respiration L5 aerobic respiration L5–6 c L5 cells L6 mitochondria L5–6 d L5 blood L6 red blood cells © Pearson Breathing and respiration L4 2 carbon dioxide L5 3 a mouth/nose, trachea/windpipe, bronchi, bronchioles, lungs L5 b diaphragm or muscles between ribs L5 4 a the number of breaths taken in a minute L4 b They both increase. L6 c More oxygen is needed by cells, therefore more air needs to be taken into the lungs so that more oxygen can be taken into the blood; the oxygen needs to be supplied to the cell more quickly by the blood so the blood must be pumped faster. L6–7 5 L6 to remove the lactic acid from their bodies L7 includes mention of EPOC or the oxygen debt 2: 8Ca Aerobic respiration L4 1 a The amount of oxygen in his blood is lower than it should be. L4 b oxygen L4 c His organs may become damaged. L4 2 finding evidence to support or not support an idea L4–5 3 8Ca-1 Aerobic respiration L4 1 a drawing of candle with no flame L4 b Candles need air to burn. L4 c The snail will die. L4 2 a draw in the water level higher than in the diagram on left L4 b Burning only uses up a part of the air. L5 3 a reactants: glucose, oxygen; products: carbon dioxide, water L5 b energy 8Ca-3 Combustion and respiration L6 Statements about both: glucose can be used as a fuel glucose + oxygen → water + carbon dioxide the energy released is transferred by heating the products of the reaction are oxides makes things get warmer energy is released produces a gas L4 Candles go out and mice are killed if you remove air. can be modelled using a word equation L5 Burning candles and living mice both need something from the air (and this may involve similar processes). oxygen is used up L5 4 a The animal/candle died/went out after the water level had risen a small way up the beaker. If all of the air could be used by the animal/candle, the water level would have risen much further/to the top. L6 b The water level stopped rising at the same level in each case. L5 5 a beaker X because the peas are respiring (and this process releases energy, some of which is transferred by heating); accept answers that refer to releasing 'heat energy' L5 b beaker X because the peas are respiring (and this process produces carbon dioxide) L6 6 a Both processes produce carbon dioxide, produce water, release energy and use oxygen. L6 b one of: burning transfers some energy as light, respiration is a series of reactions, respiration is more controlled L6 7 a oxygen + glucose → carbon dioxide + water L7 b good model, one from: you can see the reactants and products clearly, it is simple to understand; poor model, one from: it doesn't tell you anything about the energy released, it doesn't show you that a whole series of reactions is occurring © Pearson 8 C Activity Pack is useful on camping expeditions Combustion only: metals can be used as a fuel some energy released is transferred by light wood can be used as a fuel energy is released quickly Aerobic respiration only: happens in living cells energy is released slowly Neither: happens in dead cells produces a solid 8Ca-4 O2POW L4 1 Oxygen is a vital element needed by your body. Oxygen is also a key substance used in a process that keeps your body warm. This is because oxygen allows your cells to release energy. Your cells can't use glucose sugar without oxygen. L5 2 a When your body has plenty of oxygen for aerobic respiration, the only product is harmless water. L5 b When your body has plenty of oxygen for aerobic respiration, the only products are water 469 Breathing and respiration 8 C and carbon dioxide. (Note that energy should not be included here because it is not a product of the reaction.) L4 3 We get oxygen into our bodies using our lungs and not through the digestive system. L5 4 Students' own adverts. Possible health claims for 'fresh air' could include 'Contains oxygen', 'Contains the same percentage of oxygen that your lungs are adapted for', 'Contains very little carbon dioxide'. 8Ca-5 Ideas about respiration L4 1 a Heat is produced by respiration. L4 b The carbon dioxide we breathe out is made by respiration. L4 c Respiration happens in all living cells. L5 2 glucose L5 3 a carbon dioxide, water L4 b It will die. L5 c The oxygen will run out (or the carbon dioxide will increase and poison the bird). L5 4 with/needing air/oxygen 8Ca-6 La vie est une function chimique L5 1 a combustion/burning and aerobic respiration L5 b Both processes release energy, which is transferred to the ice and increases its temperature, so causing it to melt. Many students will write something like 'heat is produced, which melts the ice'. Give credit for this sort of answer but encourage students to talk about 'energy being released' and this energy causing a temperature rise. L6 c Combustion and aerobic respiration were similar processes, or combustion has the same effect as aerobic respiration but takes less time. L5 d Since respiration is a chemical reaction, living things need to use a chemical reaction to stay alive. L6 2 a glucose + oxygen → carbon dioxide + water L5 b with/needing air/oxygen L5 3 a The higher you go, the less saturated your blood is with oxygen. L5 b two from: feels tired; feels short of breath (breathing rate increases); heartbeat (pulse rate) increases L6 c The climber would feel tired because his muscles cannot get enough oxygen for aerobic respiration and so don't work as well; feels short of breath because his muscles are needing more oxygen but there is less oxygen in the air; his pulse rate increases because the heart pumps faster to 470 get what oxygen there is quickly from the lungs to the muscles. L6 d The oxygen saturation at those altitudes is very low and this may harm the climber, or prevent him/her from reaching the summit. 8Ca-7 Aerobic respiration and oximetry L5 1 a with/needing air/oxygen L6 b glucose + oxygen → carbon dioxide + water L6 c glucose → pyruvate + water L7 d Possible good points: it is easy to understand; it clearly shows what you start with and what you end with. Possible poor points: it doesn't give any information about how the reaction(s) occur(s); it doesn't give any information about energy. It is a useful model because it helps us to understand why aerobic respiration causes changes in an organism/an organism's surroundings, and we don't need to know how it happens. L5 2 a 4 L6 b 50% L6 c drawing of five haemoglobin molecules to which 16 oxygen molecules are attached, with no more than four oxygen molecules on each haemoglobin L7 3 a It is likely to fall. A lower pH (i.e. more acidic solution) results in more oxygen leaving the haemoglobin molecules. L7 b suitable suggestions: temperature, time of day, restedness/level of activity of subject, room/ place of testing, pulse oximeter used L7 c suitable reasons include: temperature will cause higher oxygen saturation readings because lower temperatures make it less likely that oxygen will leave haemoglobin molecules; time of day may affect temperature or amount of food eaten by subjects; more active subjects may be respiring more and so using more oxygen from their blood; the air in different rooms/places may contain more carbon dioxide depending on the number of people in the room; a different pulse oximeter may not be calibrated the same (or words to that effect) and so may give different readings. 8Cb Gas exchange system Student Book 1: 8Cb Gas exchange system L4 1 bellows – ribs cage/muscles/diaphragm; bladder – lung L5 2 They contract (breathing in) and relax (breathing out). © Pearson Breathing and respiration L6 3 Label 1: The bellows are pushed together. Label 2: The air pressure inside the bellows is increased. Label 3: The pressure inside the bellows pushes air out of the bladder, which deflates. As it deflates the air pressure inside the bellows falls. It carries on falling until the pressure inside the bellows is the same as atmospheric pressure. L5 4 There are cells that produce mucus to trap dirt etc., and there are ciliated epithelial cells, which have cilia to sweep the dirty mucus away. L5 5 There is a movement of oxygen from the air in the lungs into the blood and a movement of carbon dioxide in the opposite direction. L5 6 a the overall movement of particles from an area where there are a lot of them to an area where there are fewer of them L6 b Molecules move in all directions, so by chance some will move in one direction and others will move in the opposite direction. L5 4 one that doesn't follow the same pattern as the others L4 5 a any sensible suggestion, e.g. running on the spot, star jumps, stepping L5 b to take multiple repeat readings so that you can be more sure that the results are correct L7 c Suggestions are likely to be three or four times. The justification should include a weighing up between the amount of time that it takes to do a lot of repeats versus how concentrating on your breathing rate can change it and so it is difficult to get accurate values. By taking a lot of readings you are more likely to get an accurate value for the reading. L5 d Add up each set of repeated figures and divide by the number of repeat readings. L5 6 Pulse and breathing rate will increase after exercise. Activity Pack L5 7 mouth/nose, trachea/windpipe, bronchus/ bronchi, lungs 8Cb-1 The gas exchange system L5 1 correctly labelled diagram L7 8 It would decrease the speed of gas exchange because there would be less area/room for the gas molecules to get from one side of the lung to the other. ventilation – air moving into and out of the lungs L7 9 The cilia do not work and so mucus builds up. This increases the distance through which gases have to move to pass between blood and air in the lungs and/or this reduces the amount of surface area for gas exchange, because some of it is blocked. 2: 8Cb Means and ranges L5 1 a to check readings so that you can be more sure that they are correct L5 b Students' own answers: the bag, because it is really simple to do and doesn't need a lot of setting up; the computer, because it can take lots of measurements quickly and easily L5 c for the bag: it is not very accurate, it is time consuming to take lots of repeated readings; for the computer and spirometer: it is expensive, you have to learn the software to run it L4 2 a Hitesh: 30 cm3 before exercise, 110 cm3 after exercise; Josie: 50 cm3 before exercise, 150 cm3 after exercise L5 b the results before exercise because they have a narrower range L5 3 Hitesh before exercise 435 cm3, Josie before exercise 327.5 cm3 (a better answer would round this up to 330 cm3 since all the figures in the table are given to only two significant figures); Hitesh after exercise 1037.5 cm3 (a better answer would round this up to 1040 cm3), Josie after exercise 860 cm3 © Pearson L5 2 breathing – using muscles to expand and deflate the lungs respiration – a chemical process that happens in cells alveolus – a small pocket in the lungs gas exchange – oxygen and carbon dioxide diffusing in the lungs L5 3 correct order (top to bottom) 5, 3, 4, 6, 2, 1 L5 4 They are constantly moving. L7 5 so that gas exchange happens quickly 8Cb-5 Mouth-to-mouth resuscitation L5 1 Correctly arranged information. The sentences should read: Step A – Place the person face upwards on a solid, flat surface. To open the airways, tilt the head backwards by placing one hand on the forehead and gently lifting up the neck. Step B – Support the back of the neck and open the mouth and check that there is nothing blocking the back of the mouth. You may need to remove anything that is blocking the windpipe or pull the tongue out of the way. Step C – Hold the nose, take a deep breath, open your mouth and place it onto the person's lips. Breathe out gently but hard enough to get the person's chest to rise. Step D – Remove your mouth and look to see that the person's chest is falling, while listening for air coming out of the lungs. Repeat these last two steps every 5 seconds until medical help arrives or breathing re-starts. 471 8 C Breathing and respiration 8 C L5 2 The cells need oxygen for aerobic respiration and will die without it. L5 3 They are causing air to flow into and out of the person's lungs. (Air flow is ventilation.) L5 4 make the trachea/windpipe as wide as possible L6 5 Too strong a breath can damage the delicate parts of lungs, especially in a young child. L6 6 Air from the person doing the resuscitation is at higher pressure than atmospheric pressure and so leaves the person and goes into the injured person. The air in the injured person is now at higher pressure than atmospheric pressure and so the lungs expand. When the person doing the resuscitation stops breathing out, the injured person's lungs deflate again because the elastic walls of the lungs squash the air, putting it at higher pressure than atmospheric pressure and so air flows out of the lungs. L7 7 a Gas exchange will be reduced because there is less fresh air (containing more oxygen) getting into the lungs because of the narrower tubes. The widening of the capillaries will squash the alveoli and so reduce their surface area, which will also reduce gas exchange. L6 8 The adult's mouth is placed to cover both the mouth and nose. 8Cb-6 Breathing, ventilation and respiration L5 1 a ventilation L5 b mouth/nose, trachea/windpipe, bronchus/ bronchi, lungs L4–5 2 L4 respiration L5 aerobic respiration L5 3 Does the diaphragm move up or down? Does air in the trachea contain more or less carbon dioxide? Inhaling out down less Exhaling in up more L5–6 4 a L5 As the cord is pulled, it pulls down the rubber sheet and this makes the space inside the jar bigger and so air flows into the balloons and they get bigger. L6 As the cord is pulled, it pulls down the rubber sheet and so lowers the pressure inside the jar. Atmospheric pressure is now greater than this pressure and so air flows into the balloons and they expand. L5 5 alveoli L5 6 a gas exchange 472 8Cb-7 Lungs and gas exchange L5 1 a i diaphragm ii lungs iii trachea/windpipe L5–6 b A L5 answer will not talk in terms of pressure (e.g. as the cord is pulled, it pulls down the rubber sheet and this makes the space inside the jar bigger and so air flows into the balloons and they get bigger), whereas a L6 answer will be in terms of pressure (e.g. when the rubber sheet is pulled down, the pressure inside the jar is reduced. Air rushes into the balloons to balance the pressure inside and outside the balloons. When the rubber sheet is let go, the pressure inside the jar is increased. Air flows out of the balloons until the pressure inside the balloons is equal to the pressure outside them). L5 c Breathing is the movement of the muscles (to increase/decrease the volume of the lungs), ventilation is the flowing of air. L7 2 a cilia L7 b sweep mucus containing trapped dirt away from the lungs (and to the top of the gullet to be swallowed). L7 c diagram B L5 b anaphylaxis Do the ribs move in or out? L5 b Particles are always moving, so naturally move into places where there are fewer of them. L7 d The cilia are inactive. L7 3 The capillary walls are thin and so are the walls of the alveoli, and so there is not far for particles to travel (speeding up gas exchange). Also the alveoli give the lungs a large surface area (also speeding up gas exchange). Give credit for using scientific terms (such as alveoli, capillaries, surface area). Some students may also answer in terms of blood flow and ventilation maintaining the diffusion gradients of oxygen and carbon dioxide but students are not expected to know this (see Worksheet 8Cb-8). 8Cb-8 Gas exchange rates L6 1 The overall movement of particles from a place where there are more of them to a place where there are fewer of them due to the natural movement of particles. L8 2 a X – you move down the concentration gradient from left to right. Y – you move down the concentration gradient from the bottom to the top. Z – you move down the concentration gradient from right to left. Answers may also be in terms of going up the concentration gradient. L8 b Z, X, Y L6–8 3 L6 is for correctly identifying alveoli, air sac, capillaries. L7 would consider that the capillary walls are thin and so are the walls of the alveoli, and so there © Pearson Breathing and respiration is not far for particles to travel (speeding up gas exchange). Also the alveoli give the lungs a large surface area (also speeding up gas exchange). L8 is for talking in terms of the concentration gradient being maintained. With a continuous supply of blood replacing the newly oxygenated blood in the capillaries, the concentration gradient of oxygen is maintained and kept steep (between blood and the air in the lungs). With a continuous supply of air replacing the newly de-oxygenated air in the capillaries, the concentration gradient of carbon dioxide is maintained and kept steep (between blood and the air in the lungs). 8Cc Getting oxygen Student Book 1: 8Cc Getting oxygen L5 1 no because they are a dark browny-red colour L5 2 a carbon dioxide (accept water vapour) L5 b aerobic respiration (try to ensure that students use this full terminology) L6 c mitochondria L5–6 d It diffuses out of the cell and into a capillary, where it dissolves in the blood plasma. In the lungs, it diffuses out of the capillary and into an alveolus/air sac, from where breathing movements then move it out of the lungs and into the surrounding air. L5 The answer will talk in terms of 'moving'. L6 The answer will mention diffusion (although the term does not need to be explained). L5–6 3 L5 in the blood L6 The answer will state that it is dissolved in the blood plasma. L6 4 a During exercise, more energy is needed therefore more aerobic respiration needs to occur, which needs more oxygen. The swimmer breathes faster to get more oxygen into the blood. L6 b During exercise, more energy is needed and increased blood flow will deliver more oxygen to the muscle cells. L6 5 Tar coats the alveoli making diffusion of oxygen into the blood slower; smoke irritates the lungs and can cause the alveoli to break down, reducing surface area; carbon monoxide stops red blood cells carrying oxygen; smoke and heat cause the cilia to stop working and mucus builds up which can cover some of the surfaces used for gas exchange. L6–7 6 a Y L6 because the cavities are much bigger © Pearson L7 resulting from the alveoli breaking down L6–7 b L6 They would have a higher breathing rate because there is less surface area in the lung when someone has emphysema, so there is less area over which oxygen can diffuse and less oxygen gets into the blood. With less oxygen getting into the blood in each breath, the person needs to breathe faster in order to make sure that enough oxygen gets into the blood. L7 The answer will mention the need to maintain a steep concentration gradient (the steeper the concentration gradient, the faster diffusion occurs and by cycling air through the lungs more quickly the percentage of oxygen in the lungs is always maintained at a higher level than with slower breathing). 2: 8Cc Cause and effect L5 1 a three from: until about 500 years ago only native Americans smoked; smoking became popular around the world, starting from the 16th century; smoking is harmful; the popularity of smoking has decreased L5 b the increase in the number of lung cancer patients was due to road tar; the increase in the number of lung cancer patients was due to increasing traffic; the increase in the number of lung cancer patients was due to smoking L5 2 a for example: The increase in lung cancer patients is due to road tar. The increase in lung cancer patients has been caused by increasing traffic. There has been an increase in smoking and as a result there are more lung cancer patients. L5 b for example: As the smoking rate increases so the death rate increases. L5 3 a paragraph 3 L5 b paragraph 3: cause, due to, the effect of which, causing, resulting in; paragraph 4: because, due to L5 4 a Students' own answers: ensure that the paragraph starts with a short and to-the-point topic sentence (e.g. 'You should stop smoking.'); ensure that linking words and phrases have been used to show cause and effect; ensure that only facts have been used L5 b Students' own answers: ensure that the paragraph starts with a short and to-the-point topic sentence (e.g. 'You should stop smoking.'); ensure that linking words and phrases have been used to show cause and effect; ensure that only opinions have been used L6 c Students' own answers, but these should allude to the greater power of facts over opinions 473 8 C Breathing and respiration 8 C Activity Pack 8Cc-1 Getting enough oxygen L4 1 a All three factors will go up. L6 b She needs more oxygen because aerobic respiration is happening faster. L6 2 a red blood cell L6 b to carry oxygen L6 c bright red L6 d dark browny red L6 e carbon monoxide L5 f tar or nicotine or 'particles' (do not accept 'heat') L6 3 aerobic respiration L6 4 a emphysema L6 b There is less surface area. L6 5 They die. 8Cc-5 Gas exchange and circulation 2 L6 1 a circles only drawn inside blood vessels L6 b Circles nearer to the entry of the blood are coloured in brown and those nearer to the exit of the blood are coloured in red. L5 2 a Arrows of appropriate colour for oxygen going from the alveolus to the inside of the blood vessel. L5 b Arrows of appropriate colour for carbon dioxide going from the inside of the blood vessel to the alveolus. L6 3 plasma L6 4 Circles nearer to the entry of the blood (on the left) are coloured in red and those nearer to the exit of the blood are coloured in brown. L6 5 a Arrows of appropriate colour for oxygen going from a capillary to the tissue. Award extra credit for arrows that start in a red blood cell and end clearly inside a tissue cell. L6 b Arrows of appropriate colour for glucose going from a capillary to the tissue. Award extra credit for arrows that start in the plasma of the blood and end clearly inside a tissue cell. L6 c Arrows of appropriate colour for carbon dioxide going from the tissue into a capillary. Award extra credit for arrows that start in a tissue cell and end clearly in the blood plasma. 474 L6 6 a The blood vessel leaving the lungs should be coloured (e.g. bright red) to show oxygenated blood and the blood vessel going to the lungs should be coloured (e.g. brown) to show deoxygenated blood. Elsewhere, the blood coming from the heart towards the body is oxygenated and the blood leaving the capillaries before returning to the heart is deoxygenated. Award extra credit if there is an attempt to show a gradual deoxygenation of the blood as it moves through the capillaries. L6 b W – high oxygen because the blood has just gone through the lungs and picked up oxygen X – high oxygen because the blood is returning from the lungs where it picked up oxygen Y – high oxygen because the blood is still in an artery and has not been through any capillaries yet Z – low oxygen because the blood has just been through capillaries where tissue fluid has leaked out taking oxygen to be used up by the cells for aerobic respiration. L6 c correctly labelled diagram L4 7 a The heart pumps faster so moving blood faster through the system. L6 b The cells are respiring more. So, the cells need more oxygen. Oxygen is carried by the blood. So, the heart pumps blood faster to supply more oxygen. L6 8 a Any way in which the surface area of the lungs is decreased (e.g. emphysema) or the flow of air into and out of the lungs is diminished (e.g. asthma attack). L6–7 b i L6 explains that their blood contains less oxygen and so has to be pumped

faster to get enough oxygen to the cells. L7 will mention concentration gradients and explain that blood needs to be moved on faster in order to maintain a steeper concentration gradient. L6–7 ii L6 there is less of the oxygen in each breath getting into the blood and so more breaths are needed to get enough oxygen into the blood. L7 the air needs to
be cycled faster in order to maintain a steeper concentration gradient. © Pearson Breathing and respiration 8Cc-6 Diagnosis attempted murder? L6–7 1 Condition Cause Symptoms Treatment hypercapnia (too much carbon dioxide in the blood) lung disease breathing very quickly breathing in 100% oxygen carbon monoxide poisoning breathing in
poisonous gas parts of the skin go bright red due to the poison sticking to red blood cells and turning them bright red breathing in 100% oxygen hydrogen cyanide poisoning breathing in poisonous gas skin goes pink due to high oxygen concentration in blood injecting a chemical that sticks to the poison and makes it harmless blue-baby syndrome the
skin turns a bluish colour in severe cases a blood since the blood cells break transfusion (extra blood) apart and cannot carry is given oxygen too many chemicals called nitrates in drinking water L6 2 Hydrogen cyanide and carbon monoxide poisoning. Students may have included blue-baby syndrome if they make the reasoned point that someone
could have been giving the baby water containing excess nitrates on purpose. 8Cc-7 Capillaries and respiration L4 1 a it increases/goes up L4 b it increases/goes up L5 c He needs to release more energy using aerobic respiration. L5–6 d L5 blood vessel L6 capillary L6 e tissue fluid L6 f oxygen, glucose L6 g arrow drawn from the end of the dashed
arrow back to a capillary L6 2 a A reduction in internal surface area of the lungs, or an increase in the distance over which diffusion occurs (e.g. by covering surfaces with a film). L6 b A reduction in the surface area from emphysema or the loss of a lung. An increase in distance over which diffusion occurs (e.g. mucus from asthma or lung infection, tar
coating from cigarette smoke). L5 3 a tar or nicotine L6 b It stops red blood cells carrying oxygen. 8Cc-8 Reducing and increasing gas exchange L4 1 a i Y ii X iii Z L6 b The more active she is, the more energy she needs. Energy is released by aerobic respiration. Aerobic respiration requires oxygen. A faster pulse rate delivers more blood carrying
oxygen to the muscles. © Pearson L6 2 Oxygen from red blood cells dissolves in the plasma. The plasma leaks out of capillaries, carrying oxygen and glucose. The oxygen and glucose diffuse into cells. The oxygen and glucose are used up in aerobic respiration, and carbon dioxide is produced. This is carried in the tissue fluid back to a capillary. L5 3 a
Nicotine reduces the blood flow. L5 b The more nicotine in the cigarette, the more the blood flow in the capillaries is slowed. L6 c it narrows them L6 d They may not run so fast because less blood would get to their muscle cells and so less oxygen would get to their muscle cells (to be used in aerobic respiration). L7 e Tar coats the lungs and so makes
diffusion of gases/gas exchange more difficult, so less oxygen enters the blood. Carbon monoxide stops red blood cells carrying oxygen, so less oxygen can be carried by the blood. L6 f aerobic respiration (do not accept respiration) 8Cc-9 Coronary heart disease L6 1 Oxygen leaves red blood cells and dissolves in the plasma. Plasma leaks out of the
capillaries, forming tissue fluid. Oxygen diffuses from the tissue fluid into the heart muscle cells. L5 2 a Doing exercise lowers the risk of developing CHD. L7 b Exercise reduces the amount of fatty substances in the blood and so there is a lower risk of plaques forming. Exercise increases lung volume meaning that there is more air in every breath and
so more oxygen gets into the blood. Exercise increases heart volume and so more blood is pumped around the circulatory system with each 475 8 C Breathing and respiration 8 C beat. All of these increase the amount of oxygen that can get to heart muscle cells. absorbs the small amounts of carbon dioxide in the air that is bubbling through it.) L6 3 a
The heart muscles work harder and so respire more and so need more oxygen. The pain starts as the cells start to become short of oxygen. L4 5 a oxygen, glucose (sugar) L6 b oxygen diffuses into the leaves through the stomata/oxygen is made by photosynthesis; plants make their own glucose (sugar) L7 b The pain is likely to start at lower intensities
of exercise if the amount of oxygen in the blood is already lower. This can be caused by smoking in various ways: tar coating the lungs slows down diffusion of oxygen into the blood carbon monoxide reduces the amount of oxygen that the red blood cells can carry irritation of the lungs can damage the air sacs/ alveoli, reducing the surface area over
which oxygen can diffuse heat from cigarettes causes cilia to stop working, so mucus builds up and coats the surfaces of the lungs leading to slow diffusion of oxygen In addition, nicotine makes the build up of plaques more likely, causing arteries to become narrower and reducing the flow of blood to the heart muscles. L5 6 Fish are respiring and
producing carbon dioxide, an acidic gas. The carbon dioxide diffuses into the water in the fish's gills. L6–7 7 similarities include: L6 oxygen diffuses into the blood L7 carbon dioxide diffuses out of the blood, the surfaces where gas exchange takes place are covered in water, the organs used for gas exchange have very large surface areas differences
include: L6 mammals exchange gases with the air but fish exchange gases with water L7 the fluid from which gases are exchanged flows into and out of the lungs in the same tubes but there is a one-direction flow of water across gills 8Cd Comparing gas exchange Activity Pack Student Book 8Cd-1 Comparing gas exchange L4 1 All ticked apart from
'fire'. 1: 8Cd Comparing gas exchange L5 1 a They have an organ full of blood (note that this is an adaptation of the spleen of an elephant seal). L6 b The blood in the organ contains oxygen which can then be pumped around the body when needed, while the animal is diving. L6 2 It will last longer: Allan is doing less exercise so his muscles will be
respiring less and he will use less oxygen. L5 3 Nitrogen remains the same because nitrogen is not used in aerobic respiration. Oxygen levels are lower in exhaled air because oxygen diffuses out of the lungs and into the blood where it is carried to cells for respiration. Carbon dioxide levels are higher in exhaled air because carbon dioxide produced by
respiration diffuses from the blood and into the air in the lungs. Water vapour levels are higher because the surfaces of the lungs are damp and the water evaporates from them. The temperature is higher in exhaled air because the body is warmed by aerobic respiration and the temperature of the lungs warms the air inside them. L5 4 a tube X L5 b It
has gone milky/cloudy. L5 c Tube X will go yellow because exhaled breath contains a lot of carbon dioxide and this lowers the pH and makes the indicator turn yellow. (Tube Y will also go yellow after a while, as it 476 L5 2 a It went from clear and colourless to cloudy/milky. L5 b Sasha's breath contained carbon dioxide. L5 3 a The temperature
increases. L5 b Energy is released into the surroundings by respiration. L6 4 a Arrows showing movement of carbon dioxide out of the leaf and movement of oxygen into the leaf. L6 b stomata (accept 'stoma') L6 5 a water L6 b gills 8Cd-6 Respiration card sort L4–6 Statements that apply only to animals: Lungs excrete carbon dioxide. Respiration
occurs in heart tissue. Gas exchange can happen in gills. Statements that apply only to plants: Respiration happens in leaf cells. Gas exchange happens using stomata. Respiration happens in root cells. Statements that apply to both plants and animals: Respiration releases energy from glucose. Aerobic respiration occurs in mitochondria. Cells die if
they do not get enough oxygen. Oxygen can be taken from air or water. Water is a product of respiration. One product of respiration turns limewater cloudy. © Pearson Breathing and respiration Respiration uses up a sugar. Gas exchange occurs through diffusion. Respiration makes the temperature go up. Statements that apply to neither: Respiration
only occurs when it is dark. The reactants in aerobic respiration include water. Respiration produces an alkaline gas. 8Cd-7 Respiration in plants and animals L4 1 oxygen L4 2 oxygen L4 3 carbon dioxide L4 4 carbon dioxide L4 5 all cells L5 6 limewater L5 7 A – yellow, B – yellow, C – yellow, D – pink 8Cd-8 Differences in gas exchange L5 1 a The
temperature in A will rise because the cells in the peas are respiring. The temperature will not rise in B as all the cells in the peas will be dead. L5 b The gas from A will turn limewater milky because the peas in A are alive and respiring. The gas from B will not produce any effect in the limewater. L5 c Use an indicator (such as hydrogen carbonate or
bromothymol blue) to test for acidity in the gases. The gas from A will be more acidic due to additional carbon dioxide from respiration. Alternatively, students might suggest burning candles in the different gases. The candle will burn for less time in flask A because some of the oxygen will have been used up in respiration. L6 2 a The higher the
temperature, the more often the operculum opens and closes. L6 b It would appear from the experiment that warmer water must contain less oxygen. Fish need to pump warmer water faster over their gills in order to get the same amount of oxygen as they would in colder water. L6 c They do not have a mechanism to pump water and so must swim to
create a flow of water over their gills. L6 3 Since gas exchange happens through their skins as well, they don't have so large a surface area in their lungs. L6 4 a All the cells are living and so need to respire. L6 b Gases produced by respiration diffuse out of a leaf through the stomata. 8Cd-9 Efficient gas exchange L6 1 a one of: they both have a large
surface area; they both have a rich supply of blood; they both are moist to allow gases to dissolve; they both have short distances for diffusion to occur; they both use concentration gradients © Pearson L6 b one of: lungs have pockets but gills have projections; lungs expand and contract but gills do not; lungs extract the oxygen from air, gills extract it
from water L7 2 a Oxygen from the air needs to dissolve in water in order to get into the blood and so frogs must keep their skin moist for it to exchange gases to obtain oxygen. L7 b The gill filaments collapse and stick together, reducing the surface area for gas exchange. L6 3 a so that gas exchange can occur when they are exposed to air or when
submerged by the tide L7 b When the two volumes of blood are mixed, the resulting oxygen percentage has equal contributions from the lungs and from the gills. If the mixed blood is 53% and the blood from the lungs is 61% (8% higher), then the blood from the gills must be 8% lower; 45%. L7 c The lungs are more efficient. d three of: the gills
collapse in air, the gills have less surface area, the gills maintain a lower concentration gradient, the distance gases have to travel is greater for the gills L7 4 a Gills, because they have the greatest surface area. L7 b one of: there is a greater concentration gradient between the blood and the air in pouch X, there is less of a distance for gases to travel
into and out of the blood in pouch X. (It is this last explanation that has been shown to be most likely.) L7 c It cannot obtain all the oxygen it needs using its gills. 8Ce Anaerobic respiration Student Book 1: 8Ce Anaerobic respiration L5 1 lactic acid L6 2 The more they move, the more energy they need and the more of their oxygen reserves will be
used up. L6 3 aerobic respiration and anaerobic respiration L5–6 4 a L5 It cannot be done for long. L6 It uses up more oxygen than can be produced by aerobic respiration. L7 b The swimmer needs more energy than can be supplied by aerobic and anaerobic respiration./The swimmer is using anaerobic respiration and this makes the muscles become
tired quite quickly. L6–7 5 Students' own answers, containing the following – 477 8 C Breathing and respiration 8 C similarities: L6 they both use glucose, they are both used during strenuous exercise, they both release energy differences: L6 anaerobic respiration produces lactic acid but aerobic respiration does not, anaerobic respiration makes the
muscles become tired quickly L7 aerobic respiration occurs in mitochondria but anaerobic respiration occurs in the cytoplasm, anaerobic respiration releases less energy than aerobic respiration L6 6 It is transported in the blood to the liver where it is turned back into glucose. L6 7 a to get extra oxygen into the body L6 b to get oxygen to cells/the
liver faster L7 8 lactic acid being turned into glucose in the liver requires additional energy from aerobic respiration; replenishing oxygen stores in blood and muscles; additional aerobic respiration required to operate rib muscles and diaphragm at a faster rate (faster breathing rate); additional aerobic respiration required to operate heart muscles at
a faster rate (faster pulse rate) 2: 8Ce Fitness training L5 1 a aerobic respiration L5 b glucose and oxygen L5 c it turns limewater milky L5 d anaerobic respiration L5 2 attached to the ribs, in the diaphragm L5–6 3 L5 It diffuses into the blood and is carried on red blood cells to the capillaries where it dissolves in the blood plasma. L6 It is then carried
out of the capillaries as tissue fluid and diffuses into cells. L6–7 4 L6 oxygen is need for aerobic respiration; nicotine can cause the arteries to narrow, reducing blood flow; tar can coat the lungs, reducing gas exchange L7 carbon monoxide prevents the blood carrying as much oxygen; tar can irritate the lungs and cause coughing, which, over time,
can cause the air sacs to collapse and so reduce gas exchange; smoke stops cilia from working, which means that an athlete may be more prone to lung infections that disrupt training; non-working cilia mean that mucus can coat the lung surfaces reducing surface area for gas exchange L6–7 5 a L6 Before exercise there is a steady pulse as the heart
pumps blood containing enough oxygen so that all cells can respire aerobically. When exercise starts, the pulse rate increases to supply more 478 oxygen to the cells because they are respiring faster. L7 The pulse rate increases to increase the rate at which lactic acid is removed from muscle cells. After exercise, the pulse rate starts to drop since not
as much oxygen is needed by the cells because they are working less hard. However, it remains above resting level for a while in order to replenish oxygen stores and provide oxygen for additional aerobic respiration. L6 b Their pulse rate returns to normal faster after exercise than when less fit and their pulse rate is not as high while they are
exercising. L6–7 c L6 Regular exercise causes the heart muscle to increase in strength and so it pumps out more blood with each beat./Regular exercise causes the breathing muscles to increase in strength. L7 Increase in strength of the heart muscles means that the heart does not need to pump so fast to supply enough oxygen./ Increase in strength
of the breathing muscles means that the lungs become bigger and can exchange more oxygen. Activity Pack 8Ce-1 Anaerobic respiration L4 1 a carbon dioxide L4 b the girl sprinting L6 c She is doing the most strenuous exercise and so is respiring more and so is producing more carbon dioxide. L5 2 a lactic acid L5–6 b doing hard exercise L5 ,
sprinting L5 , holding your breath for a very long time L5 , when there is a lot of carbon monoxide in the blood L6 L5 c both aerobic and anaerobic L6 d All cells always respire aerobically. They respire anaerobically as well if aerobic respiration cannot meet the energy needs of the body. L6 3 lactic acid in cell → lactic acid in blood → lactic acid in liver
→ converted to glucose L6 4 in blood, in muscles 8Ce-3 Comparing respiration L5–6 1 Aerobic respiration only: Produces carbon dioxide; Requires oxygen; Water is a product; Occurs in mitochondria. Anaerobic respiration only: Causes muscles to become tired quickly; Produces lactic acid; Produces a substance that is broken down by the liver; Is a
main cause of EPOC; Can be switched on suddenly. Both aerobic and anaerobic respiration: Releases energy from glucose; Occurs in muscle cells; © Pearson Breathing and respiration Increases as hardness of exercise increases; Produces an acidic substance. L5 d if the cell is dead Neither aerobic nor anaerobic respiration: Produces oxygen;
Requires lactic acid; Requires water as a reactant; Carbon monoxide is a product; Uses up blood. L6 4 a glucose → lactic acid b liver 8Ce-4 Changing ideas about anaerobic respiration L5–6 L6 5 a To the left – because the maggots are using up oxygen for aerobic respiration and the gas that they produce is being removed by the soda lime, so reducing
the volume of gas in the flask. The cards are already in the correct order. Scientist 1: A – F. Scientist 2: G – L A&G – observation C&I – hypothesis L4 b It gradually decreased for both sets of maggots. L6 d To ensure a fair test. The maggots in set A were being agitated by being transferred to a new flask so those in set B had to be agitated too. D&J –
prediction E&K – experiment F&L – results 8Ce-5 Aerobic and anaerobic respiration L5–6 1 Aerobic Anaerobic respiration respiration Releases energy? ü ü Needs glucose? ü ü Needs oxygen? ü × Produces a gas? ü × One product is acidic? ü ü L4 2 a It goes up. L6 b More energy is needed by muscles at higher speeds, so more respiration needs to
happen, which requires more oxygen to reach cells. L5 c 18 km/h L5 d The lactic acid line on the graph is higher for this value than the others. L6 e Not enough energy can be released by aerobic respiration alone. L6 f If this aerobic respiration stopped, then the muscles would not have enough energy. 8Ce-6 Maggot and human respiration L5 1 two
from: one needs oxygen and the other does not; aerobic respiration occurs in mitochondria but aerobic respiration occurs in the cytoplasm; anaerobic respiration releases less energy than aerobic respiration; anaerobic respiration produces lactic acid but aerobic respiration does not; anaerobic respiration makes the muscles become tired quickly L5 2
a at rest, or low activity L5 b during strenuous exercise © Pearson c carried in the blood L6 c There was less and less oxygen available and so aerobic respiration slowed down. B&H – scientific question L5 c never L6 3 It makes the muscles become tired quickly. L7 e As the amount of oxygen was reduced in the flask, the maggots used anaerobic
respiration. When given fresh air (containing more oxygen) the maggots showed EPOC, using up more oxygen than originally in order to replace oxygen stores and to provide additional oxygen for additional aerobic respiration required to convert/remove lactic acid. 8Ce-7 Cellular respiration L5 1 a 40 km/h L6 b To start with, the horse is going faster
and faster but its energy needs can mainly be supplied by aerobic respiration, showing a steady increase in the rate of glucose use. After the anaerobic threshold, the energy needed can no longer be supplied by just aerobic respiration and so anaerobic respiration is also used. This does not release so much energy from each gram of glucose and so
glucose use rapidly increases. L7 c It needs extra glucose because aerobic respiration is still required to release more energy than before. This is due to the extra energy needed to move the lungs (faster breathing rate) and heart (faster pulse rate). The faster rates are because additional oxygen needs to get to the liver to help turn lactic acid back
into glucose, and to replenish the store of oxygen in the muscles and blood. L6 2 X – the cells are respiring and so using up glucose and so the concentration of glucose decreases; Y – the cells are using anaerobic respiration (they have no mitochondria for aerobic respiration) and are producing lactic acid, so it gradually increases in concentration; Z –
the cells are not using aerobic respiration (they have no mitochondria for aerobic respiration) and so the levels of carbon dioxide do not increase L7 3 IAA stops both aerobic and anaerobic respiration. Cyanide only stops aerobic respiration. 479 8 C Unicellular organisms 8 D 8D Unicellular organisms 8Da Unicellular or multicellular Student Book 1:
8Da The Black Death L3–4 1 a L3 movement, growth L4 reproduction, sensitivity, respiration, excretion, nutrition b tiny organisms/an organism that you L5 need a microscope to see L4 2 any three of: fungi, plants, animals, protoctists L5 3 They decomposed. L5 4 any sensible answer, e.g. baking, brewing L6 4 a Arrows show particles X diffusing
throughout, and into the cell. L6 b diffuse, materials, organisms, tissues, systems L6 5 nucleus, mitochondria 8Da-3 Diffusion and cells L6 Suggested order of the diagrams is W, Z, X, Y. Suggested links (but students may have used the diagrams and sentences in other ways): W Particles are in a constant state of motion. Z The particles diffuse through
the water. X The particles diffuse into the cells. Y The particles take longer to diffuse into cells surrounded by other cells. L6 5 to get enough raw materials/or to take waste away So, cells in tissues need a system to supply them with raw materials. L6 6 anaerobic respiration because oxygen would be hard to get Diffusion may not allow bigger cells to
get enough raw materials. 2: 8Da Unicellular or multicellular L5 1 movement – locomotor system; reproduction – reproductive system; sensitivity – nervous system; growth – locomotor system; respiration – gas exchange system, circulatory system; excretion – urinary system; nutrition – digestive system The particles take longer to diffuse evenly inside
bigger cells. L5 2 They are made of a lot of cells. L4 3 (aerobic) respiration So, cells in most organisms are small rather than big. 8Da-4 Microorganisms L3–4 1 Life process Meaning movement being able to move all or a part of itself reproduction producing more living things like itself L4 6 fungi L6 7 unicellular – it is a prokaryote because it has no
mitochondria and all prokaryotes are unicellular sensitivity sensing and reacting to things around it growth increasing in size L6 8 protoctists, plants L7 9 a They do not carry out any of the life processes on their own. respiration using a chemical reaction to release energy excretion getting rid of waste materials that it makes nutrition needing food L5
4 diffusion L5 5 a circulatory system L6 b There are so many cells that it would take too long for materials to diffuse through all the cells to get to every cell. L7 b They are not living organisms. Activity Pack L5 2 unicellular: bacteria, yeast; multicellular: cat, daffodil, mouse, oak tree 8Da-1 Unicellular and multicellular L3 1 a growth L6 3 plants,
protoctists, animals, fungi, prokaryotes L3 b movement L4 c excretion L4 2 all organisms L5 3 a made of one cell L5 b bacteria – unicellular; humans – multicellular; plants – multicellular; yeasts – unicellular; prokaryotes – unicellular 480 L5 4 The particles are in a constant state of motion and so spread out evenly. This means that there is an overall
movement of particles from areas in which there are many to areas in which there are fewer. L5 5 a circulatory system L5 b It would take too long to diffuse. © Pearson Unicellular organisms 8Da-5 Unicellular vs multicellular L5 1 a The number of cells (a unicellular organism is made of one cell and a multicellular organism is made of many cells). to
the surroundings. We do the opposite on hot days. L4 b movement, reproduction, sensitivity, growth, respiration, excretion, nutrition L7 b Possibilities include that it has a very slow rate of respiration/growth and so only needs a very slow supply of raw materials. Or it may have ways of moving the cytoplasm ensuring that raw materials are quickly
transported from the outer parts of the cell to all parts of the cell. L5 2 a diffusion L6 b The particles are constantly moving and so spread out evenly. This means that there is an overall movement of particles from areas in which there are many to areas in which there are fewer. L6 c It is smaller and so has a greater surface area. L6 d Diffusion will
not allow the cell to take in enough of the raw material to supply the whole cell. L5 e Diffusion would not be fast enough to allow raw materials like glucose to move from the small intestine to all cells in the body. L7 3 a prokaryotes L7 c nucleus, mitochondria, chloroplasts 8Db Microscopic fungi Student Book 1: 8Db Microscopic fungi L4 1
Microscopes were not good enough until then to be able to see the organisms. L4 2 Ethanol was not produced if there was no yeast. L5 3 a Daughter cells are identical to the parent cell. L7 b plants L7 c protoctists L7 d prokaryotes L7 e animals L7 4 They can only 'live' when inside another living cell. Or, on their own they do not carry out all the life
processes. 8Da-6 Surface area : volume ratios L5 1 a As the sphere gets bigger, the volume increases at a faster rate than the surface area. L7 b As they get bigger, they have more volume and so need more raw materials but the surface area does not increase enough to be able to supply the additional raw materials. Some students may have also
talked about getting rid of waste (or both taking in raw materials and getting rid of waste). L5 2 a Radius (mm) Surface area:volume ratio 1 3.25 2 1.47 3 1.00 4 0.75 5 0.60 6 0.50 L7 b so that they can take a lot of raw materials – enough to supply the whole cell L7 3 Low ratio. The higher the ratio, the more heat the organism will lose to its
surroundings. In cold habitats, animals need to conserve heat. L7 4 On cold days we curl up, making our surface area:volume ratios smaller so that we lose less heat © Pearson L5 5 a 0.12 (This is a ratio and so should not have units.) L6 b Students' own drawings, showing two cycles of budding; the buds can both come off the first parent cell, or the
parent cell can bud and that daughter cell can then bud. L5 4 carbon dioxide L6 5 If there is air then there is oxygen and this means that the yeast will use aerobic respiration. Aerobic respiration releases more carbon dioxide and so will make the bread rise further/faster. L5 6 mitochondria L5 7 ethanol (alcohol) L5 8 to stop aerobic respiration
occurring, since only anaerobic respiration produces ethanol L5 9 anaerobic respiration/fermentation L5 10 a warmth, food (sugar, glucose), moisture L7 b Food/sugar/glucose because it takes a long time for water to evaporate at the temperatures at which yeast grow, and heat is produced when cells respire so their surroundings will be warm. 2:
8Db Modal verbs L5 1 a 1 might, could, must, will; 2 must, will; 3 must; 4 could; 5 might; 6 will (not) L5 b 1, 2, 3, 6 L6 c e.g. These things are swimming so they may be living things. I could call them 'animalcules'. L6 2 a Broth will go off if microorganisms get into it. L6 b e.g. Spontaneous generation might still be correct for microorganisms other
than those that feed on broth. L6 3 a Microorganisms must cause diseases. 481 8 D Unicellular organisms 8 D L6 b Microorganisms might/may cause diseases. Activity Pack L4 c To get air trapped inside it. The yeast cells use the oxygen in aerobic respiration. L4 2 It cuts the dough into loaf-sized pieces. L4 3 fungus 8Db-1 Microscopic fungi L5 1 a
white loaf and baguette circled L4–5 4 a L5 b They have bubbles in them caused by carbon dioxide from yeast respiration. L4 respiration L4 c any sensible example (e.g. beer, wine) L5 2 tube 4 L5 3 a Y L5 b It does not use oxygen. L5 aerobic L5–6 b glucose + oxygen → carbon dioxide + water L5 5 Reactions occur faster when it is warmer and so
respiration occurs faster, producing more carbon dioxide. L5 c When there is no oxygen, but there is water and the temperature is suitably warm. L4 6 a an oven L5 d X: glucose + oxygen → carbon dioxide + water L4 7 Students' own questions. Y: glucose → carbon dioxide + ethanol (accept alcohol) L5 4 a budding L5 b limiting factor 8Db-6 Bread and
beer L4 1 a The higher the temperature the greater the volume increase. L5 b Respiration is faster at higher temperatures (and so more carbon dioxide is produced at higher temperatures, which increases the volume of the dough). L4 b They are killed. 8Db-8 Yeast populations L5 1 a when yeast/microorganisms use anaerobic respiration L5 b glucose
→ carbon dioxide + ethanol/ alcohol L5 c It doesn't need oxygen. L6 2 Drawing of budding, as shown on Worksheet 8Db. Labels should mention the terms 'parent cell' and 'bud'. L4 3 a 250 L4 b 4000 L4 c Dough B rises more than dough A at higher temperatures. L4 c 5000 L5 d Dough B contains more sugar and so there is more respiration occurring,
which means that more carbon dioxide is produced. L6 5 1000 cells per day L6 4 4200 L4 e Dough C volume increases more than dough A at all temperatures. L6 6 a The rate of growth would be lower because reactions occur more slowly at lower temperatures, and with slower rates of respiration, less energy is released for reproduction. L5 f Dough
C contains more yeast and so there is more respiration occurring, which means that more carbon dioxide is produced. L6 b The rate of growth would be greater because there would be more sugar available for all the cells for respiration. L4 2 any sensible example (e.g. wine) but not bread or beer L5 3 a 1st equation: water; 2nd equation: ethanol L5 b
fermentation L6 c Ethanol/alcohol is not made if the yeast get oxygen. L6 d To get more oxygen into the dough. Aerobic respiration produces more carbon dioxide than anaerobic respiration. 8Db-7 Making bread L4 1 a flour, sugar, water and yeast (NB: sugar is not often added, a simplification has been made here to aid understanding. See
Background information.) L4 b folding and squashing the dough 482 L7 7 The food/sugar started to run out. L7 8 a limiting factor L7 9 any sensible suggestion (sugar was all used up, ethanol poisoned them) 8Db-9 Populations L6 1 Drawing of budding. Labels should mention the terms 'parent cell' and 'bud'. L7 2 lag phase: 0–3 days; log phase: 4–8/9
days; stationary phase: 10–11 days; death phase: 11–14 days. L7 3 a The death rate is the same as the reproduction rate. L7 b The amount of food (sugar). It is not oxygen, as the yeast is fermenting. © Pearson Unicellular organisms L7 4 a ethanol (alcohol) L7 b Bubble air through the mixture so that aerobic respiration occurs, which does not produce
ethanol/alcohol. L6 5 1000 cells per day. L7 6 a stationary and death phases L7 b log phase L7 7 a two from: contraception, (epidemic) diseases, drought, famine, natural disaster, legal restrictions, war etc. L7 b There will be so many people that food/ resources will start to run out, or overcrowding will spread disease at faster rates and lead to more
conflict. L7 8 a To stop a country becoming overcrowded and running out of resources for its population. L7 b Students' own answers. reactions, including respiration; cell membrane – to control what comes into and goes out of the cell; chromosome – contains the information to control the cell; students are not expected to know the function of the
slimy layer, which can be used to help movement, protect the cell and help it to attach to surfaces L5–6 9 human human bacterial yeast yeast aerobic anaerobic anaerobic aerobic anaerobic aerobic anaerobic releases energy ✓ requires oxygen ✓ produces carbon dioxide ✓ requires glucose Student Book ✓ ✓ ✓ ✓ ✓ produces lactic acid 8Dc Bacteria ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ 1:
8Dc Bacteria L5 1 a yeast and bacteria L5 b glucose/nutrients (Students who have not covered Unit 8C at this point are unlikely to have included anaerobic respiration in humans.) L6 2 the beige/brown/larger cells – because you can see their budding scars or because they are much bigger than the blue-coloured, smaller bacteria 2: 8Dc Pie charts L4
1 a the causes of death in two time periods L6 3 e.g. budding binary fission asexual ✓ ✓ creates two cells ✓ ✓ creates cells of the same size ✗ ✓ L5 4 a They had the resources they needed – warmth, glucose, moisture. L6 b It would have slowed it down because the enzymes (needed to break down substances and make new substances) work more
slowly at lower temperatures. L7 5 an S-shaped curve, similar to that shown for yeast on page 57; award additional credit for correctly labelled axes and a title L5 6 a anaerobic respiration L5 b lactic acid L5 b It dropped from one year to the next. L6 c more – the blue sector covers more than half of the circle L6 d more – the blue sector covers more
than three-quarters of the circle L6 2 The pie chart should look like the one using the 1855 data. The angles are: diseases 212°; wounds 130°; other causes 18°. L6 3 b (a would be best plotted on a line graph and c would be best plotted on a scatter graph) Activity Pack 8Dc-1 Bacteria L5 1 glucose L5 2 a glucose → lactic acid L5 b It does not require
oxygen. L6 3 a Bacteria Yeast asexual ✓ ✓ binary fission ✓ L5 c It makes it sour and thickens it. L5 7 photo A – Lactobacillus delbrueckii; photo B – Salmonella typhimurium; drawing D – Vibrio cholerae; photo E – Streptococcus pyogenes L6 b Enzymes work faster when it is warmer. L6 8 cell wall – for support and protection; flagellum – for
movement; cytoplasm – for cell L6 5 soft cell wall – helps support and protect the © Pearson budding ✓ L5 4 They make it sour. 483 8 D Unicellular organisms 8 D cell; flagellum – moves the cell; cytoplasm – where respiration occurs; chromosome – contains the information to control the cell L6 c controls the cell L4 b actinobacteria L4 c It increased
(by about three times). L5 2 Two pie charts using the following data: Degrees for yoghurt X Degrees for yoghurt Y Bifidobacterium lactis 72 99 Lactobacillus acidophilus 108 72 Lactobacillus bulgaricus 36 81 Streptococcus thermophilus 144 108 360 360 Totals L6 2 a They do not have flagellae. L6 b (circular) chromosome 8Dc-5 Bacterial pie charts
L4 1 a firmicutes Bacterium causes proteins to clump together to thicken the milk. Respiration reduces the amount of carbohydrate. L6 3 Q (P is best plotted on a bar chart and R on a scatter graph). L6 d cytoplasm L6 e Drawing should show one bacterium splitting into two equally, and then each of those bacteria growing. If students have included
the circular chromosome, make sure that it is a similar size in all the cells. 8Dc-9 Bacterial cell walls L6 1 anaerobic respiration L6 2 protection and support L6 3 to control what goes into and out of the cell L7 4 a It is permeable to crystal violet because this substance can get into the cytoplasm of the cells. b It is permeable to iodine because this
substance can get into the cytoplasm of the cells. 8Dc-6 Bacterial cell model L6 Refer to diagram D on page 57 of the Student Book. c It is not permeable to CVI because this layer has to be removed using ethanol to wash the CVI out of Gram-negative bacteria. 8Dc-7 Bacterial questions L5 1 glucose, moisture, warmth L8 6 Escherichia coli and
Pseudomonas aeruginosa – colourless cells; Staphylococcus aureus – purple cells L5 2 a Respiration that does not need oxygen. L5 b lactic acid L5 3 It gets thicker. L5 4 a Coccus L5 b Salmonella L5 c Streptococcus L5 d Spirillum L6 5 a swim/move L6 b one of: soft cell wall – for support and protection; cytoplasm – for cell reactions, including
respiration; cell membrane – to control what comes into and goes out of the cell; chromosome – contains the information to control the cell 8Dc-8 Yoghurt and bacteria L5 1 a warmth, moisture, sugar/glucose/ nutrients L5–6 b Bacteria grow faster when it is warmer L5 because the enzymes that make new substances work faster at higher
temperatures L6 . L5 c anaerobic respiration by microorganisms L5 d lowers the pH, thickens it, reduces the amount of carbohydrate L5 e Lactic acid lowers the pH. The lowered pH 484 L8 5 Y because it has an outer membrane (and thin cell wall). L8 7 to make it easier to see the cells of Gramnegative bacteria L8 8 It allows hospitals to do a test to
help work out what bacterium might be infecting a patient and so work out how best to treat the patient. 8Dd Protoctists Student Book 1: 8Dd Protoctists L5 1 a mitochondria L5 b A Amoeba nucleus ✓ cell surface membrane ✓ cytoplasm ✓ storage vacuoles ✓ cilia ✗ flagella ✗ mitochondria ✓ cell wall ✗ pseudopods ✓ eyespot ✗ B C Paramecium alga
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✗ ✗ ✓ ✓ ✓ ✓ ✓ ✓ ✗ ✗ ✗ ✓ L6 c chloroplast © Pearson Unicellular organisms L6 2 towards the top left of the photo because that is the direction in which the pseudopods are stretching L6 3 Student's drawing should show one Amoeba cell splitting into two equally and then each of those cells growing. If a nucleus is included, it
should be a similar size in all the cells. L5 4 Photosynthesis traps energy which is then stored in plants. Eating plants is how animals get their energy. L6 5 a carbon dioxide, water L6 b glucose L5 b light (for photosynthesis) L5 7 As the light from the Sun decreases, they swim closer to the light in order to continue photosynthesising quickly. L5 8 a
mussel L5 b algae L5 b stickleback L5 c the Sun L5 d in wastes and respiration (for moving) 8Dd-4 Protoctist cell model L6 Refer to diagram D on page 61 of the Student Book for labelling of a similar protoctist. L4 b temperature L5 c The higher the temperature, the more/ faster the algae grew. L5 d EITHER oxygen for aerobic respiration OR carbon
dioxide for photosynthesis L6 e chlorophyll/chloroplasts L6 c It is lost in respiration (e.g. for moving) and as undigested waste. L7 d Energy is lost at each step of the food chain so going along a food chain there is less and less energy available for the animals and as a result the populations of the animals are smaller and smaller, reflected by the
lengths of the bars on the pyramid of numbers. L7 9 Energy from the Sun is transferred by light. The energy is trapped by chlorophyll. The energy is transferred to glucose as it is being produced in the chloroplast. L7 10 They had eaten fish containing a large amount of toxin. The toxin was produced by photosynthetic protoctists and because the toxin
is not broken down, it moves through the organisms in a food chain, becoming more and more concentrated. Activity Pack L5–6 2 The answer can be presented as either a food chain or a pyramid of numbers. algae → pond snail → minnow → grey heron L6 3 X uses a flagellum, Y uses cilia, Z uses pseudopods 8Dd-7 The protoctists L4 1 a They feed on
other organisms/they do not make their own food. L5 b two of: oxygen, warmth, minerals L6 c using cilia L4 d Paramecium (award additional credit if the word is italicised or underlined) L6 e As the population of Paramecium increases it provides more food for the Didinum and so their population can then increase. L6 g With fewer Paramecium, the
food source for the Didinum population becomes a limiting factor and the population starts to fall. L5 b carbon dioxide, light L6 2 Amoeba ✓ Paramecium ✓ alga ✓ ✓ ✓ ✓ ✓ ✓ ✓ L6 3 a molecule that contains carbon atoms joined together L6 f for photosynthesis, to make their own food L6 f Too many Paramecium are being eaten and so their population
starts to fall. 8Dd-1 Protoctists L5 1 a moisture, warmth, oxygen © Pearson L5 5 a carnivore: stickleback; consumer: water flea and stickleback; herbivore: water flea; producer: algae 8Dd-6 Algae and others L4 1 a protoctists L5 6 a two from: warmth, moisture, glucose/ nutrients, oxygen cell surface membrane cell wall cilia flagella mitochondria
pseudopods L5 4 to get more light for photosynthesis ✓ ✓ ✓ L6 h chloroplast L6 i three of: soft cell wall – for support and protection; cytoplasm – for cell reactions, including respiration(s); cell membrane – to control what comes into and goes out of the cell; nucleus – contains the information to control the cell; vacuole(s) – for storing substances L5–6 j
The answer can be presented as either a food chain or a pyramid of numbers. Chlamydomonas → Paramecium → Didinum 485 8 D Unicellular organisms 8 D L5 2 a The Chlamydomonas move towards the light because more light allows faster photosynthesis. L6 b three from: light, carbon dioxide, water, warmth L6 c Energy from the Sun is transferred
by light to a chloroplast in a Chlamydomonas cell, chlorophyll traps the energy and uses it to help make glucose, which stores the energy in the cell. L6 d carbon dioxide + water → glucose + oxygen 8Dd-8 Toxins and eutrophication L5 1 a The more light they can get, the faster they will photosynthesise. L6 b flagellae L6 c Energy from the Sun is
transferred by light to a chloroplast in a Gambierdiscus toxicus cell, chlorophyll traps the energy and uses it to help make glucose, which stores the energy in the cell. L5–6 d The answer can be presented as either a food chain or a pyramid of numbers. Gambierdiscus → small fish → large fish → humans L7 e The poison from Gambierdiscus does not
break down so stays in the bodies of the small fish. The large fish eat many small fish and so get many doses of poison. The large fish contain enough of the poison to poison humans. L6 2 a Photosynthesis produces oxygen, which fish need for (aerobic) respiration. L6 b The respiration of many bacteria uses up all the oxygen in the lake, so not leaving
enough for the fish to respire. L7–8 c [Topic sentence] Using too much fertiliser can kill fish in ponds and lakes. [Supporting sentences in chronological order] Fertilisers contain substances that help plants and algae grow well. When these substances wash out of farmland into bodies of water, the algae and plants in the water grow very quickly.
Eventually there is so much algae that they block the light getting to water plants. These then die. The large amount of dead plant material encourages the growth of bacteria, and these use up the oxygen in the water. This can mean that fish are not able to get enough oxygen from the water for respiration. [Summary sentence] This sequence of
events, caused by fertiliser getting into bodies of water, causes the fish to die. 8De Decomposers and carbon Student Book 1: 8De Decomposers and carbon L5 1 an organism that breaks down dead organisms and animal wastes L5 2 pieces of wood 486 L6 3 They break down the bodies of dead things and so remove them. They recycle nutrients,
making them available for other organisms. L5 4 a enzymes L5 b The molecules in their food are too big/ insoluble to absorb. L5 c absorption L5–6 5 gases produced by the respiration of microorganism decomposers: L5 carbon dioxide L6 methane/hydrogen L5 6 a Respiration releases energy, some of which makes the compost heap increase in
temperature. L6 b Bacteria produce lactic acid when they respire anaerobically. (Carbon dioxide from aerobic expiration is also acidic.) L5 7 yeast L6 8 list of organic compounds (e.g. carbohydrate, protein, fat, glucose, starch); carbon dioxide does not contain a chain of carbons and so is not organic L6 9 diagram to show how respiration and
photosynthesis are the reverse of one another L7 10 We are burning more fossil fuels. We have cut down forests that remove carbon dioxide from the atmosphere. 2: 8De Black Death hypotheses L4 1 a bacteria are prokaryotes, humans are animals L5–6 b L5 prokaryotes are unicellular, animals are multicellular L6 prokaryotes do not have a nucleus
but a circular chromosome; prokaryote cells have cell walls but animal cells do not; prokaryote cells do not contain mitochondria but animal cells do L4 2 a Microorganisms decompose the softer tissues. L5 b They break down the bodies of dead things and so remove them. They recycle nutrients, making them available for other organisms. L6 c any
sensible suggestion, e.g. fewer microbes can reach the dead bodies from the air, there is less oxygen underground for use by aerobic decomposers L6 3 Algae need light to survive (for photosynthesis). L6 4 no, it does not have a flagellum (or cilia) L6 5 Student's drawing should show one bacterium splitting into two equally and then each of those
bacteria growing. If students have included the circular chromosome, it should be a similar size in all the cells. © Pearson Combustion L6 6 a controls the cell L6 b nucleus L7 7 S-shaped growth curve drawn and labelled in a similar fashion to that shown on page 57 Activity Pack 8De-1 Decomposers and carbon L5 1 a all the organisms living in an
area L5 b light L5 2 protoctists L5 3 1 Enzymes are released; 2 Large organic molecules are broken down; 3 Small organic molecules are absorbed. L5 4 glucose, proteins L6 5 They break down the bodies of dead things and so remove them. They recycle nutrients, making them available for other organisms. L6 6 1 decay; 2 respiration; 3 feeding; 4
photosynthesis; 5 burning or combustion 8De-3 The carbon cycle L5 See diagram on page 67 of the Student Book. 8De-4 The importance of decomposers L5 1 An ecosystem is made up of a community (all the different species of organism) and physical environmental factors (e.g. wind, temperature). Microorganisms are an important part of an
ecosystem because they are decomposers; they break down dead organisms and animal wastes in a process called decay. This means that carbon and nutrients can be recycled and used again by other organisms. L5 2 two of: fungi, prokaryotes, protoctists. L5 3 Names of two organic compounds (e.g. carbohydrate, protein, fat, glucose, starch).
(Carbon dioxide does not contain a chain of carbons and so is not organic.) L6 4 clockwise from the top: combustion, respiration (or decay), photosynthesis, respiration (or decay) 8De-5 Natural recycling L5 1 a glucose L5 b name of one organic compound apart from glucose (e.g. carbohydrate, protein, fat, starch). (Carbon dioxide does not contain a
chain of carbons and so is not organic.) L5 2 fungi, prokaryotes, protoctists L5 3 photosynthesis L6 4 See diagram on page 66 of the Student Book. L6 5 See diagram on page 67 of the Student Book. L7 6 any two from: burning plants/fossil fuels releases more carbon dioxide into the air; removal © Pearson of trees decreases the amount of carbon
trapped; more people on Earth respire more, releasing more carbon dioxide L7 7 plant more trees/plants; stop burning fossil fuels L6 8 They break down the bodies of dead things and so remove them. They recycle nutrients, making them available for other organisms. 8De-6 Decomposers and food L7 a Microorganisms grow/reproduce more slowly
when it is cold. The enzymes in microorganisms do not work very quickly when it is cold, so the decay process is stopped or slowed right down. L7 b The heating kills the decomposers. Further bacteria are not able to enter the container because it sealed. Decay is stopped. L7 c The low pH kills some microorganisms. It also prevents enzymes working.
Decay is stopped. L7 d Microorganisms need moisture. Substances cannot move around inside microorganism cells if they are dry. Decay is slowed right down. L7 e Many of the microorganisms are killed. So there are less microorganisms and decay will happen more slowly. L7 f The salt causes water to leave the microorganisms, by osmosis.
Substances cannot move around inside microorganism cells if they are too dry. Decay is slowed right down. L7 g Many decomposers need oxygen. If there is no oxygen decay will be slowed. L7 h The sugar causes water to leave the microorganisms, by osmosis. Substances cannot move around inside microorganism cells if they are too dry. Decay is
slowed right down. L7 i Many decomposers need oxygen. If there is no oxygen decay will be slowed. 8E Combustion 8Ea Burning fuels Student Book 1: 8Ea Engines L4 1 burning L4 2 Energy is transferred to the wheels so the car moves: without a source of energy, the car cannot move. L4 3 any two suitable fuels, e.g. wood, coal, petrol, hydrogen,
biofuel (do not accept 'steam' as it is not a fuel) L5 4 Fuel is burnt to release energy, which is transferred to the wheels to make them go round. L5 5 When the fuels are burnt they release substances that cause pollution. 487 8 E Combustion 8 E L6 6 Both burn fuels to transfer energy. In external combustion, the energy is transferred to steam outside
the engine in the boiler. The steam passes into the engine and there transfers energy to parts of the vehicle so that movement occurs. In internal combustion, the energy is transferred from the fuel inside the engine during combustion directly to parts of the vehicle so they can move. 2: 8Ea Burning fuels L4 1 a substance that contains stored energy
that can be transferred (e.g. by heating) to make things happen L6 5 hydrocarbon + oxygen → carbon dioxide + water L5 6 The rise in temperature shows energy is transferred by heating, and the brightness of the flame shows energy is transferred by light. 8Ea-3 Combustion questions L4 1 a combustion L4 b fossil L5 c hydrocarbon L5 2 a reactant b
product L4 2 water L4 3 a spark or flame that transferred energy to the fuel L5 4 any three from: heat, light, sound, movement L5 5 It contains substances formed from carbon and hydrogen that store energy which can be usefully transferred to do work. L6 6 carbon + oxygen → carbon dioxide L6 7 coal (hydrocarbon) + oxygen → carbon dioxide +
water L5 8 Limewater goes cloudy. L5 9 blue (dry) cobalt chloride paper turns pink L5–6 10 L5 Hydrogen is a fuel. L6 When it is in contact with oxygen (in the air), the flame from the splint causes the hydrogen to react with the oxygen, producing flames. L5 3 carbon dioxide L5 4 a water b carbon dioxide c temperature rises d Energy is released by
the burning fuel, which causes the air in the flask to heat up. 8Ea-4 Methane explosion L4 1 a burning L5 b It contains only carbon and hydrogen. L5 c oxygen from the air L5 d water and carbon dioxide L5 e Limewater test for carbon dioxide: limewater turns from clear to cloudy when the gas is bubbled through it. Cobalt chloride paper test for
water: blue paper turns pink when it touches water. L6 The flames continue after the splint is removed and will last until all the hydrogen has reacted. Then the flame goes out. L6 f methane + oxygen → carbon dioxide + water L6 g Energy was released, transferred as heat and light in the flames and as sound in the explosion. Activity Pack L6 h The
reaction needs energy to start it, such as by a spark or a flame. 8Ea-1 Burning fuels L4 1 burning, or to burn L5 2 oxygen L5 3 water L5–6 4 hydrogen + oxygen → water L5 5 a hydrogen or oxygen b water L5–6 6 carbon + oxygen → carbon dioxide L5 7 A substance that contains only carbon and hydrogen. L6 8 hydrocarbon + oxygen → water + carbon
dioxide 8Ea-2 Burning a fuel L5 1 To draw the products of the combustion reaction through the equipment. L4 2 It rises. 3 It turns pink L4 , because water is present L5 . 4 It goes cloudy L4 , because carbon dioxide is present L5 . 488 L5 2 When methane burns energy is transferred causing the surroundings to heat up. We can use this energy
transfer usefully to make other things happen, for example heating water to produce steam or driving an engine to turn a motor. L6 3 Energy is transferred from the hydrogen fuel as electricity. The hydrogen then combines with oxygen to form water. 8Ea-5 Combustion engines L5 1 a Fuel is burnt inside the engine. L6 b A steam engine burns fuel to
produce steam. The steam enters the engine to cause movement. So a steam engine is an external combustion engine. L6 2 As the combustion chamber is outside the engine, this makes it much heavier. A smaller engine means that the energy released from combustion can make the vehicle go faster. Also, as the energy from combustion is transferred
© Pearson Combustion directly to the pistons, less is likely to be wasted by transfer to other parts of the surroundings. L6 b mass is conserved during a reaction, therefore: L6 3 As the fuel ignites and forms gases that heat up and expand rapidly. This expansion produces a force on the top of the piston, pushing it down. mass of oxygen = mass of
magnesium oxide – mass of magnesium L6 4 The combustion reaction releases energy, some of which is transferred to the engine causing it to get hot. If the engine gets too hot, it could stop working (as the metal expands) or oil around the engine could get hot enough to start combusting. L7 6 Explanation should include: mass is not lost; petrol is a
hydrocarbon and so combines with oxygen (a gas) to produce carbon dioxide (another gas) and water (released as water vapour, a gas); if all the gases are contained, then the mass of petrol and oxygen will equal the mass of carbon dioxide and water produced. L6 5 a Without one of the reactants (fuel) the reaction cannot happen. b Combustion
reactions need an initial input of energy to begin. The spark needs to provide enough energy to make the fuel/air mix start reacting. = 4.0 – 2.4 = 1.6 g Activity Pack 8Eb-1 Oxidation b 4 L5 1 a 4 c 2 d2 c Water doesn't combust, so this reduces the amount of fuel in the fuel/air mix. As a result, the reaction won't happen as forcefully. e The total mass of
hydrogen and oxygen is the same as the mass of water. d Air entering the mix will change the proportions of oxygen and fuel, which will affect how well they react together. b copper oxide c oxidation L7 6 The rocket engine does not use oxygen from air, but from an oxidising agent. This is needed because the engine needs much more oxygen than can
be supplied from the air as it travels through the atmosphere, and beyond the atmosphere there is no oxygen at all. There are no moving parts in the rocket engine, which means less energy is transferred wastefully and the engine is more efficient. The fuel may be solid. This means it would take up less space than a liquid or gas, so the rocket can be
smaller. 8Eb Oxidation 1: 8Eb Oxidation L4 1 a carbon dioxide L6 5 The gain in mass of the magnesium oxide is the mass of oxygen that reacted with the magnesium during the oxidation reaction. 8Eb-3 Phlogiston L7 1 a wood → phlogisticated air + calx b wood + oxygen → carbon dioxide + ash b metal + oxygen → metal oxide L5 2 O O C O (The exact
arrangement of atoms in the right-hand molecule is not essential, as long as one carbon and two oxygens are together.) L5 3 a magnesium + oxygen Æ magnesium oxide b iron + oxygen Æ iron oxide c copper + oxygen Æ copper oxide L5 4 mainly as light (bright white flame), a little as heating of the surroundings and as sound L5 5 a It is an oxidation
reaction because magnesium reacts with oxygen. It is also a combustion reaction as the magnesium burns. © Pearson 8Eb-2 Changing mass L4 4 The mass of magnesium oxide is greater than the mass of magnesium. L7 2 a metal → phlogisticated air + calx L5 b oxidation O L6 3 from the air c Phlogiston theory suggests that the loss of mass after
combustion is due to the loss of phlogiston to the air. Oxygen theory suggests that the loss of mass is due to the production of carbon dioxide gas. Student Book C L5 2 a magnesium oxide c Phlogiston theory suggests that the gain of mass after combustion is because phlogiston has a negative mass, so mass will go up when it is lost by combustion.
Oxygen theory suggests that the gain of mass is from the mass of the oxygen it reacts with. 8Eb-4 Metal reactions L5 1 The very bright flame shows that energy is released. L5 2 oxidation L5 3 oxygen L6 4 magnesium + oxygen → magnesium oxide L6 5 copper + oxygen → copper oxide L5 6 The same as the mass of copper added to the mass of
oxygen. 489 8 E Combustion 8 E 8Eb-5 Mass in reactions L5 1 a oxygen L5 b oxidation L5–6 c Light is given out, which shows the release of energy in a chemical reaction. L6 d magnesium + oxygen → magnesium oxide lead + oxygen → lead oxide potassium + oxygen → potassium oxide L5 2 a zinc oxide L5 b The mass of zinc oxide is greater than the
mass of the zinc it was formed from. L6 c The mass of zinc has reacted with a mass of oxygen, which means the mass of zinc oxide must be greater than the mass of zinc. L5 3 a The mass decreases over time. L6 b As the hydrocarbon fuel burns it forms carbon dioxide and water. The products are both gases, and so mix with the air. This causes an
apparent loss in mass during the combustion reaction. 8Eb-6 Formula equations L6 1 one carbon atom, two oxygen atoms L6 2 a same number of atoms in products as in reactants b Nothing is gained or lost during the reaction, so the mass stays the same. L6 3 hydrogen + oxygen → hydrogen peroxide L7 $H_2 + O_2 \rightarrow H_2O_2$ L7 4 a $S + O_2 \rightarrow SO_2$ b $2Zn$
$+ O_2 \rightarrow 2ZnO$ c $2H_2 + O_2 \rightarrow 2H_2O$ 8Eb-7 Ideas old and new L7 1 Idea 2: If there is no air in the container there is no oxygen. When something burns it combines with oxygen, so if there is no oxygen then burning cannot happen. Idea 3: A substance will burn until it has used up all the oxygen in the container. When there is no oxygen left, burning
stops. Idea 4: 'Mercury calx' is mercury oxide; 'dephlogisticated air' is oxygen. mercury oxide → mercury + oxygen L7 2 $C + O_2 \rightarrow CO_2$ L7 3 The phlogiston theory can explain why substances lose mass when they burn, because substances give off phlogiston. It could also explain why air that has had something like a candle burnt in it has a greater
mass than at the start, due to the extra mass of the phlogiston. However, it cannot explain how hydrogen burns but the product has a greater mass (the theory says that hydrogen should release its phlogiston to the dephlogisticated air). 490 L7 4 Since the theory cannot explain all the observations it is no longer believed to be correct. 8Ec Fire safety
Student Book 1: 8Ec Fire safety L6 1 It is a reaction in which energy is transferred to the surroundings so that they get hotter. L4 2 fuel, oxygen, heat L5 3 The grass in the burnt area was the fuel. As there is no grass left, there is no fuel to keep the fire burning. L5 4 flammable – these substances will catch fire very easily (are fuels), oxidising – these
substances release oxygen (promotes fire), explosive – exposure to fire might cause these substances to explode (thus spreading the fire) L4 5 a heat L4 b oxygen L5 6 Water will turn to gas explosively, spreading droplets of burning oil and so spreading the fire. L5 7 The carbon dioxide smothers the fire, excluding oxygen. Oxygen is one of the three
factors needed for fire, so the fire is put out. L6 8 a an extinguisher that does not contain water or water-based liquid (e.g. powder or carbon dioxide) as water will evaporate explosively, spreading the fire b A water extinguisher will cool the wood and paper, removing heat. c A foam or powder extinguisher will exclude oxygen, and so put out the fire.
Carbon dioxide could also be used if the fire is on a flat surface, otherwise the gas will flow away from the fire. 2: 8Ec Fair testing L5 1 independent – volume of fuel, dependent – time taken L5 2 a Different fuels may burn at different rates (changing the dependent variable). L6 b any sensible answer, e.g. the dish in which the fuel is burnt (different
sizes will contain different amounts of oxygen), how the fuels are set alight (one method may supply more energy, which may make the fuel burn faster to start with) L5 3 a the amount of reactant b the amount of MMT c the temperature L4 4 independent – height of flame above surface, dependent – time until flame goes out L5 5 e.g. 'Does the height
of the flame above the base of the container affect the time it takes for the flame to go out?' L4 6 a (suggestions) L6 b (explanations) © Pearson Combustion L5 c (descriptions of controls). a–c any two suggestions that would affect time for flame to go out, e.g. size of container (affects how much oxygen is available to react with fuel – control by using
the same size container in each test), type of candle (may change the fuel, so changing the rate of reaction – control by using same type of light/candle), length of wick (affects how quickly the fuel reaches the point where combustion is taking place – control by trimming the wicks of the lights/candles so that they are the same length), length of time
candle was burning before it was placed in the container (affect how much wax has melted and is able to travel up the wick to the point of combustion – control by allowing the lights/candles to burn for the same length of time before covering with the containers) Activity Pack 8Ec-1 The fire triangle L4 Oxygen: the gas in air that is needed for things
to burn; taken away if you smother a fire with a fire blanket Heat: a water extinguisher cools the fire and takes this away; energy needed to start a fire Fuel: a substance that contains a store of energy; cutting down trees in a forest takes this away 8Ec-2 Candle height L4 1 a size of container, type of fuel used to make tea light, size of tea light, length
of time tea light has already been burning (affects size of pool of liquid fuel at base of wick), length of wick L5 b In all cases, make sure identical apparatus used, and that the tea lights have the same size pool of melted fuel at the base of the wick. L4 2 Results should show that tea lights nearer the top of the container go out first. L5 3 Combustion of
the hydrocarbon in the fuel produces carbon dioxide. L6 Although carbon dioxide is a gas that is heavier than air, it is also hot and so collects at the top of the container. This excludes oxygen, so the nearer the flame is to the top of the container, the quicker it will be surrounded by carbon dioxide and so go out. L4–5 4 Answer along the lines of: all
other variables that could have affected the time were controlled. 8Ec-3 Comparing fuels L5 1 independent – type of fuel, dependent – increase in temperature of water in a given time L6 2 The more energy released per gram of fuel, the greater the increase in temperature of the water in a given time. © Pearson L6–7 3 i The greater the mass of
water, the more energy that needs to be transferred to it to increase it to a particular temperature. Therefore, it needs to be controlled by using the same mass of water each time. ii The volume of the beaker will only affect how much energy is transferred to the water if the beakers have different base areas. The wider the base, the more energy is
likely to be transferred to the beaker and water rather than to the surrounding air. So the beakers should have identical base areas. iii/iv Answer will depend on method used. If a fixed mass of fuel is burnt then time will vary. If a fixed temperature increase is used, then time is the dependent variable, and the mass of fuel is irrelevant as long as there
is more than enough fuel to cause the required increase in temperature. v The greater the height of the beaker above the flame, the greater the proportion of energy that will be transferred to the surrounding air rather than to the beaker and the water it contains. So the height of beaker above the flame should be the same in each test. L7 4 Any
suitable suggestion with an explanation about how it should be controlled. For example, all or no beakers should be stirred so that energy transfer through the water and to the surroundings is the same. 8Ec-4 Fire extinguishers L4 1 bands should be: water: no band (coloured red as rest of extinguisher) carbon dioxide: black powder: blue foam:
cream/yellow 8Ec-5 Fire safety L4 1 a Explosive, dangerous because a fire could cause the substance to explode which can cause harm and damage. b Flammable, dangerous because the substance can easily burn, causing a fire or making an existing fire worse. 2 chip pan fire: L5 damp cloth; L6 oxygen (and heat) plane fuel fire: L5 foam extinguisher;
L6 oxygen electrical: L5 carbon dioxide extinguisher; L6 oxygen forest: L5 water or cut down trees; L6 heat or fuel 8Ec-6 The Great Fire of London L4 1 accidentally, in a bakery L4–5 2 a an oven b wooden houses (mainly) c strong easterly winds 491 8 E Combustion 8 E L5 3 The wood provided the fuel for the fire and the houses were very close
together so the fire could spread from one to the other very easily. L7 5 Hexanol releases the most energy per gram of fuel because this had the smallest mass that raised the temperature of the water by 30 °C. L5 4 there was no running water supply; too far from the river; not enough water pumps; fire spread too quickly L7 6 a Hexanol and pentanol
are more than five times the price of propanol and butanol, and more than 10 times the price of ethanol and methanol, so methanol is the cheapest. L5 5 No. Houses are further apart, there is running water and a professional fire brigade and most properties are not wooden. L5 6 to leave bigger gaps between buildings/ wider streets and have better
water supplies L6 7 Fire breaks aim to contain a forest fire as the fire cannot spread because there is no fuel to burn in the gaps. L5–6 8 whole rows of houses were blown up L5 . They hoped to escape the fire and keep their belongings and homes L6 . L6 9 Flames show energy is given out, and spreading fire means new material is combusted by the
energy given out by the initial fire. 8Ec-7 Energy in fuels L6 1 a The reaction releases energy, usually heating the surroundings. b One way to stop a fire is to reduce the temperature around the fire so that the combustion reaction stops. L6 2 a Energy released from the fuel burning in the lamp is transferred to the beaker and water, so raising their
temperature. The change in temperature is measured by the thermometer. b Not all of the energy released by the combustion reaction is transferred to the water. Some may be transferred to the air and surroundings. c If the proportion of energy transferred to the air and surroundings is different for the different fuels, then the results will not be
reliable and it will not be a fair test. L5–6 3 volume of water must be the same each time; thermometer used to measure temperature change should be the same each time as different thermometers may read differently; height of beaker above the flame should be the same, as more of the energy released will be transferred to the beaker the closer
the beaker is to the flame; other equipment must be identical, e.g. use of safety gauze, as different materials (and different amounts of the same material) may absorb different amounts of energy and so change the proportion of energy released being transferred to the water; shape of beaker must be the same as a larger area will intercept more of
the energy released than a smaller area L5 4 mass of fuel burnt for each alcohol is: methanol 0.48 g; ethanol 0.41 g; propanol 0.39 g; butanol 0.27 g; pentanol 0.26 g; hexanol 0.25 g 492 b any suitable suggestions, such as: how easy it would be to refuel with each fuel; pollution caused by each fuel; any problems with containing fuel; fire hazards; affect
of fuel on engine 8Ed Air pollution Student Book 1: 8Ed Air pollution L5 1 soot (carbon), carbon monoxide, carbon dioxide L6 2 Incomplete combustion is occurring: some of the carbon in the diesel fuel is not reacting with oxygen in the engine. L5 3 sulfur + oxygen → sulfur dioxide L6 4 a any suitable answer, e.g. nitrogen oxide (nitrogen monoxide) or
nitrogen dioxide figure a figure b N O O N O L6 b nitrogen and oxygen from the air react together in the hot temperature inside the engine L5 5 a substance that harms the environment or living things L5 6 small particles of soot L6 7 a Fossil fuels contain substances that react with oxygen to produce polluting gases. For example, carbon monoxide is
formed by the incomplete combustion of carbon in the fuels, and nitrogen and oxygen from the air react together to form nitrogen oxides. Carbon monoxide is poisonous and nitrogen oxides can cause acid rain. Vehicles that burn diesel fuel also release soot particles, which can trigger asthma in some people. b Catalytic converters cause carbon
monoxide to react with more oxygen to form carbon dioxide, which is not poisonous, and breaks down nitrogen oxides to nitrogen and oxygen, which are not pollutants. Particles in diesel exhausts are removed from the gases as they pass through a filter. L6 8 a rain that is more acid than usual because it contains dissolved sulfur dioxide and nitrogen
oxides b Sulfur is removed from the smoke before it leaves the chimneys. © Pearson Combustion 8Ed-5 Pollution by non-metal oxides L5 1 sulfur dioxide, carbon dioxide Activity Pack 8Ed-1 Air pollution L5 1 a carbon dioxide, water b carbon monoxide, soot (carbon) c sulfur dioxide d nitrogen oxides L5 2 carbon dioxide – probably causing global
warming and climate change carbon monoxide – poisonous, will kill if too much is breathed in L5 2 A substance that can cause harm to the environment and living things. L5 3 any suitable suggestions, such as: combustion of fossil fuels L5 4 a sulfur + oxygen b It is more acidic than normal rain, and the acid can damage living things and make soil and
water more acidic than is usual. soot particles – coat the lining of the lungs when breathed in and can trigger asthma c The amount of sulfur dioxide in the air has decreased greatly over the past 30 years. So less acid rain is being formed. sulfur dioxide and nitrogen oxides – acidic, dissolve in water droplets in clouds and cause acid rain L6 5 a When
only part of the substance reacts with oxygen during combustion L6 3 a neutralisation b filters b It is poisonous and can kill. c when breathed in, it coats the linings of the lungs and causes damage. It can also trigger asthma. c oxygen, carbon dioxide d nitrogen and oxygen 8Ed-2 Measuring pollution L4 2 b The site where most particles were collected
had the most pollution. L5 c nearest to the greatest source of particulate pollution L5 3 a so that particles were only collected at the site L5 b To avoid adding particles from your fingers. OR To change the surface so that it is less sticky. L6 c Rain drops collect particles, so this would increase the amount of particles that stuck to the card and may
mean that the comparison of results from different sites may not be reliable as it may have rained more at one site than others. L5 4 to make the test fair 8Ed-6 Sources of air pollution L6 1 a hydrocarbon + oxygen → carbon dioxide + water 8Ed-4 Acid rain 1 b When the rain falls, the acid makes the soil and water more acidic than normal. This can
harm the organisms living there. D I (either order) E J C G © Pearson L6 2 a sulfur + oxygen → sulfur dioxide b nitrogen + oxygen → nitrogen oxides c Incomplete combustion produces carbon monoxide and soot, which are both pollutants. L6 3 a Acidic gases sulfur dioxide and nitrogen oxides, released into the air from burning fossil fuels, dissolve in
water droplets in clouds to form acid rain. L6 4 Nitrogen oxides, because the largest segment in this pie chart is for road vehicles. L6 6 a energy generation b Removing the sulfur from the gas emissions from power stations and related sources (process known as scrubbing). F H c There is not enough oxygen for all the carbon to react to form carbon
dioxide. L6 5 The segment for road vehicles would have been larger than it is now (although it could have been the same if the other sources were also producing more sulfur dioxide then). B A b hydrocarbon + oxygen → carbon dioxide + carbon monoxide + carbon (soot) + water (any order) L6 7 Catalytic converters cause nitrogen oxides to be
broken down to nitrogen and oxygen, which are not pollutants. They also convert carbon monoxide to carbon dioxide, which is not poisonous. However, carbon dioxide is a pollutant because it is linked to global warming and climate 493 8 E Combustion 8 E change. (Sulfur dioxide is no longer a problem because of ultra-low sulfur fuels.) L6 8 Using
fuels that don't contain nitrogen, such as methane or hydrogen, as this would eliminate nitrogen oxides emissions. Making sure carbon is fully burnt in the car engine so that carbon monoxide and soot are not produced. Only using a fuel or energy source (e.g. battery) that doesn't contain carbon will eliminate carbon dioxide emissions. 8Ed-7 Flue gas
desulfurisation L6 1 sulfur + oxygen → sulfur dioxide L6 2 The liquid was acidic because it contained sulfuric acid. This would have increased the acidity of the river which could harm organisms living in it. L6 3 a Because people would be less affected as the pollution created would not create smog in the cities. b This only moves the problem from
where it is obvious. Winds can move acidified water droplets in clouds to other places before they fall as acid rain. The acid rain can cause pollution where it falls. L6 4 Possible to break them down to nitrogen + oxygen using a catalyst (like in the catalytic converter on car exhausts). L6 5 The dark colour of smoke is caused by particulates and soot in
the gases, due to the incomplete combustion of fossil fuels. The particulates could be removed by filtering. L7 6 Both treatments use calcium carbonate. The wet treatment is more effective at removing sulfur dioxide from the gases (90% removed compared with dry, which removes about 75%), but the wet treatment is more expensive to set up and
run than the dry treatment. L7 7 For smaller production processes, the wet treatment would be too expensive, but using the dry treatment makes a big difference in sulfur dioxide emissions. Large production processes can afford to use the wet treatment and remove a greater proportion of sulfur dioxide. L5 4 a the present time b about 130 000 years
ago L5 5 The temperature changes were caused by natural factors such as the tilting of the Earth's axis and the amount of energy transferred from the Sun to the Earth. L5–6 6 L5 The emission of carbon dioxide increased gradually from 1900 to about 1950 and then more rapidly from then to now. L6 In 1900, only about 2000 million tonnes of carbon
dioxide were released each year. This value rose gradually to about 5000 million tonnes in 1950, at a rate of about 60 million tonnes each year. Since then, the rate of release has increased more rapidly to about 460 million tonnes each year so that by 2008 around 320 000 million tonnes were released. L5 7 The graph suggests that around 1950 there
was a sudden increase in activities that released carbon dioxide. This may have been due to an increase in a particular activity (e.g. building with concrete) or to the increase in industrialisation of large countries such as China, India and Brazil. L5 8 an increase in the greenhouse effect, resulting in an increase in the Earth's surface temperature L5 9
melting icecaps and glaciers; changing climate resulting in changed weather patterns; rising sea levels L6 10 We release carbon dioxide when we burn fossil fuels for energy (e.g. for heating and cooking, to generate electricity, to run vehicles). As we burn more and more fossil fuels, increasing amounts of carbon dioxide are released into the air. As

carbon dioxide is a greenhouse gas, it absorbs energy radiated from the warm Earth's surface and transfers it back to the surface. More carbon dioxide in the air will increase this effect, so the Earth will get warmer. 2: 8Ee Information and explanation text L4 1 a how global warming could cause climate change L4 b the title or the sentences in the first paragraph 8Ee Global warming L5 c to introduce the context for the rest of the article Student Book L5 2 a why the air sinks in a different place from where it rises 1: 8Ee Global warming L4 1 the Sun L5 2 the warming of the Earth's surface as a result of the trapping of energy from the Sun by greenhouse gases in the atmosphere L6 3 Carbon dioxide is a greenhouse gas that absorbs some of the energy emitted by Earth and transfers it back to the Earth's surface. 494 b because of the spinning of the Earth c 'Due to' L5 3 The winds could get stronger and carry more water. L5 4 The stronger, wetter winds could result in greater storms and more flooding. L5 5 Global warming could cause the climate © Pearson Combustion to change and produce greater storms and floods than we have had before. L6 6 Global warming might change our climate because it could cause greater differences in air pressure in different places, which would result in stronger winds that collect more water. 3: 8Ee Reducing pollution L6 1 advantage – pollution from the car is less, disadvantage – pollution still occurs in power stations when they make electricity, cars don't perform as well as conventional cars L6 2 advantage – burning hydrogen fuel does not release carbon dioxide, disadvantage – making hydrogen fuel is uneconomical, cars don't perform as well as conventional cars L6 3 a saves fuel b lowers pollution Natural causes of changes in the Earth's temperature include … the amount of energy transferred from the Sun to the Earth, and the tilt of the Earth's axis. Global warming is caused by … an increase in the greenhouse effect because there are more greenhouse gases in the atmosphere. Greenhouse gases include … carbon dioxide and other gases. Global emissions of carbon dioxide have increased over the past 200 years because … there has been an increase in the burning of fossil fuels. The largest sources of carbon dioxide emissions are … transport and electricity generation from power stations. 8Ee-2 Climate change modelling 1 'Difficulties in predicting climate change.' L6–7 4 L6 Road tax encourages use of less-polluting vehicles. 2 and 3 Students' own answers. L6 Annual tests remove cars that are emitting too much pollution. L7 Congestion charges dissuade people from driving in areas where there are lots of people travelling around and so lower pollution levels. L7 Fuel prices encourage people to use less polluting forms of transport (e.g. walking, cycling, public transport). L7 Travel restriction lowers pollution in areas where there are lots of people travelling around and encourages people to use less polluting forms of transport (e.g. sharing cars). Activity Pack 8Ee-1 Global warming L6 1 See figure at bottom of page. Sun L6 2 8Ee-4 Carbon dioxide emissions L6 1 Labelled sources should include: exhaust emissions from burning fossil fuels (petrol, diesel or LPG) in vehicle engines and trains; exhaust emissions from burning fossil fuel in aircraft engines; smoke from burning fossil fuels in power stations; industrial processes; and for heating homes. L7 2 Vehicles and trains: use electricity as energy source, or fuel such as hydrogen that does not produce carbon dioxide on combustion. Power stations: use non-carbon fuel such as nuclear energy source, or replace with renewable energy supplies from wind, Sun, water, etc. Alternatively, capture carbon from emissions and store it in a form that prevents release of carbon dioxide. Some reflected energy is transferred to space. As the Earth's surface gets warmer, it emits more energy. Energy is transferred from the Sun to the Earth's surface. Earth Some energy is absorbed by greenhouse gases and transferred back to the Earth's surface. Most energy is absorbed by the Earth's surface, making it warmer. Worksheet 8Ee-1, Question 1 © Pearson 495 8 E Combustion 8 E Industry: use electricity generated from non-fossil fuel source or capture and store carbon from emissions. Homes/buildings: use electricity generated from non-fossil fuel source, or make them more efficient so they use less energy. Aircraft: more fuel-efficient engines, or the development of carbon-less fuel that can be carried on long-distance flights. 8Ee-5 Which car? L5 1 a diesel car b diesel car c diesel car d Because it can travel further on the same amount of fuel. L5 2 a An increase in the Earth's temperature as a result of extra greenhouse gases/carbon dioxide in the atmosphere. L5 b any suitable answer, such as: climate change, increase in storms, drought, flooding L6 c Diesel car because it burns less fuel, so releases less carbon dioxide. L6 3 a Since no fossil fuel is burnt, no carbon dioxide is released. b Even though the car releases no carbon dioxide, the power station releases carbon dioxide as it produces electricity. 8Ee-6 Climate change L6 1 a increasing levels of greenhouse gases/ carbon dioxide in atmosphere L5 b It will affect weather patterns, which could lead to floods, droughts and food shortages. It could also cause the icecaps to melt, which would cause sea levels to rise and some low-lying countries could be permanently flooded. L6 2 a Gases in the atmosphere trapping some of the Sun's energy. b No, without any greenhouse effect the Earth would be much colder than it is now. L6 3 burning more fossil fuels and cutting down forests L4 4 a about 280 ppm L4 b approx. –0.3 °C L4 c about 1980 L4 d It is rising fast. L4 e It has been slowly rising. L5 f It will rise at a much faster rate, by about 4.5 °C. L6 g As the level of carbon dioxide has risen, the average global temperature has risen similarly. L7 h Not strong evidence as the graphs are on different time scales and provide too little detail. 496 L6 5 a Answers should include factors such as the amount of energy reaching the Earth from the Sun; the amount of carbon dioxide and other greenhouse gases in the air; how much energy is reflected by the Earth; how much is absorbed by the atmosphere; etc. Accept any sensible suggestions. b There is a lot of different information needed by the models, and scientists do not have accurate data for all the inputs. Also, the climate is very complex, and might be modelled in different ways. Accept any other sensible suggestions. 8Ee-7 Global warming evidence L6 1 a The graph shows that the pattern of change of temperature is very similar to the pattern of change of carbon dioxide. L6 b The greenhouse effect is how gases in the air, including carbon dioxide, absorb energy emitted from a warm Earth surface and re-emit it back to the surface, so keeping the Earth warm. If the amount of greenhouse gases/carbon dioxide increases in the atmosphere, then this effect will be increased, causing global warming. L7 c Two other possible interpretations are that (1) an increase in temperature as a result of something else is causing carbon dioxide concentration to increase, or (2) some other factor is changing and causing both temperature and carbon dioxide to change in the same way. L6 2 a Fossils and rocks …/A number of different studies … The Sun could be …/The link between solar … More than 31 000 scientists …/ Over 97% of published … Computer models are not …/Computer models do show … L7 b Responses may vary but should give suitable reasons for decisions, such as: a larger number of studies/scientists/models support the view that human activity is causing global warming, while the arguments against are more limited, have less support and therefore are not as strong. 8Ee-8 Whose responsibility? L7 1 Industry needs energy from burning fossil fuels, either as part of industrial processes or as a result of generating electricity for use in industrial processes. L7 2 a China and India are developing their economies, which developed countries have already done so. If China and India have to control emissions then their rate of development may slow, making it more difficult for their economies to catch up with those of developed countries. b If developing countries do not control or reduce carbon emissions, then anything that © Pearson The periodic table developed countries do will have less of an effect on controlling global warming. Also if the developed countries reduce emissions further, to make up for developing countries, then that could damage their own economies. 2: 8Fa Dalton's atomic model L5 1 Democritus thought that substances were made up of tiny particles (called atoms) which had different sizes and shapes and so different properties. L8 3 Carbon emission reduction can be achieved in many ways. If a country is forced to generate electricity only from sources that release little carbon dioxide, some countries will have to spend more for their energy than others, which is considered unfair. L5 2 In ice the particles are close together and vibrate while fixed in position. In water the particles are close together but can move past each other. In steam the particles are far apart and move freely in all directions. L7 4 Answers will depend on students' own views. Suitable examples are: a Draft laws that make it illegal to release large amounts of carbon dioxide; increase taxes on fuels/processes that release large amounts of carbon dioxide; reduce taxes on fuels/processes that release no carbon dioxide. L5 3 The atoms in an element are all identical and each element has its own type of atom. L5 4 Democritus just thought up his answers while Dalton carried out experiments (then thought about what the results meant). L4 5 b Actively research new methods and processes that reduce carbon dioxide emissions without making the products more expensive. c Change lifestyle in ways that reduce carbon dioxide emissions, for instance by choosing electric cars; walking/cycling more; re-use and recycle rather than throw away; lobby industry and government to reduce emissions. d If people prefer a lifestyle that results in higher carbon dioxide emissions, this will jeopardise the chances of achieving national targets. Education is one way to tackle this. Taxation is another. 8F The periodic table Element Appearance copper browny colour, 1083 shiny solid flexible sulfur yellow solid 113 brittle carbon black solid 3500 brittle 650 flexible magnesium silvery colour, shiny solid Melting Flexible point (°C) or brittle L5 6 melting point and boiling point L5 7 a freezing (crystallising, solidifying) b any three from: melting – changing from solid to liquid; sublimating – changing from solid to gas; condensing – changing from gas to liquid; evaporating – changing from liquid to gas L5 8 a Dalton's atomic model Student Book i 1: 8Fa Fireworks L5 1 a new substance is formed L4 b any IUPAC symbol, e.g. C – carbon, Cl – chlorine, Pb – lead L5–6 2 L5 An element is a simple substance that cannot be broken down into anything simpler. A compound can be broken down into simpler substances. L6 An element contains only one kind of atom while a compound contains different kinds of atoms joined together. L5 3 a carbon + oxygen → carbon monoxide/ carbon dioxide sulfur + oxygen → sulfur oxide/sulfur dioxide aluminium + oxygen → aluminium oxide b combustion or oxidation reactions c air L5 4 The energy given out and gases released produce the explosion. © Pearson ii iii iv v L5 c so scientists can communicate with each other, even if they speak different languages Activity Pack 8Fa-1 Dalton's atomic model L5–6 1 a compounds b atoms c destroyed d elements e new L6 2 a molecules and element b molecules and compound L5 3 brown colour, high melting point, good conductor of heat and strong L5 4 carbon – C; chlorine – Cl; oxygen – O; nitrogen – N 8Fa-2 Atoms, symbols and equations L5 1 correct colours for atoms 497 8 F The periodic table 8 F L6 2 missing words: atoms; created; same; number; different; fixed L5 4 a carbon C L8 6 a 16 g b 4g b potassium K 8Fa-5 Modelling matter L6 1 atoms L6 5 a iron + oxygen → iron oxide b silver + oxygen → silver oxide L6 2 A set number of atoms joined together. L6 3 solids, good conductors of heat and good conductors of electricity c tin + chlorine → tin chloride 8Fa-3 Properties and change L5–6 1 Electricity can pass through iron … … because it is a conductor of electricity. Elements are substances … … that contain only one kind of atom. L6 5 Compounds contain atoms of different elements joined together. L6 6 calcium + oxygen → calcium oxide L6 7 Al; C; Ca; Na Sulfur will turn from a liquid into a gas … at its boiling point. The symbols of iron and sulfur … … are Fe and S. L6 8 O; F; H; I L6 9 Si; Ar; Ne; Ca 8Fa-6 Ideas about matter and chemical change L6 1 a They contained different kinds of atoms (different shapes and sizes). Iron and sulfur are examples … … of elements. Iron is used make bridges … … because it is strong. Iron sulfide is a solid at room temperature … … as its melting point is high. Iron sulfide is a compound … … because it contains different atoms joined together. Compounds are different from the elements they are made from … … in terms of their properties. b The atoms changed shape and size. L6 2 Aristotle thought there were four elements and that different substances contained different amounts of the four elements. L5 3 melting point; boiling point; flexibility; strength L6 4 Lavoisier and Dalton carried out experiments. All substance are made up … … of tiny particles called atoms. L6 2 a A chemical property describes how a substance reacts with other substances. A physical property describes a substance on its own. b He said that different elements had different properties because their atoms were different. L7 5 a copper oxide + hydrogen → copper + water b silver carbonate → silver + oxygen + carbon dioxide L7 6 three of: copper oxide; water; carbon dioxide; silver carbonate L7 7 All the atoms in an element are the same while compounds contain different types of atoms. 8Fa-4 Comparing atoms L4 1 L7 8 a He would have said that atoms don't change to form new materials. New substances were formed when different atoms joined together. 70 b Correct: all matter was made up of atoms (the atoms in an element were all the same). Wrong: atoms could change to make new substances. 60 50 40 8Fa-7 Calculating relative atomic masses L6 1 The mass of a carbon atom is 12 times the mass of a hydrogen atom. 30 20 L6 2 a Because different elements contain different atoms. 10 0 L6 4 The atoms of elements are all the same (all have the same size and mass). l Ca C Cu H L5 2 Copper L5 3 40 Fe N O Si S b Because all the atoms in a reacting element had to join to the same number of atoms of another element. L6 4 a sulfur b nitrogen L8 3 a 7g L8 4 17 L8 5 1g L8 5 32 498 b7 © Pearson The periodic table All atoms of the same element are identical. Atoms can be different from each other. 8Fb Chemical properties Student Book 1: 8Fb Chemical properties L6 1 a gas being produced (bubbles forming in a test tube), energy being released (light being emitted) L5 2 chemical properties: flammable (it burns), reacts with water; physical properties: solid, conducts electricity, shiny when polished L6 3 5 g L6 4 a 30 g b 5 g L7 5 a 1:1 b CuO L7 7 three L7 8 O In a physical change … no new substances are formed. O Changes of state … are examples of physical changes. S a b O O d pH of solution – chemical property N Ar d H H L7 9 a HF L7 b PCl_3 2: 8Fb Using sentences L5 1 a Atoms are tiny particles. L5–6 3 1:2 L5 4 b Melting point and boiling point – physical property c Conduction of electricity – physical property H c L6 5 Students' own answers: ideally the paragraph would be three or four sentences with a short opening topic sentence that is just a single clause; the sentences that follow should be a mix of long and short sizes and they should clearly link together ideas using conjunctions 8Fb-1 Elements and their symbols L5–6 1 a compounds b new L5 2 In chemical changes … a new substance is always formed. L7 6 a CO L5 b 'All matter is made up of atoms' because it introduces the idea of atoms, and the other sentences then tell you more about what atoms are like. Activity Pack b 1:1 Atoms are represented by symbols. b All matter is made up of atoms. c Scientists study elements and compounds. (Scientists study compounds and elements.) d Chemical reactions make new substances. L5 2 subjects: atoms, scientists, chemical reactions; verbs: are, made, make L6 3 A chemical reaction is not a physical thing and so cannot be 'made'. L6 4 a There are various ways this can be achieved, but the sentences about atoms not being created/destroyed and being the same/different should be paired. For example: L6 5 a NO_2 b PH_3 8Fb-3 Chemical and physical change L6 1 chemical changes: iron rusting; frying an egg; lighting a match; carbon burning physical changes: ice melting; dissolving sugar; water evaporating; water freezing; cutting up wood L5 2 In physical changes, no new substances are formed. New substances are formed in chemical changes. L7 3 When carbon reacts with oxygen the carbon atoms are broken apart and the oxygen atoms are broken apart and then the carbon atoms are joined to the oxygen atoms. 8Fb-5 Using clauses 1 (examples) a Fireworks are dangerous. b Atoms are tiny. c Magnesium burns brightly. All matter is made up of atoms. 2 a An element can be a metal or it can be a nonmetal. Atoms are extremely small. b Atoms are tiny so they cannot be seen. Atoms cannot be created. Atoms cannot be destroyed. c Sulfur is a yellow solid and it does not conduct electricity. © Pearson 499 8 F The periodic table 8 F d Iron oxide contains two elements so it is a compound. 3 a A chemical reaction occurs when a new substance is formed. b Aluminium is used for aircraft because it is so light. b copper + chlorine → copper chloride L6 3 a oxygen – O, fluorine – F, chlorine – Cl (or any other three examples) b the masses of atoms c Magnesium has to be heated before it catches fire. L6 4 a react with metals forming solid compounds d Copper is used in electrical wires as it conducts electricity. b react with water forming hydrogen (and an alkaline solution/solution of metal hydroxide) 8Fb-6 Types of change L5 1 A chemical change always forms a new substance. A physical change involves a substance on its own. L6 2 physical; chemical; chemical; chemical; physical; physical L5 3 Students' own answers, such as: a burning gas fire b frying an egg L6 4 carbon + oxygen → carbon dioxide L5 5 flammability, reaction with water and pH 8Fb-7 Formulae and masses L6 1 i, iii, iv and vi L7 2 iii is phosphorus chloride and vi is hydrogen chloride L7 3 i is water as it contains two small atoms joined onto one larger atom L6 4 Only in a chemical change are new substances formed. L7 5 During a reaction no atoms are lost or gained so the mass of the products is the same as the mass of the reactants (as the same atoms are in them). L7 6 13.2 g L7 7 a 24 g L6 b calcium + bromine → calcium bromide L7 8 a 15 g b 36 g L7 9 a methane + oxygen → water + carbon dioxide b The atoms are split apart and (rearranged) joined together in a different way to make the new substances (products). c very unreactive L5 5 It did not fit into (the pattern of) his periodic table. L7 6 a increasing atomic weight L6 b similar chemical properties L7 c he left gaps for yet to be discovered elements; he swapped the order of the elements round in a few places 2: 8Fc Anomalous results L5 1 a because they are very different from the pattern of the other results in the graph and table L4 b 34 – 12 = 22 s L5 c It will reduce the range (to 6 s for the rocket fuse burn times). L5 2 a The anomalous result is 29 s. b range with anomalous result = 14; range without anomalous result = 4 L5 3 a It is very much higher than the rest of the results. L6 b they heated longer than the other groups/ they used less water than the other groups L4 c i 26 °C ii 6 °C L5 4 a group 6, change in mass 0.01 g L6 b magnesium oxide has been lost as smoke L6 c balance error when reading mass, the strip of magnesium used was not 10 cm, the magnesium was not clean/the magnesium did not burn completely 8Fb-8 Chemical formulae L7 1 CaS 2 Li_3N 3 MgF_2 4 CCl_4 5 PH_3 6 Li_3P 7 Na_2S 8 CaO 9 CO_2 10 BP 11 AlN 12 SiC Activity Pack 8Fc Mendeleev's table L6 2 Elements in the same group … … have similar chemical properties. Student Book 1: 8Fc Mendeleev's table L5 1 a any one of: good conductors of heat, good conductors of electricity, flexible 8Fc-1 Mendeleev's table L6 1 a Mg b Cl c Ar d K Fluorine gas has similar chemical properties to … … bromine liquid. Lithium metal is … … an alkali metal. b any one of: poor conductors of heat, poor conductors of electricity The group of elements that are very unreactive is … … the noble gases. L6 2 a lithium + water → lithium hydroxide + hydrogen b valency of 2 500 L6 3 a A © Pearson The periodic table 8Fc-3 Groups in the periodic table L6 1 Group Group 1 2 Alkali metal Group 3 Halogen Noble gas H He Li B C N O F Ne Na Al Si P S Cl Ar K Ge Br Kr Rb Sn I Xe L6 2 Across 1 noble gases Down 2 chlorine 3 lithium 4 halogens 5 potassium 8Fc-5 Anomalous result L5 1 a 5.30 m L6 b Even when measured properly there will be some experimental error which means the results will be close but not exactly the same. L4 c 6.80 – 6.25 = 0.55 m L5 d 6.25 m + 6.45 m + 6.30 m + 6.70 m + 6.40 m + 6.80 m + 6.35 m + 6.55 m + 6.45 m + 6.35 m + 6.65 m = 71.25/11 = 6.48 m L6 e Because it is wrong and it will change the mean and make it less accurate. L6 f They could have forgotten to count in 1 metre lengths when measuring the room with the metre stick. L5–7 2 a, b & d 30 25 20 15 10 5 0 0 10 © Pearson 20 30 40 50 60 70 L7 c The line of best fit is drawn by drawing a line so the data points each side of the line are equal. L5 d The anomalous result identified is well away from the best fit line. L6 e You should ignore anomalous results when drawing a line of best fit. L5 f Outlier. L6 g The length of the piece of magnesium used could have been shorter than recorded, etc. 8Fc-6 Sorting elements L6 1 a viii b i c iv d v and vi e vii f viii L6 2 a C, Ca, Co and Cu. b halogens, fluorine, chlorine and bromine L6 3 An unreactive element that does not form compounds easily – Noble gas An element that reacts quickly with water forming hydrogen gas – Alkali metal 8Fc-7 The first periodic table L6 1 a i fluorine, chlorine, bromine and iodine ii halogens b i lithium, sodium, potassium, rubidium and caesium ii alkali metals iii copper, silver and osmium do not react with water like the alkali metals L6 2 a the masses of atoms (relative to hydrogen) L7 b He knew that there were undiscovered elements that would fit into these places. L7 c i The mass of its atoms came between zinc and germanium. ii Its properties would be like aluminium and boron as these elements are in the same group. 8Fc-8 Predicting new elements L7 1 That was all the known elements at that time. L7 2 The mass of their atoms (relative to hydrogen). L6 3 Most properties will be in between silicon and tin. Therefore semi-metal, in between a metal and a non-metal. Difficult to predict conductivity, so could be a poor or a good conductor. Relative atomic mass between 60 and 80 as masses get greater in increasing steps down the group. Melting point about 1000 °C, or at least less than 1410 °C, the melting point of silicon. Density between 4 and 6 g per cm^3, between silicon and tin. GeO_2 (same as other compounds in the group). Solid, as both silicon and tin. L6 4 He switched a few elements around out of order with the masses of their atoms. 501 8 F The periodic table 8 F L6 5 Students' own answers, but might be something ending in …ium. Activity Pack 8Fd-1 Trends in physical properties L5 1 melting, boiling and freezing L5 2 b & c Temperature lines marked and coloured with given melting and boiling points. L5 3 Shaded on periodic table: metals on left and non-metals on the right. L5 4 Metals: Good conductors of electricity and Most have high melting points Non-metals: Most are brittle when solid. 8Fd Physical trends Student Book 1: 8Fd Physical trends L4 1 a melting point = 111 °C, boiling point = 445 °C (answers acceptable within plus or minus 5 °C) b L5 i solid L5 ii liquid L6 2 a As it melts the particles move slightly further apart and can move past each other. b The energy supplied is used to break the bonds between solid particles. L6 3 a one from: silicon – Si, germanium – Ge, tin – Sn, lead – Pb, flerovium – Fl b one from: sodium – Na, magnesium – Mg, aluminium – Al, silicon – Si, phosphorus – P, chlorine – Cl, argon – Ar L5 4 a –210 °C b Magnesium would melt first. 8Fd-3 Changing states L5 1 See figure at bottom of page. L5 2 a liquid b solid L5 3 c i solid ii liquid L7 5 a Melting points increase going down groups 7 and 0. b estimates for caesium should be between 5 °C and 30 °C, the real value is 28 °C (to two significant figures); estimates for astatine should be between 200 °C and 400 °C, the real value is 302 °C (to three significant figures) L6 6 conduction of electricity, all metals conduct electricity while non-metals (except carbon) do not conduct electricity L7 7 they have properties in between metals and non-metals/they lie between metals and non-metals in the periodic table 1 2 3 4 5 6 7 metals semi-metals non-metals Metals: shiny (when polished), high melting points, strong, good conductors of heat and electricity, flexible and malleable. Non-metals: dull, low melting points, brittle (when solid), poor conductors of heat and electricity. 8Fd-4 Looking for trends L7 1 a Melting points decrease down the alkali metal group. energy being used to change state from liquid to gas energy being used to change state from solid to liquid energy being used to raise temperature of solid energy being used to raise temperature of liquid Gas boiling point Liquid melting point Solid Worksheet 8Fd-3, question 1 502 © Pearson The periodic table b Between 20 and 30 °C. Bar drawn on L7 melting point chart to fit answer. 400 °C. c Boiling points decrease down the alkali L7 metal group. ii Melting point xenon between –140 and –100 °C. d Between 600 and 700 °C. Bar drawn on L7 boiling point chart to fit answer. e Data book values: astatine melting point = 302 °C; xenon melting point = –112 °C, plus comments. e Data book values: caesium melting point L7 = 28 °C and boiling point = 671 °C, plus comments. f All fit the trend, as they all decrease L5 (in smaller steps each time) as you move down a period. L5–7 2 a i & ii L8 2 a Size decreases across a period. c All results fit the trends as there is a steady increase down groups and a steady decrease across periods. –150 –175 L7–8 3 a 6 b 5 000 000 –200 8Fd-6 About properties L4 1 a solid changes to liquid –225 –250 b liquid changes to solid c liquid changes to gas –275 Helium Neon Argon Krypton 125 L5 2 a Element X is a non-metal due to its properties, for example being a non-conductor of electricity as all metals are conductors. b Element Y is a metal due to its properties, for example being a conductor of heat electricity. All metals are conductors while most non-metals are non-conductors. 100 75 c Element Y. 50 d Element Y as it is a good conductor of heat. 25 e i X = solid and Y = solid ii X = liquid and Y = solid iii X = gas and Y = solid iv X = gas and Y = gas 0 –25 8Fd-7 Looking for trends L4 1 a rising L5 b solid L5 c boiling –50 –75 d The temperature doesn't rise as the L6 energy added is used to free the particles in the solid to allow them to move over each other as the substance melts. –100 –125 L6 2 a fluorine, chlorine, bromine, iodine. –150 b The melting points decrease down the L7 alkali metal group and increase down the noble gas group. –175 –200 –225 8Fd-5 Atomic sizes L8 1 diagrams of atomic sizes in periodic table order b Size increases down the groups. –125 –300 d i Melting point astatine between 200 and Fluorine Chlorine Bromine Iodine b Range for halogens is 334 °C. Range for noble gases is 115 °C. c Melting points are increasing down each group. © Pearson c Down group 6 the melting points L7 generally increase except for polonium, which has a lower melting point than tellurium. d melting point estimates: germanium L7 between 500 and 2000 °C (between the melting points of silicon and tin); bromine between –50 and +50 °C (between the melting points of chlorine and iodine) 503 8 F The periodic table 8 F 8Fd-8 Tiny measurements L6 1 water molecule < virus < grain of salt < ant < small boy L7 2 a 1 000 000 b 10 000 000 c 50 000 000 L6 3 a Rubidium (Rb) is the largest and helium (He) is the smallest. b Atomic size increases down the groups. L7 c Atomic size decreases across the periods. L7 d See graph at bottom of page L6 e i germanium between 0.272 and L8 0.228 nm and magnesium osmium 0.236–0.368 nm ii Estimates made by looking at the atomic sizes of elements above and below and on either side in the periodic table and choosing a value that fits the trends. f It is described as periodic because the L8 graph rises and falls regularly. 8Fe Chemical trends Student Book 1: 8Fe Chemical trends L5 1 three from: soft, low melting point, react quickly with oxygen (producing a metal oxide), react quickly with water (producing metal hydroxides and hydrogen) L5 2 a lithium fizzes/bubbles, sodium fizzes rapidly then melts into a ball, potassium bursts into flames b i sodium + oxygen → sodium oxide L6 ii potassium + water → potassium hydroxide + hydrogen L5 3 a because they react quickly with air and water/to keep out air and water b lithium L6 4 a rubidium hydroxide and hydrogen b e.g. an explosive reaction, burns very brightly, sparks L6 5 a photo B: sodium + oxygen → sodium oxide; photo C: phosphorus + oxygen → phosphorus oxide; photo D: sulfur + oxygen → sulfur dioxide b There is no general increase or decrease L7 across the periodic table from left to right (or the reactivity goes up and down across the table). L7 6 From left to right across the periodic table the oxides become more acidic/form solutions with lower pH/become less alkaline. L6 7 a Add universal indicator and check the pH against the colour chart. b Element X is on the right-hand side of the L7 periodic table while element Y is on the left. L7 8 a It would burn brightly. b Fluorine would be more reactive than chlorine as reactivity increases up the group of halogens. 2: 8Fe Firework ban L5 1 a hands and fingers b burns c rockets d i Someone could pick up a spent sparkler that was still very hot. ii Rockets could fall over when lit or go in the wrong direction and fly into people. L5 2 any five from: carbon – C, sulfur – S, iron – Fe, magnesium – Mg, aluminium – Al, lithium – Li, potassium – K, nitrogen – N, oxygen – O 500 450 400 350 300 250 200 150 100 50 0 H He Li Be B C N O F Ne Na Mg Al Si P S Cl Ar K Ca Worksheet 8Fd-8, question 3d 504 © Pearson The periodic table L5 3 a because they had similar chemical properties b the alkali metals; their reactivity increases down the group L5 4 a carbon + oxygen → carbon dioxide sulfur + oxygen → sulfur dioxide b the sulfur dioxide solution; oxides of elements get more acidic from left to right across the periodic table Activity Pack 8Fe-1 Trends in chemical properties L5 1 Missing information: Li; sodium; 1; under oil; gas; sodium hydroxide + hydrogen; potassium; fire; water and hydrogen. L5 2 The reaction of zinc with oxygen … … produces zinc oxide. When elements react with oxygen … … compounds called oxides form. When an element burns in air … … it is reacting with oxygen. The product of sulfur and oxygen … … is sulfur dioxide. 8Fe-3 Chemical properties L6 1 a 1 L6 b under oil L6 c oxygen → sodium oxide L5 d hydrogen L5 e they react with water L5 2 b Making metal oxides copper + oxygen → copper oxide sodium + oxygen → sodium oxide magnesium + oxygen → magnesium oxide Making non-metal oxides carbon + oxygen → carbon dioxide sulfur + oxygen → sulfur dioxide phosphorus + oxygen →phosphorus oxide 8Fe-4 Trends and patterns L5 1 a drawings of lithium fizzing, sodium melting into a fizzing ball and potassium burning L6 b Caesium would burn brightly or explode as reactivity is increasing down the group. L7 2 a pH decreases from group 1 to 5, then rises again from 5 to 7. L7 b Metal oxides form alkaline (or neutral solutions), non-metal oxides form acidic (or neutral solutions) solutions. L6 c Argon does not form compounds (it's a noble gas). © Pearson L6 d Their oxides have a pH of 7, which is the same pH that would result if they were insoluble (as the pH of water is 7). 8Fe-5 Atoms, molecules and lattices L6 1 b Data sheet figures: sodium chloride melting point = 801 °C and boiling point = 1413 °C sulfur melting point = 113 °C and boiling point = 445 °C water melting point = 0 °C and boiling point = 100 °C magnesium oxide melting point = 2614 °C and boiling point = 2850 °C carbon dioxide melting point = 801 °C and boiling point = 1413 °C methane melting point = –183 °C and boiling point = –164 °C carbon melting point = 3642 °C and boiling point = 3642 °C (sublimes) copper melting point = 1083 °C and boiling point = 2567 °C L7 c Molecular structures: sulfur, water, methane and carbon dioxide. Lattice structures: sodium chloride, carbon, copper metal and magnesium oxide. L7 2 Molecular substances have fairly low melting points and boiling points. Lattice substances have high melting points and boiling points. 8Fe-6 About chemical reactions L6 1 a lithium + oxygen b sodium oxide c carbon d sodium + water … hydrogen L7 2 Across 3 hydrogen 6 caesium 8 oxide 9 potassium 11 and 7 down alkali metals Down 1 burn 2 and 4 down chemical reactions 5 hydroxide 8 oil 10 water 8Fe-7 The halogens of group 7 L6–7 1 a i between –200 and –250 °C ii burns iii Br_2 iv solid v MgI_2 L6 b group 7 L6 c i magnesium + bromine → magnesium bromide 505 8 F Metals and their uses 8 G ii sodium + fluorine → sodium fluoride iii magnesium + oxygen → magnesium oxide L7 d reactivity decreases 8G Metals and their uses 8Ga Metal properties L6–7 e Astatine formula = As_2; melting point 200– 400 °C and solid. Formula same as other halogens, melting point greater than iodine and solid state as melting points increasing down the group. Student Book L7 2 The trend goes the opposite way, so the alkali metals get more reactive going down the group. L4 2 It is strong and flexible (malleable). L4 3 any appropriate answers, e.g. aluminium for windows, copper for pipes and wiring, lead for roof flashings and gutters L7 3 Metal oxides: all solids; high melting point; alkaline solutions. Non-metal oxides: can be gases; low melting point; acidic solutions. 8Fe-8 Atoms, molecules and lattices L6 1 group 0 L6 2 They are very unreactive. L7–8 3 Melting points and atomic sizes both increase going down the group. L6 4 nanometres L7–8 5 Melting point between –60 and –90 °C as the trend is decreasing down the group. Atomic size 0.10–0.20 nm as the trend is increasing down the group. 1: 8Ga Building up L5 1 At the time people didn't know how to make steel. L5 4 too expensive/not enough available/not strong enough L5 5 Students' own answers, e.g. advantage: doesn't use up a lot of land space; disadvantage: expensive/difficult to build 2: 8Ga Metal properties L4 1 any four from: shiny, hard, strong, high density, high melting point, malleable, flexible, good conductors of heat and electricity L5 2 a Mercury is unusual because most metals are solids. L5 b Carbon is unusual as most non-metals do not conduct electricity. L5 3 a It is a good conductor of electricity. L5 b Iron rusts/reacts with water. L7 6 XeF_6 L7 7 L7 8 Reactivity increases down the noble gas group. L7–8 9 In terms of reactivity, helium doesn't form compounds, argon and neon compounds are rare however some compounds of krypton have been made and the xenon forms compounds most easily. Reactivity is increasing down the group. L7 10 In air the filament would react with the oxygen, but it will not react with argon. L6 11 Helium is safer as it will not burn, whereas hydrogen gas will burn readily with oxygen. L8 12 Molecular structures have a set number of atoms joined together in small groups, e.g. xenon hexafluoride has molecules containing one xenon atom and six fluorine atoms. Lattice structures have billions of atoms joined together with no set number being joined in the structure, e.g. sodium chloride lattice contains billions of sodium and billions of chlorine atoms joined together. 506 L5 4 A physical property is what a substance looks like or does without reacting. A chemical property is what a substance does in chemical reactions. L6 5 a i sodium + oxygen → sodium oxide ii magnesium + chlorine → magnesium chloride iii silver + oxygen → silver oxide iv iron and sulfur → iron sulfide L6 b fast – sodium + oxygen, magnesium + chlorine, iron + sulfur; slow – silver + oxygen L6 6 a a substance that speeds up a chemical reaction without being used up L6 b because they are very expensive L6–7 7 any appropriate answers, e.g. L6 used in car exhausts L7 platinum catalyst speeds up the reaction changing harmful gases into harmless gases L6 used in gas hair curlers L7 contain platinum catalyst that speeds up the reaction which releases energy by heating L5 8 any appropriate answers, e.g. copper electrical wiring, as it is a good conductor of electricity; steel in radiators, as it is a good conductor of heat; aluminium for doors and windows, as it is light and strong; lead for flashing © Pearson Metals and their uses on roofs, as it is malleable; copper for water pipes, as it is strong and flexible or unreactive or malleable Activity Pack 8Ga-1 Metals L4 1 yes: good conductors of electricity; shiny solids when polished L4 2 copper – water pipes, iron – building frames, aluminium – window frames L5 3 a strong b conductor c react d flexible e faster 8Ga-4 Metals and reacting L6 1 Reactions which occur quickly without a catalyst: iron + fluorine → iron fluoride (zinc + hydrochloric acid → zinc chloride + hydrogen) Reactions which occur quickly with the help of a catalyst: copper + oxygen → copper oxide zinc + hydrochloric acid → zinc chloride + hydrogen aluminium + iodine → aluminium iodide. L6 2 A catalyst is a substance that speeds up a chemical reaction without being used up (permanently changed). 8Ga-5 Metals and properties L4 1 Most metals are brittle malleable so they don't bend. Non-metals are usually 'bendy' brittle. L5 2 Copper is used because it is cheaper less reactive than iron or zinc. L5 3 Metals are used for mirrors because they are good conductors of electricity shiny when polished. L5 4 Aluminium, copper, glass iron and wood lead. (or other metals) L5 5 Because they need to be able to hold heavy weights bend without breaking. L4 6 All metals react with air when heated conduct electricity. L5 7 Aluminium is stronger lighter (less dense) than iron. L5 8 Copper is used as it is a good insulator conductor of heat. 8Ga-6 Useful properties L4 1 relative cost of metals L6 2 aluminium + oxygen → aluminium oxide and copper + oxygen → copper oxide L5 3 a high-energy conduction by electricity b It has a lower density. c It has a lower strength. d good conductor of heat e Copper is too expensive. L6 4 a A catalyst speeds up chemical reactions without being used up. The catalyst in car exhausts helps speed up the reactions which change harmful gases into harmless gases. b density 8Ga-7 Formulae 1 L7 1 Group 1 Valency Examples 1 Li/Na/K 2 3 2 Be/Mg/Ca 3 B/Al/Ga 4 5 4 C/Si/Ge 3 N/P/As 6 2 O/S/Se 7 1 F/Cl/Br L7 2 a Na_3P b CaO c Mg_2C d AlN e $BeBr_2$ f B_2S_3 g $CaCl_2$ h BF_3 i SiO_2 L5 2 Corrosion is the reaction of any metal with oxygen. Rusting is the corrosion of iron (and steel). L7 3 a FeF_3 b Ag_2O c CoO d Cu_3N e $CuBr_2$ f Fe_2S_3 L5 3 a, b, c any appropriate answers, e.g. quick – magnesium; slow – copper; not at all – gold 8Ga-8 Formulae 2 L7 1 a N_2O b CH_4 c $BrCl$ d CaO L6 4 The titanium oxide is strong and prevents further corrosion (and looks good). L7 2 a K_3N b $MgCl_2$ c Al_2O_3 d NCl_3 e AlP f CaO g $FeBr_2$ h Zn_3N_2 i Co_2O_3 L7 3 a 1 b 3 c 2 8Gb Corrosion Student Book 1: 8Gb Corrosion L5 1 oxygen © Pearson L5 5 a Pb L5 b PbO L5 6 a tin + oxygen → tin oxide L6–7 b L6 The ratio of tin to oxygen atoms is 1:2. L7 There are twice as many oxygen atoms as tin atoms in tin oxide. L6 7 a oxygen and water 507 8 G Metals and their uses 8 G L6 b hydrogen, oxygen and iron L7 c There is not much water to cause rusting. L7 8 any appropriate answers, e.g. barriers are paint, plastic, oil and tin; they work by keeping out air and water; this needs to be done to protect iron objects from being destroyed by rust 2: 8Gb Describing materials L4 1 metallic, heat-conducting, electricalconducting, soft, malleable, reactive (also shiny, silver, low-density, flexible, flammable) Down 1 oxide 2 oxygen 4 destroys 6 plastic 7 painting 8Gb-4 Stop rusting L6 1 missing words: iron; water; oxygen; rusting; barrier; oxidation; water L6 2 missing words: Products; titanium oxide; oxygen; chromium oxide L8 8Gb-5 Balancing equations $2Ca + O_2 \rightarrow 2CaO$ L5 2 metallic, firm, heat-conducting, electricalconducting, low-density, soft, squashy, bendy, flexible, malleable, flammable, reactive $Ca + Cl_2 \rightarrow CaCl_2$ L5 3 Students' own answers, including: (photo B) brown, crumbly, solid, weak; (photo C) liquid, silver $2K + F_2 \rightarrow 2KF$ L4 4 a does not reflect light L4 b is not poisonous $4Ag + O_2 \rightarrow 2Ag_2O$ $4Al + 3O_2 \rightarrow 2Al_2O_3$ 8Gb-6 Oxidation and rusting L5 1 oxidation L5 2 iron, water and oxygen L5 7 olive green, yellow, purple or green L5 8 L5–6 3 Physical properties Chemical properties Other facts light strong high-melting-point malleable non-magnetic low density corrosionresistant unreactive insoluble in water non-toxic attractive silver shiny dull smokylooking Opinions Activity Pack 8Gb-1 Corrosion L5 1 a Corrosion is when a metal … … reacts with oxygen. b Zinc oxide forms during … … the corrosion of zinc. c For rusting to occur … … oxygen and water are required. d Rusting is the … … corrosion of iron. e Rusting can be prevented … … by painting the metal. L5 2 a oxide b corrosion (oxidation) c rust/corrode/react L5 3 any sensible suggestion such as the rusting of iron L5 4 oxygen L5 8Gb-3 Corrosion and rusting Across 3 oxide 5 copper 8 reactive 9 water 10 rusting 11 slowly 12 corrosion 508 $2Na + S \rightarrow Na_2S$ $4Co + 3O_2 \rightarrow 2Co_2O_3$ L5 5 unreactive (or corrosion resistant) L4 6 attractive (or shiny, dull, smoky-looking) $Pb + 2Br_2 \rightarrow PbBr_4$ L5 a paint, oil and plastic L6 b It acts as a barrier keeping out water and oxygen. L6 4 zinc oxide L5 6 test tube 2: no water present test tube 3: no air (oxygen) present test tube 4: iron covered by paint to keep out air and water 8Gb-7 Describing materials L5–6 1 When describing substances or reactions. 2 a A transparent, flexible solid is used to make rulers. b The carbon in pencil leads is a black, brittle solid. 3 a nasty and horrible; four year-old child b flexible and malleable c slow d slower, pure and alkaline e crumbly and brittle f Nasty, horrible from quote A. Expensive and ugly from quote F. Time-consuming, interesting and useful from quote G. 8Gb-8 Symbols and balancing L8 $2Zn + O_2 \rightarrow 2ZnO$ $Sn + O_2 \rightarrow SnO_2$ © Pearson Metals and their uses $2Cu + O_2 \rightarrow 2CuO$ $Ge + 2F_2 \rightarrow GeF_4$ $3Ca + 2P \rightarrow Ca_3P_2$ $4Na + O_2 \rightarrow 2Na_2O$ $2Al + 3Br_2 \rightarrow 2AlBr_3$ 8Gc-4 Reactivity series L5 1 names of metals and missing words: copper/water; sodium/alkaline; calcium/hydrogen; lithium/gas; magnesium/gas (hydrogen); potassium/ burns $4Fe + 3O_2 \rightarrow 2Fe_2O_3$ L6–7 2 L6 a potassium hydroxide + hydrogen L7 b $2K + H_2O \rightarrow 2KOH + H_2$ 8Gc Metals and water L6 c sodium + water L7 d $2Li + H_2O \rightarrow 2LiOH + H_2$ Student Book 1: 8Gc Metals and water L5 1 any three from: caesium, rubidium, potassium, sodium, lithium, calcium, magnesium 8Gc-5 More about reactivity L6 1 a tin and copper L5 2 $NaOH$, H_2 L4 3 a photo B: indicator changing colour and gas given off; photo C: bubbles of gas forming/gas given off; photo D: few bubbles of gas formed c The metals that slow down rusting are higher in the reactivity series than iron, and the metals that make rusting faster are lower than iron in the reactivity series. L5 b bring a lit splint near and it burns with a 'squeaky pop' L6 4 potassium + water → potassium hydroxide + hydrogen calcium + water → calcium hydroxide + hydrogen L5 5 copper, tin, zinc, lithium L5 6 a gold, platinum L5 b caesium, francium L5 c copper L7 7 a just below magnesium, as magnesium burns in air but reacts slowly with water L7 b i X oxide ii X hydroxide + hydrogen Activity Pack 8Gc-1 Metals and water L5 1 a calcium b hydrogen c copper L5 2 a Magnesium reacts very slowly producing a few bubbles. b magnesium and zinc d aluminium and calcium (or potassium, sodium or lithium) L7 2 a magnesium + water → magnesium hydroxide + hydrogen zinc + water → zinc hydroxide + hydrogen b because the other metal reacts or is sacrificed instead of the iron c The order of decreasing reactivity is: magnesium, zinc, iron, tin, copper. d No changes required, the order is correct. e Any one of the following metals would slow down the rusting iron in a similar way to magnesium and zinc: aluminium, calcium, potassium, sodium or lithium. Any one of the following metals silver or gold would speed up the rusting of iron in a similar way to copper and tin: lead, mercury, silver or gold. 8Gc-6 Wet metals Potassium burst into flames. L5 1 missing words: Lithium floats on the surface producing bubbles of gas. a fizz/bubble (do not accept reacts and hydrogen) Sodium melts into a ball and fizzes a lot on the surface. b alkaline b 1 potassium, 2 sodium, 3 lithium, 4 magnesium d calcium L6 3 lithium hydroxide + hydrogen L5 4 True: Hydrogen is a gas at room temperature. Hydrogen burns with a 'squeaky pop' when lit. Other statements are false. L5 8Gc-3 Reactions of metals missing words: hydrogen; unreacted; pops (explodes); floating; melts; fizzes © Pearson c most and flames e melt f hydrogen and alkaline 2 a Place a lit splint near hydrogen and it burns with a squeaky pop. b the oxidation (or combustion or corrosion) reaction 3 a Because they would react with water. b Copper doesn't react with water whereas iron does. 509 8 G Metals and their uses 8 G 8Gc-7 Metals in water L5–6 1 a calcium 23 cm^3, lithium 33 cm^3, magnesium 0 cm^3 and sodium 43 cm^3 b Students' own bar charts. c hydrogen d in order: sodium, lithium, calcium and magnesium e The order is the same as the reactivity series (getting less reactive). 2 Place a lit taper/splint near the mouth of a test tube and if hydrogen is present it will burn with a squeaky pop. 3 a sodium b copper c calcium 4 a sodium + water → sodium hydroxide + hydrogen b magnesium + water → magnesium hydroxide + hydrogen 5 metal + water → metal hydroxide + hydrogen 8Gc-8 Rusting and sacrificial protection L5–7 1 a It keeps out air (oxygen) and water. b Eventually the coating will become broken or damaged and the water and air will get in. c magnesium and zinc d because it will react until it has all gone 2 a If you use iron screws then the screws will corrode quickly, as iron is more reactive than copper. Once the screws have corroded, the roof plates will fall off. b When the tin coating becomes scratched the water and air get in. As iron is more reactive than tin, the iron corrodes (rusts) faster than usual. The rust will spoil the food inside the can. c The zinc coating will protect, like paint, by keeping out air and water. In addition, if the coating becomes scratched or broken the zinc will continue to protect the iron, by sacrificial protection, as the zinc is more reactive than the iron. 8Gd Metals and acids Student Book 1: 8Gd Quality evidence L4 1 a It would need to be filled over and over again (which would repeat any error again and again). L5 b any four from: volume of acid, mass of metals, concentration of acid, type of acid, temperature, size/shape of flask, form and cleanliness of metals (e.g. shavings, rusty) L5 c 43 cm^3 510 L4 2 a result that is very different from the others L5 3 Data is repeatable if the results measured by one experimenter are all very close. Data is reproducible if other people can also get similar close values. L4–5 4 L4 volume of gas, type of acid used, mass of metal L5 form of metal, cleanliness of pieces of metals, temperature, size of glassware, concentration of acid L4 5 Calcium is most reactive, then magnesium, then zinc. The more reactive metal will produce more gas in the same time. L5 6 a They are reliable as the results are all very similar. L5 b The mean is 22.7 cm^3 (accept 23, which is the mode). L4 7 range = 19 – 5 = 14 (without anomalous results = 12 – 10 = 2) L6 8 The anomalous result is zinc, 5 cm^3. The answer should include an appropriate explanation, e.g. it could have been caused by not cleaning the metal properly. 2: 8Gd Metals and acids L6 1 paint them or use another coating L6 2 add a pH indicator (certain colours indicate if it is acidic) or add litmus (if acidic it turns red) or use a pH meter (any pH value below 7 is acidic) L5 3 a one from: potassium, sodium, caesium, rubidium L5 b one from: copper, mercury, silver, gold L6 4 copper, iron, zinc, sodium L6 5 Use a metal like zinc, which reacts with acid but not with water. If you add it to the liquids, the acid will form bubbles while the water will not. L6 6 a calcium nitrate L6 b lithium chloride L6 7 iron sulfate and hydrogen L6–7 8 a L6 zinc + sulfuric acid → zinc sulfate + hydrogen L7 $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ L7 b After the reaction is completed, filter out excess zinc and heat the solution of zinc sulfate to evaporate the water and leave the salt. Activity Pack 8Gd-1 Metals and acids L5 1 How do you test a solution to see if it is an acid? use colour of an indicator Name a metal that does not react with dilute acids. copper © Pearson Metals and their uses What gas is formed when metals react with acids? hydrogen Complete the general equation: metal + acid → salt + hydrogen Name a metal that reacts quickly with dilute hydrochloric acid. magnesium Name the salt formed between hydrochloric acid and magnesium. magnesium chloride. L5–6 2 L5 a acid L5 b gold L5 c salt L6 d sulfuric acid L5 e zinc L5 f hydrogen 8Gd-3 Matching salts L6 2 Possible answers include: potassium + hydrochloric acid → potassium chloride + hydrogen tin + hydrochloric acid → tin chloride + hydrogen zinc + sulfuric acid → zinc sulfate + hydrogen aluminium + sulfuric acid → aluminium sulfate + hydrogen magnesium + nitric acid → magnesium nitrate + hydrogen 8Gd-4 The reactivity series L6 1 the order is: Potassium, Sodium, Calcium, Magnesium, Aluminium, Iron, Tin, Copper, Silver, Gold 2 potassium + hydrochloric acid → potassium chloride + hydrogen sodium + hydrochloric acid → sodium chloride + hydrogen calcium + hydrochloric acid → calcium chloride + hydrogen magnesium + hydrochloric acid → magnesium chloride + hydrogen aluminium + hydrochloric acid → aluminium chloride + hydrogen iron + hydrochloric acid → iron chloride + hydrogen tin + hydrochloric acid → tin chloride + hydrogen 8Gd-5 Modelling reactions L6–7 1 $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ $Ni + H_2SO_4 \rightarrow NiSO_4 + H_2$ $Co + 2HCl \rightarrow CoCl_2 + H_2$ $Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$ $Ca + H_2SO_4 \rightarrow CaSO_4 + H_2$ 2 a $Ni + 2HCl \rightarrow NiCl_2 + H_2$ b $Ba + 2HCl \rightarrow BaCl_2 + H_2$ c $2Na + H_2SO_4 \rightarrow Na_2SO_4 + H_2$ d $Sn + 4HCl \rightarrow SnCl_4 + 2H_2$ e $2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$ f $2Fe + 6HCl \rightarrow 2FeCl_3 + 3H_2$ © Pearson 8 G 8Gd-6 Reactions and metals L5–6 1 potassium 2 sodium hydroxide and hydrogen 3 copper oxide 4 magnesium 5 a iron b copper (or silver) c magnesium (or aluminium) 6 chloride 7 sulfuric acid 8 reactive (accept dangerous) 9 aluminium 10 water 8Gd-7 Quality evidence L4–6 1 Sulfuric acid reacts faster than nitric acid as in all experiments the magnesium disappeared more quickly in the sulfuric acid. 2 The concentration and volume of acid used, the size, form and cleanliness of the magnesium and the temperature. 3 The size and cleanliness of magnesium ribbon will vary slightly in each experiment (or deciding when the magnesium has completely disappeared will vary between students). 4 The mean for sulfuric acid = 36 s, and for nitric acid = 51 s. 5 Accurate means a result is close to the true value. 6 They are repeatable because the results for each acid are very close. 7 The 2nd try for sulfuric acid is anomalous as it is very different from the other results. 8 The results look reproducible, as the results obtained by the different groups are close. 9 Group 5 used sulfuric acid that was twice as concentrated, as it took half the time to react compared to the other groups. 10 Group 3 used 2 cm pieces of magnesium ribbon, as it took twice the time to react compared to the reactions of both acids in most of the other groups. 11 a magnesium + sulfuric acid → magnesium sulfate + hydrogen b magnesium + nitric acid → magnesium nitrate + hydrogen 8Gd-8 Making salts L7–8 1 a 2 b 3 c 2 2 a 1 b 3 d4 511 Metals and their uses 3 a $NaCl$ b MgF_2 c $CuCl_2$ d CaO e Co_2O_5 f PbS_2 4 a $MgSO_4$ b Li_3PO_4 c $ZnCO_3$ d $Mg(NO_3)_2$ e $Al_2(SO_4)_3$ f $FePO_4$ 8Ge Pure metals and alloys Student Book 1: 8Ge Pure metals and alloys L4 1 A pure substance only contains one substance; a mixture contains two or more substances that are not chemically joined together. L4 2 shiny, hard, strong, high melting point, high boiling point, malleable, flexible, ductile, good conductor of heat, good conductor of electricity L4 3 a stainless steel b joining pipes or wires in electrical circuits L4 c It is strong but light making flying easier/ L4 cheaper. L5 4 a a metal with another element added/an impure metal b In the pure metal the atoms are L7 arranged in regular rows and so they can slip over each other fairly easily, allowing the metal to bend. In the alloy, the different-sized atoms disrupt the structure so the rows of atoms cannot slip over each other easily and therefore it is harder to bend. L5 5 a lead 327 °C, tin 232 °C b 61% tin, 39% lead L5 L6 6 a Iron X is the pure metal as it has an exact melting point. b Iron alloys have better properties for L6 building, e.g. stronger, resist corrosion, etc. 2: 8Ge Metals in art L5 1 a Rust is iron hydroxide (or a compound of iron, oxygen and hydrogen). It is formed by the reaction of iron with oxygen and water. b a mixture of metals or a metal mixed with L6 another element or an impure metal c The alloy forms a strong rust-coloured L6 coating and does not rust like iron. L5 2 a In copper, the atoms are arranged in regular rows and they slip over each other fairly easily, allowing the metal to bend. In bronze, the different-sized tin atoms disrupt the structure so the rows of copper atoms cannot slip over each other easily and therefore it is harder. b They would last longer/cut things better, L5 etc. L6 3 a It keeps out air and water. b zinc sulfate and hydrogen L6 512 Activity Pack 8Ge-1 Pure metals and alloys L4–5 1 Missing words (clockwise from top right): cooling, solid, melting, evaporation and heating. 2 Left-hand diagram is a pure substance and the right-hand diagram is a mixture. 3 a mixture, metals b stronger, harder c corrosion d lower 8Ge-2 Looking at particles L4–6 2 a In a pure metal all the atoms are the same. An alloy contains different atoms mixed together. b The melting point of an alloy will be lower and less precise (it will melt over a range of temperatures) than that of the pure main metal. 8Ge-3 Explaining properties L5–7 1 a another metal (element) mixed with it b properties c uses, properties d lower e solder, steel and brass 8Ge-4 Mixtures, alloys and change L4–6 1 Across: 3 point 5 harder 6 alloy 8 evaporation 9 useful Down: 1 corrode 2 pure 4 melting 7 liquid 2 a nickel b aluminium and alumin bronze c they are less and melt over a range of temperatures 8Ge-5 Identifying metals L6–7 1 Students' own graphs. 600 500 Temperature (°C) 8 G 400 300 200 Metal 100 Alloy 0 1 2 3 4 5 6 7 8 9 Time (minutes) 10 11 12 © Pearson Rocks 2 328 °C 3 186 – 212 °C 4 It doesn't level off completely during melting and it eventually rises to a higher temperature in the same time. (Or it stops rising so fast at a lower temperature.) 5 Alloys have different properties and these can sometimes be more useful than the pure metal. 8Ge-6 Information on mixtures L5–7 1 a mixture of metals or a metal with another element added 2 because they have different (better) properties than pure metals 3 It should melt at a low temperature and not corrode/react easily. 4 It will have a lower melting point. 400 400 300 300 200 200 100 100 0 % Lead 100% 0% % Tin melting point (°C) melting point (°C) 5 Students' own graphs. 0 80% 20% 60% 40% 40% 60% 20% 80% 0% 100% Alloy composition 6 a pure lead b around 75% lead and 25% tin ± 2% 7 It lowers it. 8 By making the line wider to show the range of temperatures, or by drawing two lines with one line showing the minimum melting temperature and the other showing the maximum melting temperature. 8Ge-7 Measuring purity L6–7 1 a two from: it could have a better appearance/colour, harder, cheaper b to get some better property c non-poisonous and unreactive d i pink gold ii red gold iii green and dental gold iv pure gold e pure gold = 1000, green gold = 750, pink gold = 375, red gold = 585 and dental gold = 750 f Pure substances have precise melting points while mixtures melt over a range of temperatures. 2 a 328 oC b When a substance reaches its melting temperature, the temperature stops rising until all the element has melted. © Pearson c The particles move about faster (and move further apart). 8H Rocks 8Ha Rocks and their uses Student Book 1: 8Ha Disaster! L4 1 a any suitable answer, e.g. building, making statues, making roads L4 b Most rocks are hard. They are more resistant to weathering/being worn away than other materials such as wood. L6 2 a It dissolves in rainwater to form acid rain. The acidic rain damages crops. L5 b Sulfur dioxide is produced when fossil fuels containing impurities are burnt, causing acid rain to form. L6 3 a It increases the temperature/keeps the Earth warm. L5 b burning fossil fuels/burning forests L4 4 a Possible answers include the colour, size of grains (or 'pieces') that make up the rock, how hard/crumbly the rock is, etc. 513 8 H Rocks 8 H L4 b Students' own answers. 2: 8Ha Rocks and their uses L4 1 a a chemical compound found in rocks L4 b one of the pieces of minerals that make up rocks L4 2 a sandstone (or any other sedimentary rock) L4 b granite/gabbro (or any other igneous or metamorphic rock) L5 3 the rocks with rounded grains/the rocks making up the gentle hills; they have worn away more to form lower hills L4 4 granite has interlocking, sharp-edged grains, sandstone has rounded grains that do not interlock; granite is not permeable, sandstone is; there are four main minerals in granite, there is only one main mineral in sandstone L5 5 There are gaps between the grains. (In fact, the gaps are usually filled with a matrix of smaller particles/cement, but this, too, has gaps.) L4–5 6 L4 drop water onto different rocks and see how much is absorbed L5 the description also indicates how the test will be made fair (e.g. dropping the same amount of water onto each rock, noting how much is left after a certain time) L5 7 a any two from: easy to carve, resistant to wearing away, attractive appearance L5 b strong, resistant to wearing away. L5 8 sandstone: both oolite and sandstone are made from mostly a single mineral (oolite from calcite, sandstone from quartz) whereas granite contains four main minerals; both oolite and sandstone are made from rounded grains, whereas granite is made from interlocking crystals Activity Pack 8Ha-1 Rocks and their uses L5 1 False – Sinkholes form when limestone dissolves in water in the ground. L4 2 True L4 3 True L4 4 False – A crystal in a rock is made of one mineral. L4 5 False – Rocks with interlocking grains are not porous. OR Rocks with rounded grains are porous. L4 6 False – Granite has interlocking grains. OR Sandstone has rounded grains. L5 7 True L4 8 False – Sandstone has rounded grains. OR Granite has interlocking grains. L4 9 True L4 10 True 514 8Ha-2 Permeable rocks 1 L4 5 To make a fair comparison. A large rock might absorb more than a small rock, so it would be best to test the same size pieces of rock. However, this is not easy to do so we make a fair comparison by working out how much water is absorbed per gram of rock. 8Ha-3 Permeable rocks 2 L5 5 To make a fair comparison. A large rock might absorb more than a small rock, so it would be best to test the same size pieces of rock. However, this is not easy to do so we make a fair comparison by working out how much water is absorbed per gram of rock. 8Ha-4 Rock textures L4–5 1 A – 5, B – 4, C – 2, D – 1, E – 6, F – 3 2 a 1, 2 and 4 (B, C and D) are probably permeable, as they are made from rounded grains. b C – 2 could be sandstone, as it is made from one type of rounded grain, and F – 3 could be granite as it is made of four different minerals with interlocking grains. 8Ha-5 Describing rocks 1 L4 1 B and C L4 2 a 1 b 2 c 3 d 3 L4 3 A L4 4 D L4 5 A and D L5 6 A, there are more gaps between the grains. L4 7 C L4 8 D 8Ha-6 Describing rocks 2 L4 1 Good answers should include the following: A = rounded, non-interlocking grains, all of similar size and all made of the same mineral B = interlocking sharp-edged grains of two different minerals, grains of similar sizes C = interlocking sharp-edged grains of three different minerals. Two minerals form small grains, the third forms larger grains/crystals. D = rounded non-interlocking grains of three different minerals. Two of the minerals form large grains. L5 2 A is likely to be the most porous, then D, then B and C. A has the biggest gaps between the © Pearson Rocks L4 3 a A could be sandstone, as the grains are rounded and all the same size. L5 4 Magma underground cools more slowly because it is trapped and insulated by the surrounding rocks. It therefore doesn't cool as much as the lava that escapes onto the surface of the Earth. b D could be conglomerate, as it has larger pebbles with much smaller grains between them. L5 5 at position 2: this is existing rock that is heated by the molten rock next to it c C could be granite, as there are three minerals present, one of which forms large crystals. L5 6 a The rocks at position 3 will cool more quickly than the rocks at position 4, because they are in contact with the cooler existing rock. They will therefore have smaller crystals. grains, so will be more porous than D, where the gaps are filled up by the small grains. B and C are not likely to be porous at all. L5 4 W is quartz, X is feldspar, Y and Z are quartz and mica (or vice versa). L5 5 Diagram should be similar to diagram B on the worksheet, but with three different types of shading to indicate three different minerals. 8Ha-7 Minerals and formulae L6 1 20 million L6 2 10 million carbon atoms, 30 million oxygen atoms L6 3 a 8 million L6 b 4 million L7 c 3 million L8 4 a Calcium and sodium are together in the first set of brackets, so it must always contain one or the other or a bit of each. b Aluminium, magnesium and iron are in the second bracket together. If there is no aluminium, the augite must contain some magnesium or some iron or some of each. Aluminium is also in the third bracket with silicon, so if the sample has no aluminium there must be some silicon. c The formula shows that the augite contains two of the atoms shown in the third bracket for every six oxygen atoms. If there is no silicon, then there must be two aluminium atoms for every six oxygens. Aluminium also appears in the second bracket – there is one of these elements for every six oxygens, but this atom may be magnesium or iron instead of aluminium. 8Hb Igneous and metamorphic Student Book 1: 8Hb Igneous and metamorphic L4 1 Magma is liquid rock under the surface; lava is magma that reaches the Earth's surface. L5 2 It forms gabbro if it cools down slowly (e.g. underground) and forms basalt if it cools down quickly (e.g. on the surface). Basalt is also formed in thin intrusions such as dykes and sills, but students have not covered this yet. L5 3 If the rock cools slowly the crystals will be bigger because there will be more time for the crystals to grow. © Pearson L5 b small crystals: the magma here will cool quickly because it is just a thin sheet surrounded by cooler rock 2: 8Hb Assessing sources L6 1 any four from: B – huge, deadly, catastrophic; C – devastating; D – vast, lethal, devastating; used to make us fear what may happen L6 2 cover: B – smother; is stored: D – lurking; erupts: D – blasted, spews L6–7 3 L6 C L7 It uses hardly any emotive language. L7 4 for report C: a – not emotive language; c – yes (detecting small earthquakes); d – yes; e – no, it only gives a reassuring opinion L7 5 for report D: a – emotive language; c – yes (detecting ground movements and earthquakes); d – no; e – no, it only gives bad news L7–8 6 L7 Report C is likely to be the most trustworthy. L8 It does not use emotive language and quotes an expert. Although it does not give balanced opinions, the one opinion it does give comes from an expert and is reassuring rather than alarmist. Activity Pack 8Hb-1 Igneous and metamorphic rocks L5 A-E; K-D; F-B; T-J; C-P; L-U; I-R; V-O; N-S; M-G; H-Q 8Hb-2 Runny lava 1 L4–5 3 Jelly gets thicker/less runny as it sets, so it may start to set if it has a very long ramp to run down. 4 Lava can be runny or quite sticky, and the different jelly mixtures are also runny or sticky. 8Hb-4 Densities of igneous rocks L6–7 2 They are made from different combinations of minerals. 515 8 H Rocks 8 H 3 More like gabbro. The experiment should show that their densities are similar. 8Hb-9 Minerals in igneous rocks L5 1 a olivine 4 Yes – the table shows that gabbro and basalt have similar combinations of minerals. L6 b Gabbro has large grains so must have cooled slowly, which means it must have formed beneath the ground. 5 It has 72% silica – so nearly three-quarters of the rock is silica. 6 Gabbro has more iron oxide in it than granite or rhyolite, so compared to those rocks it is iron-rich. 8Hb-7 Rocks and crystals L4 1 a crust L4 b magma L4 c lava L4–5 2 a A and C b D, B, E L4 3 a basalt (or any other igneous rock with small grains) b granite or gabbro (or any other igneous rock with large grains) L5 4 a E, B and F b A, C or D L5 5 a heat and pressure L4 b quartzite, sandstone L4 c Metamorphic rocks have interlocking crystals, like the first one. Sandstone has rounded grains, like the second diagram. 8Hb-8 Sills, dykes and plutons Note: the level of detail of cooling processes expected will depend on whether or not students have already studied Unit 8I. L6–7 1 L6 Intrusive igneous rocks form when magma cooled down underground. Rocks do not conduct heat well, so the underground magma would have taken a long time to cool. This allowed crystals time to grow, so the rock has large crystals. L7 If a rock cools slowly there is more time for particles to join to form crystals, so larger crystals can be formed. L7 2 A pluton. There is less mass of magma in a dyke, so there is less heat to transfer and it will cool down quicker. It also has a greater surface area compared to its volume in contact with the surrounding rock, which will also help it to cool quicker. Quicker cooling results in smaller crystals in the dyke. L7 3 The magma around the edges is in contact with the cooler existing rock, so it will cool down faster. L5–7 4 sills – X and Z; dyke – Y L5 5 in order: b and f; a and d; c and e L5 6 in the rocks immediately adjacent to the pluton 516 L5 2 a granite, diorite b diorite, gabbro, peridotite c granite L5 3 a andesite, rhyolite b basalt c basalt L5 4 a They contain mainly pale minerals. L5 b Composition of granite Mineral Minimum Maximum percentage percentage amphibole 0 8 biotite mica 4 12 muscovite mica 0 10 plagioclase feldspar 8 30 quartz 23 26 potassium feldspar 18 50 L5 5 A particular named rock can have slightly different proportions of the main minerals. It is easier to use the diagram than to use ranges of percentage compositions given in a table. L4 6 Peridotite is found in the upper parts of the Earth's mantle. It is rarely found on the Earth's surface because it reacts quickly with water. 8Hc Weathering and erosion Student Book 1: 8Hc Weathering and erosion L5 1 It contains dissolved gases from the air. L5 2 The acid in the rain reacts with minerals in the rocks. L5 3 The rock expands when it gets hot, and contracts when it gets cold. Forces from the expansion and contraction break up the rock. L5 4 a freeze–thaw action, because there is plenty of rain to run into cracks in the rock, and it gets cold enough to make the water freeze L5 b onion-skin weathering, because of large, frequent temperature changes; freeze–thaw is not likely as there is no water to freeze and chemical weathering is not likely as there is no (acidic) rain L5 c very little weathering: water is frozen all the time so it cannot run into cracks in rocks, there is little liquid water so chemical weathering is not very likely, and the temperature changes are not enough to cause much onion-skin weathering © Pearson Rocks L5 5 bits of rock in a stream or river, or bits being blown by the wind L5 6 They bump into each other and into the river bed. L5 7 a They get more rounded. L5 b Their masses will get less, as bits are knocked off them. L6–7 8 Students' own answers, e.g. L6 The sugar cubes will bump into each other and into the walls of the jar and bits may be knocked off them. This is similar to rocks being knocked against each other and the river bed as they are moved along by water. It is a good model because in both cases the lumps/rocks will become smaller and more rounded. Rocks are much harder than sugar lumps, so abrasion will take much longer in a river than in the model. L7 It is harder for things to move fast through water than through air, so the water in a river may have a cushioning effect. Activity Pack 8Hc-1 Weathering and erosion L4 1 a weathering L5 b erosion L4 c physical weathering L5 d chemical weathering L4 e biological weathering L5 f wind L5 g glaciers L5 h transport L5 i abrasion L5 j sediment L4–6 2 a D, it is the largest b A, it is the smallest c either A, C or E, as these have the smoothest, most rounded surface 8Hc-3 Wearing away L4 1 A onion-skin weathering, B chemical weathering, C biological weathering, D freeze–thaw weathering L4 2 a freeze–thaw weathering, onion-skin weathering L5 b chemical weathering L5 c freeze–thaw weathering, chemical weathering. Some students may also put biological weathering, as plants need water to grow. L4 d freeze–thaw weathering, onion-skin weathering L5 e chemical weathering L5 f freeze–thaw weathering, onion-skin weathering © Pearson 8 H L5 3 transport L5 4 a they get rounder L5 b they get smaller L5 c abrasion 8Hc-4 Weathering L4 1 north-west Scotland L4 2 eastern England L4 3 Scotland L5 4 north-west Scotland L5 5 north-west Scotland. The temperature drops below freezing most often and it is the wettest place in the country. L5 6 The stone will be worn away. A good answer will explain chemical weathering and freeze–thaw action. L6 7 south-east England and near the coast, as it has the lowest rainfall and fewest nights with frost 8Hc-5 Limestone scenery L5 1 acidic rainwater dissolving the rock L5 2 A is a collapse doline – the fallen rocks can be seen at the bottom. B is a solution doline – there are no fallen rocks and no grass cover. C is a subsistence doline (or shakehole) – there is still a covering of soil over the dip. L5 3 a a stream disappearing into a hole in the ground b water appearing from a hole in the ground/side of a hill c a depression in the ground, but no hole in the bottom of the depression L5 4 Shale is impermeable (i.e. does not let water flow through it). The stream is on the surface above the top layer of shale, so it does not allow the stream to soak through the bottom layer. L6 5 A good answer will describe/show the caves bigger, the dolines bigger (perhaps with more collapses), and will explain that this is due to weathering continuing to dissolve more of the limestone. L6 6 Clints are the 'blocks' in a limestone pavement, grykes are the gaps between them. The grykes are formed when limestone dissolves along cracks in the rock (joints), and the clints are the bits that get left behind. 8Hd Sedimentary rocks Student Book 1: 8Hd Sedimentary rocks L4 1 a when sediments are squashed by layers of sediments above them L4 b when minerals crystallise in the gaps between grains of sediment and stick them together 517 Rocks 8 H L4 2 minerals dissolved in the water that was between the grains L4 3 a The conglomerate has a mixture of grain sizes, some very large and others much smaller, held together by cement. The mudstone has grains that are too small to see in the photograph. L5 b by abrasion while they were being transported L4 4 the shape of a living organism preserved in the rock L5 5 Each layer could represent a different flooding event. L5 6 two pairs from: limestone/marble; mudstone/ slate; slate/gneiss; slate/schist; granite/schist; granite/gneiss; schist/gneiss; sandstone/quartzite L5 7 a Quartzite is metamorphic, so it will consist of interlocking crystals. Sandstone is made from rounded grains. L5 b Quartzite will be harder and more difficult to erode than sandstone. Sandstone is porous and quartzite is not. L6 8 A sedimentary rock would have separate grains, usually rounded and stuck together. Igneous and metamorphic rocks are made from interlocking crystals. If the crystals are lined up or in coloured bands, then it is a metamorphic rock. If there is no alignment of crystals, then the rock is likely to be igneous. (Marble and quartzite are exceptions to this, as they often have randomly oriented crystals.) 2: 8Hd Theories in geology L5 1 Earth scientists cannot easily do experiments, they have to rely mainly on observations. L5 2 Answers should resemble figure A but have 'gather more observations' instead of the 'experiment' and 'data' boxes. L5 3 a coal L5 b soft rocks containing fossils, with granite further down L5 4 Two answers are possible: sedimentary – because it crystallised from water; igneous – as it consists of crystals. Metamorphic is not acceptable, because there is no indication that Werner thought the rocks had been

changed after deposition. L5 5 a metamorphic rocks L6 b no, Werner thought that granite was the oldest rock because it had been deposited first; here the granite is clearly younger than the surrounding rocks L6 6 a This could support the hypothesis, as Werner considered basalt to be one of the younger rocks. L6 b This contradicts the hypothesis, as in 518 Werner's hypothesis the basalt would have been laid down as a layer in a similar orientation to the rest of the rocks. L6 7 They both disprove Werner's ideas. The Torres del Paine mountains have granite within other rocks, so granite cannot have been formed first/is obviously not below all other rocks. At High Force the dolerite (equivalent to basalt in Werner's hypothesis) has limestone above it, so it is not the last rock to form. L6 8 It does not disprove it, as there may be some basalt somewhere that does contain fossils. However, it does not support the hypothesis either. Activity Pack 8Hd-1 Sedimentary rocks L4 1 deposited, compacted, cemented, fossils L4 2 a slate L4 b marble L4 3 From top to bottom: melting and cooling erosion, deposition, compaction, sedimentation heating and/or pressure 8Hd-4 Layers of sediment L5 1 From the bottom upwards: conglomerate, sandstone, shelly limestone, shale, coal, chalk 2 conglomerate 3 chalk 4 Conglomerate, because it is the first layer deposited so will be the oldest rock and pressurised by all the other layers on top of it. 8Hd-5 The rock cycle L5 The order of the statements may vary: Rocks get weathered by chemical … and physical weathering. Small fragments of rock get transported away … from rock faces by rain, streams and rivers. When the river slows down, the sediments … are deposited at the bottom of the river. Over many years, these sediments … build up to form layers. The layers of sediment gradually get squashed … and eventually form sedimentary rock. Some sedimentary rocks get heated and … compressed under the surface of the Earth. This changes the rock into … metamorphic rock. If the rock is heated enough, it melts … and forms magma. © Pearson Rocks Some magma rises to the surface of the Earth … through cracks and volcanoes. f Sedimentary (accept metamorphic as well) When the magma cools, it forms … igneous rocks. mudstone → slate Some igneous rocks get buried and compressed … and are changed into metamorphic rock. 8Hd-6 The age of the Earth L6–8 1 Forming the grey rocks Existing rocks are weathered and break up into smaller pieces. The pieces are transported by rivers. The pieces abrade and become rounded. The sediments are deposited on the sea bed by underwater avalanches. More layers of sediment cover the deposits. The sediments are compacted, which squashes water out from between the grains. The sediments become cemented together to form greywacke rock. More horizontal layers of greywacke form on top. Tilting and eroding the grey rocks Earth movements tilt the layers. Earth movements lift the layers up. The rocks above get weathered and eroded, leaving a horizontal surface. Forming the red rocks Sediments are deposited by rivers on top of the weathered and eroded surface. More layers build up and cover the deposits. The sediments are compacted, which squashes water out from between the grains. The sediments become cemented together to form red sandstone. The layers above the sandstone are weathered and eroded. The sandstone is exposed at the surface of the Earth. L5 2 a It would have taken much longer than that for all the processes to happen. b The description shows at least two different sets of rocks being formed through erosion, sedimentation and compaction. 8Hd-7 Rocks and the rock cycle L4 1 sediments, slows down, deposited, layer, sediment, compacted, cement, sedimentary 2 a igneous, metamorphic b sedimentary 3 limestone → marble schist → gneiss slate → schist 8Hd-8 Looking at limestones L5 1 Answers should include the following: Deposition of sediments happens when the wind or water carrying the sediments slows down. Compaction is when layers above squash the sediment and squeeze most of the water from between the grains. Cementation happens when minerals in the remaining water crystallise and cement the grains together. L5 2 The sediments that form limestone are the shells of sea creatures, not bits of weathered rock. L5 3 Mud or plant remains would make the chalk coloured. It is white because it only contains calcium carbonate, which is white. L4 4 a Bits of rock knock into each other while they are being transported, and bits break off (abrasion). b The grains in oolitic limestone grow with time, rather than getting smaller. L5 5 a Marble is formed when limestone is heated/compressed. b Limestone is made of grains (or bits of broken shell). Marble is made from interlocking crystals. L4 6 any two from: building, making cement, making lime to neutralise acid soils 8Hd-9 Explaining the characteristics L6 1 a Grains of 0.25 mm are deposited when the water speed slows to 0.02 m/s, so the water could not be transporting any grains larger than this. Grain sizes will range from very small up to 0.25 mm. L7 b Well sorted, because only very small grains can be carried. L6 c sandstone or mudstone (see diagram on 8Hd-2) L7 2 a A mixture of sizes. They can move large grains, but they can also move small grains. If the water speed drops suddenly, grains of a wide range of sizes will all be deposited at once. L7 b Very poorly sorted, as the deposits will contain a range of sizes. L7 c Either angular or a mixture are both acceptable answers. d sedimentary Angular, because the flood does not last very long and there is little time for rocks to be abraded and become rounded. e all three Mixture – some angular fragments (explanation as c sedimentary © Pearson 519 8 H Rocks 8 H above), but the flood may also pick up grains that have already been rounded. L7–8 3 This is a full answer – students would not be expected to identify all of these points. L7 for answers discussing grain size and/or shape only, L8 if sorting is also explained. Near the source the river will carry grains of a wide range of sizes, and these will be deposited as it starts to slow down. The grains will not have been carried very far, so will be angular. They may be poorly sorted, as smaller grains may be trapped when the larger grains are deposited. Fifty miles from the source the river will be moving more slowly and cannot transport such large grains. The maximum grain size in the deposits will be smaller, and they will probably be moderately sorted. As the grains have been transported some distance, there will have been time for abrasion to make them more rounded, so deposits may be subangular or sub-rounded. By the time the river reaches the sea it will be travelling slowly and only able to transport much smaller grains. As the river slows down on entering the sea, the largest grains will be deposited first. The maximum grain size of sediments will get smaller as you get further from the coast. As there are only small grains to be deposited, the sediments will be well sorted. There has also been much more time for abrasion, so the grains are also likely to be well rounded. 8He Materials in the Earth Student Book 1: 8He Materials in the Earth L5 1 A mineral is a single chemical compound. An ore is a rock (a mixture of different minerals) that contains enough of a metal in its native state (or enough of a metal-containing mineral) to be worth mining. L6 2 Gold is all one type of atom. Pyrite contains two different types of atom/iron and sulfur atoms bonded together. L5 3 disturbs habitats, causes pollution L5 4 It costs money, so would reduce profits. L5 5 crushing up the ore L5 6 a Recycling reduces the need for mining more metals, so it reduces the pollution caused by mining. It also means less metal will go to landfill, so will reduce any toxic substances escaping from landfill sites. L5 b Usually less energy is needed to recycle metals than to extract them, so less fossil fuel will be burned to provide this energy. Some rare metals are needed in wind turbines and solar panels – if recycling helps to keep these metals 520 cheaper/sufficiently available, then more wind turbines/solar panels might be built, which will in turn reduce the need for burning fossil fuels in power stations. 2: 8He Living in danger L4 1 a igneous rock L4–5 b L4 Sedimentary rocks are formed when tiny pieces of existing rocks build up in layers and are cemented together. L5 Sediments are compacted, which squeezes the water from between the grains, and cementation occurs when minerals dissolved in the water become solid and 'glue' the sediments together. Metamorphic rocks are formed when existing rocks are subjected to high temperature and pressure, and the minerals in them change. L5 2 a two from: chemical weathering – minerals in rocks react with chemicals in rain/water; biological weathering – plants grow in rocks, breaking them apart; freeze–thaw weathering – water gets into rock cracks then freezes, expands and breaks the rock; onion-skin weathering – rocks expand and contract with temperature changes and cracks form L5 b two from: wind, water, ice L4–5 3 L4 It may be the only land available to them; they may not believe that the volcano will erupt. L5 Areas around volcanoes often have very rich soils (this is not mentioned in the text). Activity Pack 8He-1 Materials from the Earth L5 1 native state – When a metal is found in the Earth as an element, not as part of a compound. mining – Digging metals or ores out of the ground. ore – A rock that contains enough of a metal or metal compound to make it worth mining. mineral – A chemical compound found in rocks. L5 2 Anticlockwise from left: pollution pollution, landfill energy, ore last longer 8He-2 Where in the UK…? L4–6 Students answering these questions will be working at about level 5, although this depends on whether they are using paper maps or the online viewers (it will be harder to interpret the keys on paper maps), and on how much help they get. 2 The main areas for intrusive igneous rocks are Cornwall, parts of the Lake District, parts of Skye © Pearson Rocks and the Outer Hebrides, and a band from Aberdeen towards Mull. The main areas for extrusive igneous rocks are Skye, parts of Mull, a band across the Midland Valley of Scotland, parts of the Lake District and Snowdonia, and the eastern part of Northern Ireland. 3 Most of the Scottish Highlands are metamorphic rocks. 4 The oldest rocks are in the Outer Hebrides and the far north-west of the Scottish mainland. The youngest rocks are in a triangular shape with its apex just west of Reading, extending eastwards to the coast from Margate to Ipswich. 5 The main outcrops of the Coal Measures are in the Midland Valley of Scotland, around Newcastle and Durham, down the Pennines from just north of Leeds and Bradford to Derby, and in south Wales from west of Swansea to nearly as far east as Newport, and as far north as Merthyr Tydfil and Ebbw Vale. 8He-3 Opencast or underground? L5–7 1 and 2 Opencast mining Advantages: Old opencast mines can sometimes be filled in afterwards, or converted to lakes. Disadvantages: A lot of dirt and dust is produced. Mining the ore is noisy. Can cause pollution of rivers and streams. Large areas of vegetation are removed, destroying habitats. Neither: Ores are extracted from a large hole in the ground. Underground mining Advantages: These mines do not take up much space on the surface. Disadvantages: Can cause pollution of rivers and streams. Can pollute underground water supplies. Old tunnels and shafts can sometimes collapse, causing subsidence on the surface. There is a lot of waste rock to be disposed of. Spoil heaps may contain toxic materials. Neither: Deep shafts and tunnels are dug to reach the ore. 3 Students should present the advantages and disadvantages concisely and in a logical order. 4 Recycling metals reduces the requirements for mining ores, so it reduces pollution from mines, including the need for spoil heaps and environmental disturbance. In most cases it takes less energy than extracting metal from an ore, so there is less contribution to climate change. It reduces the amount of rubbish sent to landfill sites, and so also reduces the pollution these can cause. © Pearson 8 H 8He-4 Rocky words L4–5 1 igneous 6 sediments 2 sedimentary 7 fossil 3 metamorphic 8 marble 4 crust 9 freeze–thaw 5 chemical 10 compaction C F F R E E Z E T H A W O S M F C D P O I P P P M B E C H E M I C A L S P C T D L U I J N F D E A U A N I G G S C O S D C U M M A M N R U S Y I T L O O C J E V N S H M I L R X N R O N I I J E O T P L Y V U Y T L C N N Y H A I I S S P A B T Q C I F E D U F T T R S P M C V Q M A R B L E Y 8He-5 Finding gold L5 1 a The water is flowing more slowly on the inside of the bend (near X) and faster on the outside of the bend (near Y). b The water is moving more slowly on the inside of the bend and cannot carry such large grains as the water flowing round the outside of the bend. The largest grains being carried will be deposited where the water slows down, which is on the inside of the bend. L5 2 The water in the stream flows over the rocks that stick out of the river bed. Some water will be trapped upstream of the projections and will slow down and therefore deposit the largest grains it is carrying. L5 3 Less resistant materials would be broken up into much smaller pieces, and small pieces are less likely to be deposited. L5 4 More reactive minerals are more likely to undergo chemical weathering and change/break up. L5 5 Dense materials are more likely to sink/be deposited. L5 6 A large area of river bed will be dredged up, destroying habitats. Silt will be stirred up by the dredging and travel downstream. Machinery will produce noise and dust. L5–6 7 Recycling reduces the need for new metals and so reduces the environmental effects of mining; it reduces the amount of metals sent to landfill and so reduces pollution from landfill sites; 521 Fluids 8 I it often requires less energy to recycle metals than to extract ores, so it reduces our energy use and so helps to reduce pollution/climate change. L5–6 8 Gold is unreactive and stays as gold. Iron rusts, so not all iron collected for recycling may be usable/iron would have to be extracted again from the iron oxide/rust. 8He-6 Extracting metals L5 1 a In a physical change no new substances are formed. Examples could be dissolving, freezing, melting, evaporating, condensing. In a chemical change, new substances are formed (from the atoms present in the reactants). Examples could include combustion, rusting, respiration, etc. L4 b any two from: sieving, filtering, evaporating a solution, fractional distillation, chromatography L5–6 2 a Sn and CO2 b SnO2 and C L6 3 zinc oxide + carbon → zinc + carbon dioxide a Zn, CO2 b ZnO, C L5 4 silver, gold, platinum – they are unreactive and so they can be found in their native states L7 5 a heating with carbon b electrolysis L7 6 Magnesium is more reactive than carbon. L7 7 To extract aluminium the ore has to be melted and energy is also needed to generate electricity. For lead, the ore only has to be heated with carbon. L7 8 If heating the ore with carbon works, it is cheaper to extract the metal that way than by using electrolysis. 8I Fluids 8Ia The particle model Student Book 1: 8Ia Exploring extremes L3 1 a solid b gas c liquid b keeping warm enough, providing shelter from the weather, providing light during the Antarctic night, preventing people being buried by snowfall c providing air to breathe, keeping warm/ cool enough (keeping cool is more of a problem than keeping warm when in sunlight), providing air pressure around the body 2: 8Ia The particle model L3 1 a any three solid materials b any three liquids c any three gases L4 2 a similarity – keep same volume/ incompressible; difference – solids keep their shape and liquids do not b similarity – both take up the shape of their container; difference – liquids keep the same volume but gases expand to fill their container/ gases are compressible and liquids are not L6 3 a Particles are already close together, so they cannot be made to go any closer. b Particles are far apart, so it is easy to push them closer together. L6 4 a The forces between particles are strong so all the particles are held tightly in their places. b The forces between particles are weak so it is easy for the particles to move around and move apart. L6 5 a The movement gets less. b it gets smaller/the volume gets smaller L6 6 a The volume of the liquid inside the thermometer depends on the temperature. As it expands and contracts the volume of liquid in the tube changes and the relevant temperature is read off the scale. b Fill a flask with coloured water and put a tube in the top. To make the scale, the thermometer needs to be at two known temperatures, e.g. put the flask in ice and boiling water for 0 °C and 100 °C to be marked. Having marked the level of the liquid at these two temperatures, the scale can then be divided into equal divisions. L6 7 a The metal would expand in hotter weather, so the bridge might buckle. L4 2 a solids keep their shape, liquids and gases take the shape of their container b The metal would contract in colder weather, so the bridge might break/be pulled apart. b solids and liquids have a fixed volume, gases expand to fill their container 3: 8Ia Calculations with density L4 1 15 cm3 L5 2 Fill a displacement can with water and place a measuring cylinder under the spout. Carefully drop the lump of clay in. The volume of water pushed into the beaker is the same as the volume of the modelling clay. L4 3 suggestions could include the following (students are not expected to give all of these): a breathing underwater, keeping warm enough, withstanding pressure, providing light underwater 522 © Pearson Fluids L5 3 mass = 6.4 g, volume = 8 cm3, density = 0.8 g/cm3 L6 4 a mass = density × volume b mass = 2.7 g/cm3 × 50 cm3 = 135 g c volume = 810 g/2.7 g/cm3 = 300 cm3 L6 5 a mass of water = 1000 kg/m3 × 2500 m3 = 2 500 000 kg b As the water warms up the particles move faster and take up more space. c It will decrease, because there will be the same mass in a bigger volume. d density of the warmer water = 2 500 000 kg/2505.25 m3 = 997.9 kg/m3 8Ia-4 States and particles L4–6 1 liquids, volume, compress, close together, strong Activity Pack c 1700 kg 8Ia-1 The particle model L4 1 a False – you can pour liquids and gases but not solids. L6 b True L6 c False – particles in solids vibrate about fixed positions. L6 d False – liquids cannot be compressed because the particles are close together. L6 e False – when a substance expands the particles in it stay the same size but either vibrate more or move around faster. L6 f True L6 g True L6 h False – particles in gases move faster when the substance is heated. L6 i False – gases expand to fill their containers because there are weak forces between the particles. L6 j False – solids expand or contract when their temperature changes. 8Ia-2 Make a thermometer L4 1 a 0 °C b 50 °C (the temperature of the water bath) c 10 °C L4 3 not enough space to mark smaller divisions L4 4 Divide the space between the 10 degree marks by 10, or divide the distance between the top and bottom marks by 50. L4 5 difficult to read to small intervals, or similar answer L5 6 have a smaller reservoir of liquid L4 7 It would freeze if the temperature dropped below 0 °C. 8Ia-3 Finding the density L5 1 Not correct. If students have measured a range of materials, there should be some materials denser than water and some less dense. © Pearson volume, shape, container, close together expand, far apart, weak L6 2 a They move around faster. L5 b The volume gets bigger/the liquid expands. L6 c They move more slowly. L5 d The volume gets less/the liquid contracts. 8Ia-5 Density calculations L5 1 a 2.7 b 20 cm3 d 46; g/cm3 e kg; m3; 7800 f 0.5 m3 g 500 g L5 2 a density = 75 kg/0.285 m3 = 263 kg/m3 L6 b mass = 1000 kg/m3 × 0.065 m3 = 65 kg L6 c total mass = 75 kg + 65 kg = 140 kg total volume = 0.285 m3 + (0.066 m3/2) = 0.318 m3 density = 140 kg/0.318 m3 = 440 kg/m3 L5 3 a volume of 5 kg of water at 0 °C = 5 kg/1000 kg/m3 = 0.005 m3 b volume of 5 kg of water at 300 °C = 5 kg/700 kg/m3 = 0.007 m3 c change in volume = 0.002 m3 8Ia-6 Changing size 1 L4 1 a It will rise. L5–6 b It will expand/get bigger, because the particles have more energy and vibrate more. L6 c It will probably not go up as much, because the hot water is being run onto the lid, not the glass. L6 d The lid will get bigger. The table shows that glass does not expand as much as steel for the same temperature rise, so even if the temperature of the glass jar rises by the same amount as the steel lid, it will not expand as much. The lid will be looser and easier to remove. L5 2 a The iron will expand so the rod will get longer. b When the rod cools down again it will go back to its original length. As it was tightened up when it was longer, the contraction will help to pull the walls of the house inwards. L6 3 The weather is warmer in the summer and so the wires will have expanded. When the weather is colder in the winter the wires will contract. If they are put up so they are tight/shorter in the summer, when they contract in the winter they could break. 523 8 I Fluids 8 I L5–6 4 They are less dense in summer. Their mass does not change, and in summer their volume is greater because they expand in the warmer weather, so their density is less. 8Ia-7 Changing size 2 L5 1 length change = 10 m × 10 °C/10 × 1.1 mm/m/°C = 11 mm L5 2 length change = 20 m × 15 °C/10 × 1.2 mm/m/°C = 36 mm L6 3 length change = 33.5 m × 20 °C/10 × 1.1 mm/m/°C = 73.7 mm L6 4 When the indicator is turned on the switch is closed and a current flows through the coil of wire. Electric current has a heating effect, so the bimetallic strip warms up and bends. As it does so the two contacts move apart and there is a gap in the circuit. The current stops flowing, so the strip cools down again and goes back to its original shape. Once the contacts touch, current flows again and the whole cycle repeats. L6 5 a For the same length strip and temperature rise, copper will expand more than iron. As the bottom of the strip is trying to get longer, the end that is not fastened down bends upwards. L7 b Brass expands more than steel, so the strip will bend in the same direction. However the difference in expansion between brass and steel is 0.8 mm/m/°C, compared to the difference between copper and iron of 0.5 mm/m/°C, so the brass and steel strip will bend more. L6 c Any pair of metals where the one on the top expands more than the one on the bottom (for example, copper above iron, brass above steel, brass above copper, etc). 8Ib Changing state Student Book 1: 8Ib Changing state L4 1 a 0 °C b 0 °C L5 2 the substances do not change/the atoms in the molecules are not rearranged L6 3 a 50 °C L6 b 80 °C L7 c The energy being transferred to the substance is being used to break the particles away from their fixed arrangement. L7 d The graph should be a mirror image of the one in figure B, where temperatures decrease with time. Two plateaus for condensing (boiling) and freezing (melting) must be shown with suitable explanations. A suitable title for the graph could be 'How the temperature of a substance changes as it cools down'. 524 L6 4 a Particles vibrate further (for a solid) or move around faster (liquids and gases) so the substance takes up more space. L5 b The volume of the liquid iron gradually gets less as it cools down, then it decreases suddenly when the liquid turns into a solid. L7 5 a As the temperature of the ice increases it expands and so its density decreases. When the ice melts its density suddenly increases because the liquid water takes up less space than the solid. As the water warms up from 0 °C to 4 °C it gets more dense and then starts getting less dense again as the particles in the warmer water move around faster and take up more and more space. b For other substances, as the solid starts to melt the volume it takes up will be less and so the density will increase. The volume will continue to get less and the density more as the liquid warms up. Activity Pack 8Ib-1 Changing state L4 1 a chemical b physical c physical d physical e chemical L4 2 solid, melting, liquid, condensing, gas L4 3 a physical b evaporate, boiling, evaporation c water vapour, drops of liquid water d more, less 8Ib-2 Cooling wax 1 L4 5 The temperature fell. L4 6 It did not change. L4 7 It started to fall again. L7 9 graph should rise, level out and then rise again 8Ib-3 Cooling wax 2 L7 4 The particles will lose energy and become bonded in fixed positions. L5 5 The method should include recording the temperature at regular intervals until the wax has solidified, and at least one safety recommendation such as not touching hot equipment. L7 9 b It is easier to see a pattern in the results/ it is easier to compare with the graph sketched for the prediction. L7 11 The temperature remains the same as the liquid is turning back into a solid. Energy is still being transferred away from the wax, but the particles are also releasing energy as they begin to form a solid, so the temperature does not drop. © Pearson Fluids L7 13 graph should rise, level out and then rise again 8Ib-4 Weathering rocks L4–6 Onion-skin weathering – diagrams 1 and 4, statements M, I, D, B, E, J, A Freeze–thaw weathering – diagrams 2 and 3, statements K, H, G, F, C, L, N 8Ib-5 States questions L4 1 physical L6–7 2 a E b I c G d B e G f H L5 3 a C b B L6 4 a W and Z b X c the particles are vibrating more/the solid takes up more space/has expanded d Y 8Ib-6 Kitchen questions L5 1 The bubbles form as liquid water turns into a gas, so they are full of water vapour. L7 2 graph should rise, level out and then rise again L7 3 If the water is bubbling, it is at the boiling point of 100 °C. Having the heat on full will make the water turn to a gas more quickly, but the temperature of the water will not change, so the same amount of energy is transferred to the potatoes in both pans. L6 4 Paul is using up more gas/electricity, which has to be paid for (and also filling the kitchen with steam). L6 5 a Cooking oil can be heated to a higher temperature than water without boiling (or smoking), so energy is transferred to the things being cooked more quickly. b Water does not get hot enough to burn potatoes, even if you have the cooker turned up as high as it will go, because it will boil away rather than getting hotter. Cooking oil reaches higher temperatures before it boils (or smokes), so it can burn potatoes. L6 6 Answers to a and b may vary slightly. a The temperature inside the freezer is lower than the freezing point of lemonade. The water in the lemonade freezes, so it expands and splits the bottle. © Pearson b The freezer is below the freezing point of the wine, so the water in it freezes. The glass bottle is stronger than the plastic lemonade bottle, so it does not break but the cork is pushed out. c The freezing point of vodka is below the temperature inside the freezer, so it does not freeze. 8Ib-7 Explaining ice L7 1 It has more massive atoms. OR The atoms are packed together more closely. L7 2 a Zinc atoms have slightly greater mass than copper atoms. b Although it has atoms with smaller mass, copper is more dense than zinc, so the copper atoms must be packed together more tightly than zinc atoms. L7 3 Aluminium atoms have more mass than magnesium atoms, but only 12.5% more. Aluminium is over 60% denser than magnesium, so the extra mass of the atoms probably does not account for all the difference. Therefore the atoms in aluminium must also be more tightly packed. Accept qualitative answers to the same effect. L7 4 The molecules have less energy in ice, so are not trying to move around as much. In water they have enough energy to overcome the weak forces between the molecules. L7 5 When the atoms are held in a fixed arrangement in ice, the pattern they make takes up more space than the same number of molecules in liquid water. As the volume is larger for the same mass, the density is lower. L7 6 As water cools the molecules do not move as fast so they take up less room and the density increases. At 4 °C they are moving slowly enough for some of the weak bonds to hold some molecules together. These groups of molecules take up more space, and so the density decreases slightly. 8Ib-8 Latent heats L7 1 It is breaking the bonds between the particles in the solid to form a liquid. L7 2 All the solid has melted. L7 3 The graph should descend, level out and then descend, level out and descend again. Some students may include a final levelling off as the temperature of the ice reaches the temperature inside the freezer, but this has not been specifically covered in this unit and so is not expected here. The rate of cooling will also reduce as the difference between the temperature of the water and the freezer gets less, but again students are not expected to show this. The temperature goes down at first because energy from the water vapour is being transferred to the air in the freezer. As the gas starts to condense, 525 8 I Fluids 8 I some of the extra energy that the gas particles have is released and this stops the temperature falling until all the gas has condensed. This energy is the latent heat of vaporisation. Once it is all liquid, the temperature falls again as energy continues to be transferred to the air in the freezer. Once the water reaches freezing point, more energy is released as the liquid starts to become solid; this is the latent heat of fusion. This causes the temperature to level out again until all the liquid has frozen. Some students may add that the temperature continues to fall until the temperature of the ice is the same as the temperature inside the freezer. L8 4 Liquids evaporate faster closer to their boiling points. The boiling point of alcohol is lower than that of water, so it should evaporate more easily. The latent heat of vaporisation of alcohol is less than half that of water, so alcohol needs to absorb less energy from its surroundings to evaporate. L8 5 Steam. Water has a higher latent heat of vaporisation, which is a measure of how much energy is released when it condenses. L7 6 a All the particles in a substance need to absorb energy to melt/evaporate (or release energy when they condense/freeze), so the amount of energy absorbed/released will depend on how much of the substance is present. L6 b energy = 335 kJ/kg × 2 kg = 670 kJ L6 c energy = 2272 kJ/kg × 0.5 kg = 1136 kJ L7 7 a If the water is bubbling, it is at the boiling point of 100 °C. Having the heat on full will make the water turn to a gas more quickly, but the temperature of the water will not change, so the cooking time will stay the same. L6 b Energy has to be paid for, and if the heat is kept higher it will use more energy (which just goes to evaporate more of the water) without speeding up the cooking time. 8Ic Pressure in fluids Student Book 1: 8Ic Pressure in fluids L6 1 particles hitting the walls of a container/ particles hitting something in the fluid L4–5 2 The air pressure outside is greater than the air pressure inside because some air has been removed. This means there is a greater force pushing them together than pulling them apart. L6 3 suggestions; L7 explanations; any two from: put more particles into a container (if there are more particles there will be more collisions with the walls of the container and so the total force from the particles on the area will be increased), heat the fluid (if the fluid is heated the particles 526 will move around faster and the collisions will be harder, so the total force will be increased), make the volume of the container smaller (if the volume is decreased the particles don't have to move as far before they hit the walls again, so there will be more collisions) L6 4 a There is less air above you so the particles are further apart. Not as many particles hit you each second, so the pressure from the air on you is less. b There are fewer particles in each lungful of air, so each breath will not get as much oxygen into the body. The oxygen mask provides extra oxygen. L6 5 When the bag was sealed at sea level, there were a certain number of air particles in it, giving the same pressure inside the bag as outside it. When the bag is taken up a high mountain, the pressure outside the bag is less. This means there are more particles hitting the inside of the bag than the outside, so the bag bulges outwards. L6 6 They had to withstand much higher pressure than the sides of ships, because the Trieste went down to the deepest part of the ocean where the pressures are very high. L7 7 Pressure is caused by particles in the fluid hitting us. The particles in a liquid are much closer together than the particles in a gas, so there are many more of them hitting each square centimetre of our skin. Pressure also depends on the weight of the fluid above us. Water is much denser than air, so the change of pressure with depth/height is greater. 2: 8Ic Presenting information L5 1 a on the sea bed, far below the waves, on the surface, over 100 years ago b prepositions: on, below, on, over c noun phrases: the sea bed, the waves, the surface, 100 years L5 2 a beneath b towards L6 3 Students' own answers, e.g. When divers returned to the surface they sometimes suffered severe pains. Now we know that it is important to return to the surface slowly. As they ascend to the surface the divers wait for a time to reduce the pressure gradually. Inside their bodies the dissolved gases leave the blood without forming bubbles. Activity Pack 8Ic-1 Pressure in fluids L4 1 liquids or gases L5 2 the forces from particles hitting the container © Pearson Fluids L5 L5 L5 L4 L4 L5 3 they have more air particles inside them 4 is the same in all directions 5 gets less as you go higher 6 100 000 Pa 7 increases 8 gets bigger as you go deeper 8Ic-2 Investigating manometers 1 L4 3 a This should be the liquid with the smallest density. L4 b The same liquid as in a. The greater the height difference the more precise the measurement. L4 5 a The less dense the liquid, the greater the height difference. L5 b Choose the liquid with the lowest density. 8Ic-5 A question of pressures L6 1 a B L6 b The pressure is bigger as you go further down, so the water comes out fastest near the bottom and slowest near the top. L6 2 Arrows should be on every surface, perpendicular to the surfaces, and become longer near the bottom. L5 3 The pressure inside the body exactly matches the pressure outside the body. L5 4 correctly plotted graph L5 5 approx. 65 kPa 8Ic-6 Manometers L6–7 1 Atmospheric pressure on the open side of the tube provides a force on the liquid. If the pressure of the gas supply was only atmospheric pressure, it would provide the same force on the surface of the liquid in the other arm, the two forces would cancel each other out and the liquid would not move. The manometer measures the force from the gas pressure, after the force provided by the atmosphere has been cancelled out. L7 2 The difference in the height of the liquid in the two arms depends on the density of the liquid and the force on it, not on the area of the liquid. L7 3 a P = 1000 kg/m3 × 9.81 N/kg × 0.5 m = 4905 Pa b h = P ÷ (ρ × g) = 4905 Pa ÷ (789 kg/m3 × 9.81 N/kg) = 0.63 m c h = 4905 Pa ÷ (13 590 kg/m3 × 9.81 N/kg) = 0.036 m (or 3.6 cm) L7 4 a A manometer filled with mercury could measure high gas pressures without the manometer having to be too big, as its density means that relatively small height differences are produced. © Pearson L6 b Water is not toxic (like mercury), and not flammable (like ethanol). Some students may add that it is also cheap and readily available, so the manometer does not have to be stored with the liquid in it. It would be better than mercury for measuring pressures that were not much above atmospheric pressure, as you could use a larger scale. 8Ic-7 Diving bells and depths L6 1 In a liquid the particles are all very close together and there is no space for them to get even closer, so the liquid cannot be compressed. In a gas the particles are all a long way from each other, so they can be pushed closer together when pressure is applied. L6 2 a It gets higher. b It would compress it, so the volume would get smaller. This would make the pressure of the air rise. L6 3 The compressed air presses back on the water, and stops the volume of air in the diving bell getting too small. The people in the diving bell also need a supply of oxygen or they would suffocate. L5–6 4 The bathyscaphe can go deeper as it does not rely on a supply of compressed air. If students have studied the work on decompression sickness, they may also point out that the crew would not need to decompress after using a bathyscaphe. An advantage of a diving bell could be that the scientists inside can be in direct contact with the water, whereas everything in a bathyscaphe would have to be controlled remotely. L6 5 a In both cases the pressure increases with an increase in fluid above (or students may describe this the other way round, and say that air pressure gets less as you move away from the surface and water pressure gets greater). The graph showing the change in pressure with depth in water is a straight line, which shows that the change in pressure for each metre change in depth is the same however deep you go. The graph for air is a curve, showing that the change in pressure for each metre change in height is less the higher you go. L7 b Water is not compressible, so the change in pressure with depth does not change as you get deeper. Air is compressible, so the air at the bottom of the atmosphere is more compressed than the air higher up, which contributes to the pressure. 8Ic-8 Barometers and altimeters L6 1 750 mm = 0.75 m pressure = 13 590 kg/m3 × 9.81 N/kg × 0.75 m = 99 988 Pa 527 8 I Fluids 8 I L6 2 height = 95 000 Pa ÷ (13 590 kg/m3 × 9.81 N/kg) = 0.713 m (or 713 mm) floats in water. It is more dense than air, so it will not float in air. L7 3 Reason 1: Water would freeze in the winter when the pressure dropped below freezing point. Mercury does not freeze at temperatures that normally occur in the UK. L5 7 The ship includes air spaces, so the overall density of the ship and the air inside it is less than the density of sea water. Reason 2: A barometer filled with water would have to be very tall to measure atmospheric pressure. For a pressure of 100 000 Pa, height = 100 000 Pa ÷ (9.81 N/kg × 1000 kg/m3) = 10.19 m. A 10 m high barometer would not fit in most houses or laboratories! L7 4 Temperatures in the Antarctic fall below the freezing point of mercury, so a liquid-filled barometer would have to use ethanol. This is even less dense than water, and so it would have to be even taller (the height of ethanol on a day where the air pressure was 100 000 would be 12.9 m). They would need a tall ladder to set up the barometer and read it. L5 5 Air pressure changes from day to day. The knob allows the pilot to adjust the altimeter for the pressure on a particular day so that the altimeter reads zero when the plane is on the ground. Also, not all airports are at sea level, so the knob allows the pilot to set the altimeter to read either height above sea level or height above the airport. L7 6 An aneroid barometer consists of a sealed container with most of the air removed. The box is slightly flexible, and part of its surface is connected to a pointer. The pressure of the atmosphere produces a force on the outside of the sealed box. If the air pressure changes, the box is compressed by different amounts and the movement moves the pointer against a scale. 8Id Floating and sinking Student Book 1: 8Id Floating and sinking L4 1 a weight and upthrust L5 b They are the same size when you are floating. L5 2 500 N L5 3 a weight (gravity) and upthrust b They are the same. L5 4 Find the weight of the object, then suspend it in water and find the weight again. The difference between the two weights is the upthrust. L5 5 Take pieces of different materials all of the same size and shape. Find the upthrust for each object. If the upthrust depends on the materials it will not be the same for all of them. L7 6 a Iron will float in mercury because it is less dense than mercury. 528 b Polystyrene is less dense than water, so it L6 8 For the balloon to fly it must be less dense overall than the air around it. Heating the air makes the particles move faster and take up more space. This makes the density of the hot air less than the air surrounding it. If the air inside the balloon is made even hotter, the particles move around faster and the air expands. This makes it less dense than it was and increases the upthrust. Activity Pack 8Id-1 Floating and sinking L4 1 a upthrust b weight L7 2 wood – float; iron – sink; polystyrene – float; ice – float; aluminium – sink L6–7 3 density, less, air, faster, more, less density, water 8Id-2 Factors affecting upthrust L6–7 4 Students should find that the upthrust depends only on the submerged volume of the solid. 8Id-3 Upthrust in different liquids L4 3 Students should find that the upthrust does depend on the liquid used. L4 4 Students should find that denser liquids produce more upthrust. 8Id-4 Floating questions L4 1 weight, upthrust L4 2 upthrust from the water L4 3 a iron weight b iron weight L4 4 a 11, 40, 6, 2 b wooden block L6 5 a wooden block b it does not weigh anything in water/its weight in air is the same as the upthrust 8Id-5 The Plimsoll line L4 1 They could carry more cargo and so make more money. L4 2 The ship might sink in a storm. L4 3 Paint a line on the side of the ship that showed when they must stop loading the ship. L6 4 Sea water is denser than fresh water, so it provides more upthrust. A ship loaded to the sea water line would float lower in the water if it sailed into fresh water. L6 5 The particles in warm water are moving around faster and take up more space. This makes the density of warm water less than cold water. © Pearson Fluids As the upthrust depends on the density, warm water produces less upthrust than cold water. L6 6 The water is warmer in the tropics than in the North Atlantic winter, so it is less dense, and fresh water is less dense than sea water. L6 7 The apple should float higher in the water, because the dissolved salt will make the water denser and so it will provide more upthrust. 8Id-6 Archimedes L4 1 a 8 N L5 b 3 N L6 c 3 N L5 d Upthrust is less than its weight. L4 2 a 1 N b1N L6 c 1 N L5 d Upthrust is equal to weight. L6 3 a Y, it has displaced the most water. b Y, X, Z. Y displaces most water, Z displaces least. L6 4 a It would sink lower/displace more water. L6 b 1 N L5 5 a An Archimedes screw is used for pumping water uphill. It can be used to pump water from rivers into irrigation channels at a higher level. L4–6 b The king thought the worker had stolen some of the gold provided for making a crown and mixed silver with the rest of the gold so there was enough to make the crown. Silver is not as dense as gold. Archimedes worked out the density of pure gold and compared it with the density of the crown. The densities were different, which showed that the man was stealing. 8Id-7 Submarine sums L5 1 a 8000 tonnes/8 000 000 kg b volume = mass/density = 8 000 000 kg/ 1030 kg/m3 = 7767 m3 (sea water has a density of 1030 kg/m3, which is more dense than fresh water at 1000 kg/m3). L5 2 a When it is on the surface, not all of the submarine is displacing water, but the whole volume of the submarine is displacing water when it is submerged. L6 b Density will be the same as the density of seawater – 1030 kg/m3. L6 c It is less than the submarine's density when it is submerged, and it is also less than the density of sea water. We cannot say how much less its density is than seawater unless we know how much of the submarine is below the water. L5 d Water has been blown out of/pumped out of ballast tanks to reduce the density. L6 3 a They displace some air. © Pearson L8 b When the air pressure is increased the air is denser, so the weight of air displaced by the sphere and the block increases. Because the sphere is much bigger than the block the difference in the upthrust between normal and increased pressure is greater, so it rises. L8 c The sphere will sink, because the reduction in upthrust due to the lower pressure (and hence lower density) is greater than for the block. 8Ie Drag Student Book 1: 8Ie Drag L4 1 the resistance force caused when an object is moving through a liquid or a gas L4 2 make the surface smoother, give the object a smooth shape, reduce the area of the object that faces the oncoming fluid L4 3 The large area gives them a large drag, so they will fall slowly and the crates will not be damaged when they land. L5 4 size – the naval submarine is much bigger than Alvin, which would give it a higher drag for a given speed; shape – the naval submarine is much smoother than Alvin, which would reduce the drag at the same speed; speed – the naval submarine is much faster than Alvin, so will have a higher drag when travelling at its top speed L5 5 a any two from: crouching down over the handlebars to make her shape smaller, wearing smooth clothing to give herself a smooth surface, wearing a specially shaped helmet to give herself a streamlined shape L7 b The backwards force on her is less. L5 6 a Particles transfer heat energy to the object when they hit it. L6 b Fewer particles are hitting the object each second, and they are not moving as fast when they hit, so the total force is less. L6 7 Students' own answers, but the adverts should explain the benefits of driving more slowly in terms of fuel economy. L7 8 a, L7 b any two from: increase power/ make engine bigger (increasing the amount of force produced by the engine increases the forwards force of the car), decrease drag/make car more streamlined (decreasing the drag force means more of the engine forces are used to move the car forward – increases the forwards force of the car), decrease weight of car (a lighter car uses less of the engine force to move at a steady speed – more forwards force gives a greater speed) L7 9 A boat has to move through water as well as through the air above it. Water is denser than air, 529 8 I Fluids 8 I so there will be more particles hitting the boat per second at the same speed and water resistance will be much higher than air resistance. the solid. In ice the opposite happens – the solid is less dense than the liquid and so the ice floats on water. 2: 8Ie Humans at the extremes L6–7 1 L6 The size of the balloon in the photo is due to a balance between the pressure inside it and outside it. L7 The lower density of ice is explained in terms of forces between oxygen and hydrogen atoms in the water. L6 As the balloon ascends the pressure of the air outside it will get less. L7 There are still the same number of particles inside the balloon so now the pressure inside the balloon is greater and the balloon expands. As it expands the pressure drops because the particles have further to go between each time they collide with the sides of the balloon so there are fewer impacts per second. The balloon carries on expanding until the pressure inside and outside is equal. This happens continuously as it gets higher and higher. L3 2 a solid – ice, human, immersion suit; liquid – water/the sea; gas – air L6 b solid – particles are held in fixed positions and only vibrate; liquid – particles can move around freely within the liquid and do not have a fixed arrangement; gas – particles can move around and the gas expands to fill its container L6 c solids: keep their shape and volume and are hard to compress – the particles are fixed in position with strong bonds; liquids: keep volume but not shape, are hard to compress, flow and take the shape of their container – the particles are in close position with less strong bonds which allow sliding movement; gases: change shape and volume, compressible, expand to take shape of their container – the particles are spaced far apart and move freely with only weak bonds between them L7 3 graph should show temperature increasing, levelling out then increasing again with labels for the three states describing the particles (solid – close and strongly bonded with not much movement; liquid – close with medium bonding and can move easily around each other; gas – far apart with weak bonds and moving freely) and labels for the two changes of state (melting – the energy supplied breaks strong bonds in the solid and water becomes liquid; boiling – the energy supplied breaks medium bonds in the liquid and water becomes gas) L5–7 4 L5 Objects float when they are less dense than the fluid they are floating in, and ice is less dense than water. Most solids are denser than their liquids. L6 Normally when an object melts the particles get further apart and so the liquid is less dense than 530 Activity Pack 8Ie-1 Drag L4 1 Helmet pointed at the back – streamlined shape Strong leg muscles – larger force to balance the drag forces Crouched down riding position – smaller area that meets the air in front Black painted bike – makes no difference to speed L5 2 a B bB L4 3 a US Navy submarine L4 b US Navy submarine L4 c US Navy submarine L5 d Alvin. It is smaller and slower, so it has two things that would help it to have a small drag and only one thing (its shape) that would give it a big drag. 8Ie-4 Diving experiments L5 1 a It would have been too dangerous to experiment on humans, as the experiments might have killed or permanently harmed them. b They needed to find out how the results from the experiments on goats applied to humans. L5 2 a & b Students' own opinions, including some justification of their opinion. L5 3 a Computers were not available when Haldane's team did their research. L6 b answers may vary, but may include: computer models are better because they do not involve animals suffering or possible harm to humans; to build a computer model, you need to know something about the thing you are modelling, so some other form of research is always necessary before a computer model can be made L5 4 a informed consent and the necessity for prior animal research L7 b Students' own opinions, including some justification. 8Ie-5 Word puzzle L4–5 1 upthrust 2 drag 3 pressure © Pearson Light 4 vibrate 5 sink 6 physical Speed (mph) Drag (N) 7 liquid 10 11 8 density 20 44 9 melting 30 99 10 solid 40 176 11 expand 50 275 12 freezing 60 397 13 fluid 70 540 8Ie-6 Fuel consumption L5 1 a correctly plotted and labelled graph b It makes it easier to see any trends or patterns in the results (or similar answer). 8 J 8Ie-7 Drag coefficients 1 (note that these resistive forces are only due to air resistance – cars have other resistive forces due to friction in the components) 2 correctly plotted and labelled graph L5 2 The engine force is needed to balance the forces of friction and air resistance, which are trying to slow the lorries down. 3 a The drag goes up by a factor of 4 is 4 times as large. L5 3 a They travel fewer miles per litre of fuel when their speed is higher. c Accept any reasonable answers, such as those below, or involving working out examples and comparing them. b Air resistance is greater when they are travelling faster, so a bigger engine force is needed to balance it, so the engine uses more fuel per mile, and travels fewer miles per litre of fuel. L4 4 a Daisy's lorry has a part on top of the cab that makes its shape smoother. L4 b The smoother shape will mean that Daisy's lorry has less drag than Fred's. L5 c Fred. It has a higher drag, so it will use more fuel at a certain speed, and go fewer miles per litre of fuel. L6 5 A good answer will include some or all of the following points: 50 mph is the average speed, so the lorry will have changed speed, so it will have used extra fuel when accelerating. It may have gone up hills, which would have used up extra fuel. There may have been a head wind, which would have increased the air resistance. Accept any other sensible suggestions. L5 6 a They should use less energy as friction will be less. More important is that less force (and hence fuel) will be needed to accelerate an empty lorry, but students are not expected to know this at this stage. b They should be able to travel further for each litre of fuel. c The additional line should be above the line originally plotted for lorry B. L4–6 7 answers could include: reducing the costs of buying fuels; making limited fossil fuel supplies last longer; reducing pollution; reducing the amount of CO2 put into the atmosphere, which might help to limit the effects of climate change © Pearson b It doubles. The equation for drag has V2 in it, so if the speed goes up ×2, the drag must go up ×4. The equation has A in it, so drag must be proportional to A so drag doubles if speed doubles. 4 As the vehicle moves through the air it hits air particles, which bounce off it. Each particle exerts a force when it hits, and the total force from all the particles is the drag force. 5 If the air is denser, there are more particles in a certain volume, so the vehicle will hit more particles per second as it moves through the air and the drag force will increase. 6 If the air density is less the drag force for a given speed will be less, as fewer particles will hit the vehicle each second. 7 a It will increase the drag. b increase 8J Light 8Ja Light on the move Student Book 1: 8Ja Seeing things L3 1 any four light sources, e.g. the Sun, light bulb, candle, TV screen L4 2 a Light can pass through it. b any three transparent materials, e.g. air, glass, water, clear acrylic block c any three opaque materials, e.g. wood, metal, brick 531 Light 8 J L4–5 3 Students may point out that: L4 the spotlights are a source of light; light travels in straight lines; the equipment is opaque and so stops light going through it, which creates shadows L4 e S L5 f S L4 2 absorbed – when light is taken into a material L5 light reflecting off the equipment will enter the performer's eyes and allow him to see the equipment transparent – a material that lets light pass through without scattering L4 4 a Some of the light from the spotlight is blocked by the performer. As light travels in straight lines, the shadow has the same shape as the opaque object that formed it. transmitted – when light passes through a material L4 b there is no light shining on it/we are not seeing light, we are detecting a place where there is no light L4–5 c Diagram should show a spotlight, performer and an eye, with arrows going from spotlight to performer and performer to eye. 2: 8Ja Light on the move L4 1 Light travels faster than sound, so if the light and sound are made at the same time, the light reaches us before the sound. L4–5 2 a sketch showing light going from the TV directly to eyes L5 b sketch showing light going from a light bulb (or other light source) to the book and then to eyes L4 3 a Z (it is letting most of the light pass through it, but the direction of the light is changed) b Y (it is reflecting or absorbing all the light that hits it: no light can pass through) L5 4 Students' own answers, e.g. Use the thread pulled tight to line up the three holes. Check that the candle can be seen when viewed through the holes. Show that the candle cannot be seen if it is moved out of this sight line or if one of the pieces of card is moved so that the holes no longer line up. L5 5 Sound can pass through the materials that the door/wall is made of, but light cannot. L5 6 The pinhole camera has a very small hole to let light in. Because light rays travel in straight lines, the light rays that come from the bottom of the object can only reach the top of the screen in the camera, and light from the top of the object can only reach the bottom of the screen. (Similarly, light from the left-hand side of the picture will only reach the right-hand side of the screen and light from the right-hand side of the picture will only reach the lefthand side of the screen. The image is fully inverted.) Activity Pack 8Ja-1 Light on the move L4 1 a L L5 b S L5 c L L5 d L 532 translucent – a material that scatters the light passing through it reflected – when light bounces off a material opaque – a material that light cannot pass through L4 3 a rays shown reflecting from material b rays shown going straight through material c rays shown going through material but being scattered L5 4 a correctly labelled diagram L6 b Draw two lines from the light bulb through the pinhole and onto the screen – one from the top of the bulb, one from the bottom. Clearly showing why the image is inverted. 8Ja-2 Reflecting light L4 4 a One factor that is difficult to control is the light from the room falling on the materials (for example, they may be shadowed sometimes slightly by students moving around). b A possible suggestion is to carry out the test inside a dark box. By using switches that are outside the box, it should be possible to obtain results without interference. 8Ja-3 Pinhole cameras L4 4 The image formed by a bright light is brighter than one formed by a dim light, because more light enters the camera/there is more light to form the image. L6 5 A larger hole produces a brighter image, but the image becomes more blurred as the hole is made larger. The ray diagram should show how light from the top (or bottom) of the bulb can take more than one path through a wider hole. L6 6 There are the same number of images as there are holes. Ray diagram showing rays of light from the bulb going through each hole to form separate images. 8Ja-4 At the cinema 1 L3 1 torch, projector L4 2 sound cannot travel through empty space L4 3 a reflects b opaque, shadow L4–5 4 arrow from torch to sweets, and from sweets to eye © Pearson Light L4 5 Light travels faster than sound. 8Ja-5 Light and space L4–5 1a & b Copy of diagram from worksheet, with one ray from the Sun to the Earth, and one from the Sun to the Moon, which then reflects towards the Earth. Rays should include arrows to show the direction of travel away from the Sun. L4 2 4 years L5 3 a 5 × 8.5 minutes = 42.5 minutes b 1.5 × 8.5 minutes = 12.75, so 13 minutes to the nearest minute. L5 4 8.5 minutes (or between 8 and 9 minutes). On average, the Moon is the same distance from the Sun as the Earth. L5 5 a 300 000 km/s × 8.5 × 60 = 153 000 000 km b 300 000 km/s × 1.3 s = 390 000 km c 4 years = 4 × 365 × 24 × 60 × 60 = 126 144 000 s distance = 300 000 km/s × 126 144 000 s = 37 843 200 000 000 km L5 6 time = 58 000 000 km/300 000 km/s = 193 s 8Ja-6 At the cinema 2 L4 1 a Sound cannot travel through a vacuum/ empty space. L4 b see the flames first, because light travels faster than sound L4–5 c Sound travels via longitudinal waves and light travels via transverse waves; sound is transmitted through any solid object, but light is only transmitted through transparent or translucent objects. L4 2 It should be good at reflecting light, so as much as possible of the light from the projector reaches the audience. L5 3 Diagram showing light going from the projector to the screen and then reflecting to the eye. Arrows showing the direction of travel. L5 4 The screen is reflecting light into the cinema, sufficient for the person to see their seat. Sketch to show this. L4 5 The seats are opaque, so they will absorb/ block light reflected from the screen. L5 6 Some of the light is reflected by specks of dust in the air. 8Ja-7 Shadows L5 1 Copy of diagram from worksheet, with two rays coming through the hole in the card, passing each side of the object and extending to the screen. Area of the screen between these lines is labelled as the shadow. An explanation that no light reaches that part because the object is opaque and absorbs light. © Pearson L5 2 a The shadow will be bigger. Diagram similar to above, with the object closer to the light source. b The shadow will be bigger. Diagram similar to above, with the screen further from the light source. L6 3 a On the diagram, the central area on the screen between the two parallel rays of light. b The areas on the screen outside of the angled rays. c The areas between the parallel rays and the angled rays. (So, from top to bottom of the diagram the different sections should be labelled b, c, a, c, b.) L6 4 A large source (hole) produces a shadow with blurred edges because light from the source can go past the edge of the object in several directions. This means that light from the source is only completely blocked in part of the shadow. The blurred edges are formed when light from part of the source, but not all of it, reaches some parts of the screen. A small source produces a sharp-edged shadow because the light only goes past the edge in one direction. 8Jb Reflection Student Book 1: 8Jb Drawings and conventions L4 1 A ray box makes it easier to investigate the behaviour of light. The box produces a narrow beam or beams of light that can be marked on paper. This makes it easier follow and measure the paths of light rays. L5 2 Most of the light in the ray is going along the ray and you only see this if you look directly into the ray box (which is not good for your eyes!). Some of the light hits the paper and is reflected: you see the part of this light that is reflected towards your eyes. L4 3 The angle of reflection is the same/almost the same as the angle of incidence. Students may suggest that more accurate results would be needed to confirm this conclusion. L4 4 so that all scientists can understand diagrams L5 5 If the ray is narrower it is easier to mark the middle and more precise measurements can be obtained. A brighter beam is easier to see, which may also help accuracy when looking at the beam a long way from the source. 2: 8Jb Reflection L4 1 metal, the reflecting part of a mirror is made of metal L5 2 20 ° 533 8 J Light 8 J L5 3 light is not reflected from the paper evenly/ reflection from the paper is diffuse/not specular 2 L5 4 Polishing makes the surface smoother, so light is more likely to be reflected evenly/less likely to be scattered. L5 5 The image is the same distance behind the mirror as you are in front, so you are 4 m (2 m + 2 m) from the mirror. L6 6 they are showing where the light seems to have come from/they are not representing real rays of light L5 7 a specular reflection – you can see images in the water, so the angles of incidence and reflection must be the same/you must be seeing the results of specular reflection b A ray of light from the sky is reflected from the vehicle and then reflected from the lake. The angles of incidence and reflection should be the same where the light is reflected from the water. c the wind will make ripples on the water/ make the surface of the water rough, so the reflection will be diffuse/will not be specular/ the angles of incidence and reflection will not be the same Activity Pack 8Jb-1 Reflection L5 1 reflect, reflection, incidence, scatter L5 2 a diffuse b specular c diffuse d diffuse L5 3 a correctly labelled diagram b the same size 8Jb-4 Investigating curved mirrors L6 1 Diagram should resemble the one on the left of the worksheet, with rays drawn accurately (i = r) for each section of plane mirror on the 'model'. L6 2 Pair of diagrams similar to those on the worksheet, showing convex mirrors, with rays drawn accurately on the 'model'. 8Jb-5 Ray diagrams for mirrors 1 8Jb-6 Mirrors and reflections 1 L5 1 the same size L5 2 90 ° L5 3 a Ray reflects off the first mirror vertically downwards, where it reflects off the second mirror horizontally towards the eye. b Arrowheads show direction of travel towards the eye. L5 4 correctly labelled diagram L5 5 A mirror reflects light evenly/specular reflection (the angles of incidence and reflection are the same). When paper reflects light it is scattered in all directions/diffuse reflection. 8Jb-7 Mirrors and reflections 2 L5 1 a Ray reflects off the first mirror vertically downwards, where it reflects off the second mirror horizontally towards the eye. b arrowheads show direction of travel towards the eye c Two mirrors are needed to change the direction of the light ray twice so it can reach the eye and also not be inverted. L5 2 a The rays are transmitted directly through the glass to the eye. b Light from the candle reflects off the glass surface into the eye. The eye sees a virtual image of the candle the same distance behind the glass, which happens to be the same distance as the bottle. In addition, candle light is also transmitted directly through the glass onto the bottle. 534 © Pearson Light c A mirror would not allow light to be transmitted. Glass partially reflects and partially transmits the light. 8Jc Refraction d To exclude all other light sources as the candlelight is not very bright. 1: 8Jc Refraction L5 1 a to give a sharp image b to make distant things look closer L5 3 a If the hidden room was lit up, reflections of the hidden room would also be visible on the glass. 8 J Student Book c to make small things look bigger L5 b The spotlight shines on the actor. Rays of light reflected by the actor are then reflected by the glass and appear to the audience to be coming from the part of the stage they can see. L6 2 the bending/change in direction of light as it passes from one medium to another L5–6 c answers could include: the difficulty of setting a large sheet of glass across a stage and hiding the joins from the audience; avoiding unwanted reflections in the sheet of glass; the difficulty of the actor playing the ghost whilst inverted so moving/looking in the correct direction to interface with 'normal' actors on the main part of the stage L5 4 Students' own answers, e.g. Put the block on a piece of paper and draw around it. Shine a ray of light at it, and mark the incident ray, where it enters the block and where it leaves the block. Remove the block from the paper and use a ruler to join the marks to show where the light went. Draw a normal at the point the light entered the block, and measure the angles of the light ray from the normal. 8Jb-8 Periscopes L5 1 Rays of light reflected by the top of the tree are above rays of light reflected by the bottom of the tree when they reach the eye since they have been reflected in two mirrors. L5 2 We only need to use two rays – one from the top, one from the bottom – to show the range of rays coming from the object. L5 3 Diagram showing a close and distant tree with light rays from the top and bottom of each showing that the two rays of light from the closer object make a larger angle when they reach the eye. L6 4 a Diagram with the image of the tree as far above the top mirror as the object is to its left. b Diagram with the image of the tree level with the bottom mirror and to the left of the position of the original by the vertical length of the periscope. L6 5 a The image you see in the bottom mirror is an image of the image in the top mirror. The distance of the final image is the distance the light has travelled from the real tree, so it is the distance of the tree plus the length of the periscope. b If the periscope has a longer tube, the light from the object has to travel further before reaching the final mirror. L4 6 In tanks, they allow the crew to see outside while still remaining protected by the tank. In submarines they allow the crew to look around without the submarine coming to the surface, which will make it less likely that the submarine will be detected by enemies. L6 7 If a submarine is underwater, the periscope may need a very long tube. The submarine might also be looking for distant ships. Both these factors will make the image very small, so lenses are needed to magnify it. © Pearson L5–6 3 a, b, c ray diagram with normal, angle of incidence and angle of refraction correctly marked L6 5 Rays of light reflected by the object bend away from the normal as they leave the water. The rays of light appear to be coming from a place above the bottom of the water, so the water looks shallower than it really is. L6 6 thicker/fatter in the middle than at the edges L6 7 a They would converge to a point closer to the lens (include a diagram similar to diagram E, but the prisms should have more steeply sloping sides). b shorter L6 8 A converging lens bends the light so that it comes together, so it can be used to make diverging rays parallel if a lens with suitable curvature/strength is used (include a diagram showing this). Activity Pack 8Jc-1 Refraction L6 1 labels from top left going clockwise: ray, refraction, normal, towards, away from, glass, light ray, refraction L6 2 Light rays are refracted as they pass through the lens and meet at the focal point. L6 3 refraction 8Jc-2 Investigating refraction 1 L4 1 labels from top left going clockwise: air, glass, ray box, normal L4 2 glass, light, draw, move, ray, block, ruler, angle L4 3 towards, away from, parallel 8Jc-5 Refraction questions L6 1 Angles labelled correctly, with angle of incidence within the block above the normal, and the angle of refraction outside the block. 535 Light 8 J L6 2 a towards the normal b away from the normal L6 3 8Jc-7 Prisms and fibres L6 1 a Total internal reflection is when light is fully reflected inside a piece of glass or other transparent material as the angle of incidence is larger than the critical angle. b Optical fibres, prisms used in binoculars, telescopes and cameras. L6 2 Refraction is the changing in direction of light, reflection is when light rays bounce off a surface. L6 3 a They are lighter and more compact so are easier to carry and use. b It doesn't make much difference if the image of a star or a planet is upside down. L6 4 Optical fibres can bend to fit inside various tubes in the bodies. Periscopes are rigid. L7 5 a The ray is internally reflected by the first interface, so it turns 90 ° downwards. It exits the prism at the bottom interface without any refraction. 8Jc-6 Fresnel lenses L5 1 They would not be big enough to give a bright enough beam of light to be seen from long distances out at sea. L5 2 to concentrate the beam so that it is visible from further away L5 3 a It is lighter and so easier to put into the lighthouse. It is also easier to rotate than a heavy single lens would be. b It is more complicated to make, which means it will cost more. L5 4 a It helps them to see an area behind the car that is normally not visible, so they can make sure that they do not reverse into anything. b It is thin and made from plastic, so it does not stick out and it is easier to mount. c The quality of the view is not as good as a converging lens. This does not matter so much for parking as long as the driver can see a car or other obstacle behind, but it does matter for cameras. L5 5 The lens shown magnifies a larger area than the magnifying glass. Being made of plastic, it is less likely to get broken, and is lighter. No real disadvantages. L5 6 Advantages – the same focusing power can be obtained with a thinner, lighter lens than if a glass lens is used. No real disadvantages. L6 7 The sharp edges within the lens will cause distortion and so they may not give clear pictures. Diagram could show part of a Fresnel lens with a ray of light going through one of the flat surfaces joining two curved sections. 536 b The ray is internally reflected by the first interface, so it turns 90 ° downwards. At the next interface the ray is again internally reflected so will turn 90 ° to the left. At the third interface it exits the prism without any refraction and will travel parallel to the original direction. L7 6 a Some angles at where the light is hitting the interface are less than the critical angle, so total internal reflection would not occur. Therefore, the reflective coating makes sure the light is only reflected. b With a triangular prism the image in the viewfinder would be upside down. c They would take up more space inside the camera, and the arrangement shown would not turn the light through 90 °, which is needed in the camera. 8Jd Cameras and eyes Student Book 1: 8Jd Cameras and eyes L5 1 a lens b sensor L6 2 a any two from: has a hole for light to enter, image is formed at the opposite end, image is upside down/inverted b any three from: digital camera has a lens, digital camera has a larger hole/aperture, digital camera has a shutter, digital camera makes a record of the image, pinhole camera has no moving parts, pinhole camera doesn't need electricity L6 3 a pupil b retina © Pearson Light L6 4 In a camera the focusing is done by moving the lens closer to or further away from the sensor. In the eye, focusing is achieved by changing the shape of the lens. L4 5 a red, green, blue b red and blue make magenta, red and L6 green make yellow, blue and green make cyan L6 6 a rods, cones b Rods detect faint light levels, but cannot tell the difference between different colours. There are three types of cones, each one detects a different colour. L6 7 a The photo with the large pupil is an eye in dim light (if the light is dim the pupil needs to be large to let a lot of light into the eye). b If the light is too bright it might damage the retina, so the pupil gets smaller in brighter light. L6 8 Students' own answers (either opinion is justified, but should be backed up with reasons); reasons for it being a good model: light enters through a lens, which focuses the light to form an image; reasons for it being a bad model: focusing in the eye is done by changing the shape of the lens (in a camera it is done by moving the location of the lens) 2: 8Jd Preparing a presentation L5–6 1 any three from: it summarises the information/has a clear heading, it uses a graphic/ diagram/table to compare the types of camera, it is easier to read because of the plain background, the text is in large and clear font, there is not too much text L4 2 show the picture separately L4–5 3 a Students' own answers, e.g. you only have one pair of eyes have eyes tested every year do not stare at a computer screen for too long never look directly at the Sun use good-quality sunglasses, even in winter keep contact lenses clean do not wear contact lenses while swimming b Students' own answers; key points should be grouped sensibly and presented as bullet points; students may add small images to add interest to the visual aids c Students' own answers L4 4 Students' own answers © Pearson Activity Pack 8Jd-1 Cameras and eyes L5 1 A I P E L R M P S U S E O E E O P H N D M R P I U S S O T T L T I C R U I U T R E Y R C C E I C C E N O R S O A S E N S O R R C R E O C N D L V S E R E E R E T I N A U M U S C L E S 8Jd-2 Combining colours L6 1 The one with red, green and blue. These are the three primary colours, and our eyes see a mixture of these as white light. L6 2 V: yellow (red: green) W: white (red: green: blue) X: white (red: orange: yellow: green: blue: indigo: violet) Y: magenta (red: blue) Z: pale red (magenta: yellow) Predictions may vary, but should be based on the colour combinations shown in the diagram on the worksheet. 8Jd-3 Light true or false L5 1 True L5 2 False, 90 ° L5 3 True

L5 4 False, angle of reflection L5 5 True L5 6 False L6 7 False, towards the normal L6 8 True L5 9 False, refraction L5 10 True 8Jd-5 Using lenses L5 1 A: Another ray drawn from the top of the flame passing through the hole to the screen. The image the same size as the flame but will be inverted. B: Another two rays drawn from the top of the flame
passing by the two edges of the hole to meet the screen. The image will be larger than the flame, inverted and blurred. 537 8 J Light 8 J L5 2 Second set of rays drawn from the bottom of the flame passing through the lens and converging on one point on the screen. The image would be inverted but sharp. L5 3 a Rays of light from the top of the flame
cross rays of light from the bottom as they pass through the pinhole (or similar explanation). b The hole is bigger, so more light can get into the camera. c In A, rays of light from one part of the flame can only reach one part of the screen. In B, rays of light from one part of the flame can reach more than one place/an area of screen. L5 4 Cameras need
to let in plenty of light so the sensors/film can form an image. Without a lens this would cause the image to be blurred. A lens allows the image to be both bright and sharp. L6 5 Light enters the eye through the pupil, which is larger than a pinhole. The lens helps to focus the light to form a sharp image on the retina. 8Jd-7 Seeing things L5 1 A and I:
lens B aperture C sensor D shutter E optic nerve F retina G iris H pupil J cornea L6 2 a H – pupil b I – lens (accept J – cornea) c C – sensor d F – retina e E – optic nerve L6 3 The iris makes the pupil large if the light is dim. The iris makes the pupil small if the light is bright. 8Jd-8 Taking photographs L6 1 a The one taken at f8 will be the brightest, as
this is a larger aperture so more light can enter the camera while the shutter is open. b She should make the shutter speed slower. L6 2 a Larger apertures give smaller depths of field, which means that not everything in the image will be in focus. This will allow the photographer to blur the background. b The photographer needs a certain amount of
light to hit the sensor. A large aperture could let in too much light, so the shutter speed 538 needs to be fast to limit the amount of light. (Some may answer that fast shutter speeds may be necessary due to the fast movements/reaction times of insects.) L6 3 A fast shutter speed can give a sharp picture of the fast-moving racing car. If the shutter is
open for a longer time the movement of the car will give a blurred image. L6 4 a The iris changes the size of the pupil. b This is similar to using the aperture to control the light entering the camera. c In a camera the shutter speed can also be used to control the amount of light. Eyes do not have an equivalent of the shutter. L6 5 In the eye, refraction
occurs as light passes through the cornea and through the lens. In a camera refraction happens only in the lens. L6 6 In eyes, the shape of the lens is changed by muscles. In a camera, the shape of the lens does not change, but the distance from the lens to the sensor is adjusted. L7 7 The shutter can be kept open for a long time, so the sensor can
collect more light to form the image. L7 8 Red, blue and green. These are the three primary colours of light and are the same as the colours detected by the cones in human eyes. Any image formed using only these three colours can be seen as all colours. 8Jd-9 Eyes and spectacles L6 1 the shape of the lens L6 2 a close things L6 b distant things L6 c
When you look at distant things, the lens bends light too much so it focuses in front of the retina (because the lens is too strong or the eyeball too long). L6 d diverging lenses L7 e They make the light spread out before it reaches your eye, so that it has further to bend back to be in focus (or equivalent explanation). L6 3 a distant things L6 b close
things L6 c When you look at close things, the lens does not bend the light enough to focus on the retina (it would focus behind the retina if the retina was transparent). This happens because the lens is not strong enough or the eyeball is too short. Diagram showing this. L6 d converging lenses L7 e They would make the light start to converge before
it reached your eye, so not as much convergence was needed from the lens in the eye. © Pearson Light 8Je Colour Student Book 1: 8Je Colour L4 1 red, orange, yellow, green, blue, indigo, violet L5 2 raindrops in the air refract sunlight/split up sunlight L6 3 a He would have seen green light again (as there was only green light entering the prism, the
prism could not spread it out any more). b They might have expected to see another spectrum, if they believed that the prism was giving colour to light. L6 4 a blue b all the other colours (red, orange, yellow, green, indigo, violet) L5 5 a cornea, iris, pupil, lens, retina, muscles, optic nerve L6 b cornea – lets light into the eye, iris – controls the size of
the pupil, pupil – is a hole through which light enters the eye, lens – focuses the light, retina – converts the energy transferred by light into nerve impulse, optic nerve – carries nerve impulses to the brain, muscles – control the shape of the lens, for focusing on objects at different distances Activity Pack 8Je-1 Colour L5 1 a Diagram coloured correctly
with red at the top and colours in order (red, orange, yellow, green, blue, indigo, violet. L6 5 It transmits the blue light and absorbs all the other colours. L7 6 trousers – all the colours; sleeves – red; body – none (absorbs all colours); hat – blue iii spectrum L7 7 a The red sleeves are reflecting the red light shining on them. The white trousers can
reflect all colours, but there is only red light shining on them so they only reflect red light. b The body absorbs all colours, so it looks black. The blue hat can reflect blue light, but there is no blue light shining on it so it cannot reflect any light and looks black. 2: 8Je Invisibility cloaks L5 1 a Light from the Sun is reflected by the grass and some of it
reaches our eyes. (Or the same explanation in terms of light being reflected by the photo of grass in the book!) L6 b White light contains all the colours of the spectrum. The brown grass reflects light that mixes to make brown and absorbs the other colours. L5 2 A mirror reflects light evenly, so that the angle of reflection is equal to the angle of
incidence (a mirror produces specular reflection), whereas the light reflected by the grass is reflected in all directions (diffuse reflection). A mirror reflects all the frequencies in white light, the grass only reflects the green light. L6 3 a refraction b when light goes from one transparent medium to another L5 4 a lens, aperture, shutter, sensor, memory
card b lens – focuses light, aperture – controls the amount of light that enters the eye, shutter – protects the sensor when a photo is not being taken, sensor – converts energy transmitted by light into electrical signals, memory card – records the image © Pearson b i white light ii prism L5 2 The spectrum on the left of the filter coloured in order (red to
violet from top to bottom), arrow to right of filter and filter both coloured yellow. L4 3 a clothes coloured according to descriptions L6–7 b cap and shirt coloured red, trousers coloured black 8Je-2 Splitting light L4 2 a yes b yes L4 3 Yes, a spectrum is only produced when light enters the prism at certain angles. L4 4 a red, orange, yellow, green, blue,
indigo, violet b red c violet 8Je-3 Rainbows and glories L6 1 The rainbow is 42 ° above the point opposite the Sun (the antisolar point). When the Sun is high in the sky this point will be in a downwards direction and a rainbow may not form at all. When the Sun is low in the sky (in the morning or evening), this point is fairly near the horizon, and so a
rainbow might be quite high in the sky. L5–6 2 Light rays are reflected back from the Sun by water droplets, and would appear to an observer to be coming from inside the rainbow. 8Je-4 Colour questions L5 1 white, prism, spectrum, dispersion, seven L4–5 2 filter, transmits, absorbs, orange 539 8 J Energy transfers 8 K L5 3 a blue b red, black c
black, green d black e black, black 8Je-5 All cats look grey … L6 1 a retina b They detect the three different colours. c Rod cells can detect fainter light than cone cells, but do not detect different colours. Cone cells need brighter light before they can detect it, and each type of cone cell detects light of only one colour. L6 2 The trousers look black
because they absorb all the colours in white light and do not reflect any of it. The white T-shirt reflects all the colours. The blue coat only reflects blue light and absorbs all the other colours. L7 3 a They do not reflect any light, so the colour of light falling on them does not affect their appearance. L6 b Her T-shirt will look orange, as it can reflect all
colours but there is only orange light falling on it. Her coat will look black, as it is not reflecting any light (it will only reflect blue, but there is no blue light falling on it). (In practice, the orange light from streetlights is not usually bright enough to make a white object truly appear orange.) L6 4 The light would not spread out as far if the pole was
shorter, so more streetlights would be needed. L5 5 a The light comes from the Sun and is reflected by the Moon. L7 b Moonlight reflected from coloured objects is not bright enough for our cone cells to detect. We are detecting things by the rod cells, which do not differentiate between different colours. L7 c A black cat will always look black, as it
absorbs all the colours of light that fall on it. L6 6 Coloured filters are used. These transmit one colour of light and absorb the rest. L6 7 a A red light will make a white costume look red, because the costume will reflect the red light falling on it. b Red and green lights both need to be shone on the costume. It will reflect both colours, and our eyes will
detect the mixture of the two colours as yellow. 8Je-6 Blue skies and sunsets L5 1 a Some sunlight must be scattered to allow it to hit objects in the shadow and be reflected into your eyes. Without this scattered light, objects not in direct sunlight on a sunny day could not be seen. 540 L6 b Objects in a shadow do not appear to change colour (they only
look darker), so all the colours in the white light from the Sun must be scattered. L7 c Blue light is scattered more than the other colours. L6 2 They must be scattering all the wavelengths by about the same amount, as our eyes see the combination of all the colours as white. L7 3 The light from the Sun has to travel through more atmosphere to reach
person B than person A. The Sun would appear to be low in the sky/setting to person B. So there is more chance for the blue light to be scattered and less of it would reach our eyes. White light without the blue frequencies will appear more red. (Some students could add that green may also be scattered more than red, as its frequency is closer to the
frequency of blue light.) L6 4 If blue light is scattered more than colours with longer wavelengths, you might expect violet (with an even shorter wavelength than blue) to be scattered more as well. (The reason the sky does not appear violet is partly because of some of the violet light being absorbed by the atmosphere, and partly to do with the relative
sensitivities of the different cones in the human eye – but this is beyond the scope of this worksheet.) L5 5 a from the Sun, as the only source of light in the Solar System L6 b As the Moon is in the shadow of the Earth, light from the Sun cannot reach it directly so the path of the light must have been bent. This cannot be due to the solid Earth, so must
happen in the atmosphere. L7 c Blue light is scattered by the atmosphere, so not much of it will get through. As the blue component of white light is missing (and possibly other colours as well) the light that does get through appears red. L6 6 The red colour of the Martian sky is due to clouds of red dust in the atmosphere. 8K Energy transfers 8Ka
Temperature changes Student Book 1: 8Ka Living in extremes L4 1 a any four from: light/radiation, heat/ thermal, sound/waves, electricity, magnetism, forces/movement L4 b any four from: thermal, gravitational potential, elastic potential/strain, chemical, nuclear/ atomic © Pearson Energy transfers L6 2 a Solids keep their shape and volume and are
incompressible because the particles are held close together by strong forces. Liquids keep their volume because the particles are close together but the bonds between them are not strong enough for the liquid to keep its shape. Gases do not have a fixed shape or volume because the particles are far apart with only very weak forces between them.
L6 b When energy is transferred to a substance the particles in that substance move more (they vibrate more about their fixed positions in a solid, and move around faster in fluids). When energy is transferred out of a substance, the particles move less. L6 c In melting and evaporation/boiling the particles gain enough energy to escape from their
current state. In freezing/condensation the particles lose energy and become more firmly bonded together. L6–7 3 L6 Evaporation can happen at any temperature. Boiling is when a liquid is evaporating as fast as it can, and the temperature of the liquid will stay the same while this is happening even if energy is still being supplied. L7 Students
working at a higher level might also point out that evaporation happens at the surface of a liquid, whereas in boiling the gas can form within the liquid. 2: 8Ka Temperature changes L4 1 a Internal energy is a store of energy; temperature is a description of how hot or cold something is. L4 b Energy is measured in joules/J, temperature in degrees
Celsius/°C. L6 2 The material in each spark has a very low mass, so each spark does not have much energy stored in it. L6 3 a the kettle L6 b the water in the kettle; both containers have the same material at the same temperature, but there is a greater mass of water in the kettle L6 c More energy needs to be transferred to it because there is a
greater mass of water to be heated. L5 4 a from the drinks to the room, because the drinks are hotter than the air in the room L5 b –5 °C/the same as the air temperature, because energy will continue to be transferred from the drink to the room while the drink is hotter than the air L5 5 a 37 °C/the same temperature as your body, as it has come from
your body L7 b Some of the liquid in the sweat evaporates. The particles that escape to form a gas © Pearson are the ones with the most energy/highest speeds, so the liquid left is cooler than it was. Energy can be transferred from your body to the cooler liquid. L7 6 Some of the water will evaporate, leaving the rest of it cooler than before. Energy is
then transferred from the warmer air to the cooler water. Students working at a higher level may also add that spraying the water in the air via a fountain helps the water to evaporate as it provides a greater surface area from which evaporation can occur. L4 7 It might be colder than the coldest measurement in other parts of the Earth where there
are no thermometers to measure it. The coldest temperature may have occurred before measurements were started. 3: 8Ka Choosing language L7 1 a C was written for the consumer magazine and B was written for nursing students. L7 b C contains fewer technical words and it is longer. L5 2 a answers may vary, but are likely to include three from:
diagnosis, therapeutic measures, tympanic membrane thermometers, infrared radiation, orally, pulmonary artery, invasive L5 b Ear thermometers detect heat given off by the eardrum. L5 3 advantages and disadvantages of the different types of thermometer L6 4 Students' own answers, e.g. The 'true' temperature of a patient can be measured using
a tube put into a blood vessel, but it is not usually necessary to cut into a patient just to measure their temperature. Activity Pack 8Ka-1 Temperature changes L4 1 joules (J) – the units for measuring energy degrees Celsius – the units for measuring temperature temperature – how hot or cold something is internal energy – another name for thermal
energy L6 2 a tank b kettle c tank L5 3 the correct words are cooler, lemonade, air, up, down L5 4 any temperature, its boiling point, evaporates, cooler 8Ka-2 Sweating and cooling 1 L5 4 The one wrapped in wet paper should have cooled the fastest. L5 6 Sweating can help us cool down. L5 7 As a control, so that the presence of the towel itself can
be ignored. 541 8 K Energy transfers 8 K L5 8 If it was wetted with cold water, energy would have been transferred from the hot water in the bottle to the cold water in the towel, so it would have produced some cooling without any evaporation. 8Ka-4 Outdoor survival L4–7 1 and 2 Possible answers: hypothermia – an illness/ condition resulting from
the body getting too cold, it can be fatal; manifests – shows itself; heart rate – pulse rate, how fast the heart beats; respiratory rates – how fast someone is breathing; muscle coordination – being in control of muscles; irrationally – not sensibly/logically; paradoxical undressing – when victims take their clothes off even though they are cold; terminal
burrowing – trying to hide/get into small spaces overexertion – being too energetic; over-cooling – getting too cold; evaporative cooling – cooling down when sweat dries up/evaporates; breathable waterproofs – clothing that allows water vapour out but does not let rain in; wicking clothing – clothing that draws sweat away 3 Possible answer.
Hypothermia happens when your body gets too cold. It can be fatal. If you are suffering from hypothermia your pulse will be slow and you might also be breathing very slowly. Your skin may look blue and you may start to act in strange ways. People with severe hypothermia sometimes take their clothes off, even though they are cold, and may also try
to 'burrow' into small places. 8Ka-6 Relative humidity L5 1 The amount of water vapour in the air compared to the maximum amount it can 'hold'. L5 2 30% – the air has a lower relative humidity, so sweat will evaporate more easily and you would keep cooler. L6–7 3 The air has some water vapour in it. Cold air can hold less water vapour than warm
air. As the temperature drops at night, the air might cool below the point at which it can hold all the water vapour in it. If this happens, the excess water vapour condenses as dew. L6 4 a Water from the wet cloth around the wet bulb thermometer will evaporate. As it does, it will absorb some energy from the thermometer, so the thermometer will get
colder. L6 b It will read less when the air is less humid, as a low humidity makes evaporation easier, so more water from the cloth is likely to evaporate, giving a greater cooling effect. L6 c You need to compare the wet bulb thermometer with the actual air temperature so you know how much cooling effect the evaporation has caused. 8Ka-7
Breathable waterproofs L4 1 a It evaporates. L6 b The sweat absorbs energy as it turns from a liquid to a gas. L4 2 a It bounces off and does not go through. L4 b Your body is warm and transfers heat energy to it. Avoid hypothermia by keeping warm and dry. L4 c raincoat wear a breathable raincoat – this allow water vapour out so that sweat does
not build up and make your coat wet inside L4 d It condenses. wicking underwear helps to move the sweat away and helps it to dry up don't walk too fast and get too sweaty shelter from the wind. 8Ka-5 Energy and temperature L4 1 a joules L4 b degrees Celsius L3 c thermometer L6 2 a large bowl, it has the greatest mass L5 e The jacket is colder
than the sweat vapour, and energy is transferred from the sweat vapour to the jacket. L5 3 If the water comes in contact with your skin again it will absorb energy from your body, particularly if it evaporates again. L4 4 The vapour from sweat has to be able to get out. L5 5 a It prevents rain/liquid water from getting through the outer layer, but it also
allows water vapour out, so that sweat does not condense on the inside of the jacket. L6 b soup at 80 °C, it has the highest temperature L5 b There is no water inside the jacket to absorb energy from the skin. L5 3 a Out of the soup as it is hotter than the air. L5 6 The wicking clothing spreads the sweat out so there is not too much sweat vapour to go
through the jacket in any one place. L5 b Into the ice cream as it is colder than the air. L5 4 evaporation 542 8Ka-8 Absolute zero L8 1 The mean speed of the particles. © Pearson Energy transfers L7 2 0 K is when particles stop moving, and you cannot have less movement than that. L4 3 a It was more convenient at very low temperatures. L4 b He
published a scientific paper. L6 4 a 273 K (actually 273.15 K) L6 b degrees K = degrees C + 273 L5–6 5 Scientists were used to the amount of change represented by one degree. The same thermometers could still be used for many things – you just had to adjust the number if recording the temperature in Kelvin. 8Kb Transferring energy Student
Book 1: 8Kb Transferring energy L6 1 any three from: no medium required, can go through transparent substances, can be focused, can be reflected L6 2 mug of hot water, because the hotter the object the more infrared radiation it emits L5 3 a so that heat from the cooker is conducted to the food quickly L5 b so that heat from the saucepan is not
conducted to the user's hands L6 4 Heating an object makes the particles vibrate more. The vibrating particles make the particles near them vibrate more as well, so the vibrations are passed through the object. L6 5 Their particles are in a close, regular arrangement which makes it easy for vibrations to be passed on. L4 6 a by conduction through
the metal radiator L5 b by a convection current L5 7 a It is more dense. L6 b diagram of an ice lolly with arrows going downwards next to the lolly L6 8 There are no particles to pass on vibrations or to move. L6 9 radiation; there is air between the hot element and the food, and air is a very poor conductor so not much energy will reach the food this
way; convection currents are not likely to form as the air in the oven will be hottest near the top and so will tend to stay at the top of the oven Activity Pack 8Kb-1 Transferring energy L5 1 a radiation L4 b conduction L5 c radiation and conduction L4 d convection © Pearson 8 K L4 e conduction L4 f convection L4 g conduction and convection L4 h
convection L5 2 a and b H and D near the heater L6 c circular currents indicated, moving up near the heater and down at the opposite end of the tank L5 d a convection current 8Kb-4 Explaining conduction and convection L7 2 diagram with statements correctly positioned L6 3 statements E, F and J should be coloured/ shaded 8Kb-5 Kitchen
questions 1 L4 1 a conduction L5 b convection L5 2 The metal pan conducts heat from the flame to the food well. The wooden handle is not a good conductor and stops your hands getting burnt. L6 3 a X on the part of the spoon in the water L6 b Conduction heats all the spoon as particle vibrations are passed along the spoon. L5 4 The air heated by
the element will rise because it is less dense than the rest of the air in the oven. L5 5 a by radiation L6 b Air is a poor conductor, so not much energy will be transferred by conduction. Convection will transfer the heat upwards, not sideways. 8Kb-6 Candles L5–6 1 a Heat transfers by either conduction, convection, radiation or evaporation. L5 b
Convection, as it depends on density differences causing rising or sinking. L6 2 The gases are hot, so they expand and become less dense than the air around them, so they rise. Colder gases move in to take their place. L5 3 This is the only area where oxygen is mixed with the fuel. Oxygen diffusing in from the air is used up before it reaches the inner
part of the flame. L5 4 Less dense gases only rise because they are lighter than their surroundings. In a 'weightless' environment this does not happen. As convection cannot happen, diffusion is the only means of transferring CO_2 and H_2O to the surrounding air. L5 5 It diffuses in. L5 6 a With the air hole open the flame is hot, with a blue centre
section of unburned gas and a 543 Energy transfers 8 K purple outer section where combustion is taking place. With the hole closed, the flame is not as hot, and is mainly yellow. This flame produces soot (unburned carbon from the gas). L5 b With the hole open, oxygen is mixed with the fuel (gas) before it reaches the flame, so oxygen can get to most
of the gas and allow it to burn. With the hole closed, the flame is more like a candle flame, with oxygen reaching the gas through diffusion and convection currents. Not as much oxygen reaches the gas, so it does not burn as well. L6 7 In space, oxygen only gets into the flame by diffusion. On Earth, oxygen would diffuse into the flame, but the rising
hot gases would also set up a convection current, and this current would bring more oxygen into the flame. On Earth, more oxygen gets to the flame, so more wax vapour can burn in the same time and the flame is hotter or the extra oxygen allows more complete combustion, so the flame is hotter. L5 8 suggested answers include: naked flames could
cause fires; burning uses up oxygen, which has to be supplied for the astronauts to breathe; burning produces carbon dioxide, which has to be removed from the air as too much of it would harm the astronauts; electric lights are easier to control 8Kb-7 Kitchen questions 2 L6 1 a The energy from the flame makes the particles in the pan vibrate more,
and these vibrations are passed through the pan and into the water – this is conduction. L6 b The particles in the heated water move faster so that part of the water becomes less dense and rises, setting up a convection current. L5 2 Cork is an insulating material, so it will stop energy being transferred from a hot pan to the table. Metals are
conducting materials, so they would not provide any protection without feet made from an insulating material such as plastic. L6 3 Air is a poor conductor, so not much energy will be transferred by conduction. Convection will transfer the heat upwards, not sideways. L5 4 The air heated by the element will rise because it is less dense than the rest of
the air in the oven. L6 5 The metal spoon conducts energy transferred from your hand, so the part of the spoon you are touching does not warm up much. The wooden spoon does not conduct the energy away, so the part you are touching warms up quickly. L5 6 The metal spike will conduct heat to the inside of the potato so it is heated from both the
544 outside and the inside and should cook more quickly and evenly. L5 7 Air inside the freezer is cold, and so will be more dense than the air in the kitchen. When it comes out of the freezer it will sink. 8Kb-8 Wind chill L6 1 a Sam, because there is a greater temperature difference between his/her skin and the surrounding air. L5 b It will warm up,
because energy is being transferred to it. L6 c The rate will reduce, because as the air warms up the temperature difference becomes less. L6 d It would eventually become very close to their skin temperature, although convection currents would form to remove the warmed air even without a breeze. L6 2 If the warmed air is replaced by colder air,
the temperature difference between the skin and the air remains large, so the rate of energy transfer remains large. L7 3 When water evaporates, some water vapour in the air condenses at the same time. If the rate of evaporation is greater than the rate of condensation then sweat on the skin will dry up and will cool the skin. The more water vapour
there is in the air, the greater the rate of condensation, so the net rate evaporation becomes less as the sweat dries, and the cooling effect reduces. A breeze removes the air with water vapour in it, so sweat can continue to dry up/cool the skin at the original rate. L6 4 Wind chill only affects objects that are warmer than the air around them. The water
in the puddles will be the same temperature as the air. The wind may affect the rate at which the puddles evaporate, but will not affect their temperature. L5–7 5 The paragraph should include some of the following points, expressed in clear English and a logical order. fleece is an insulating material because it contains trapped air warmth from your
body warms up some of the trapped air when the air trapped in the fleece is the same temperature as your body, you don't lose any more heat/energy not all the air in a fleece fabric is immobilised on a windy day, the wind can move away some of the trapped and warmed air leaving cooler air near the skin again using a thicker fleece won't stop this
effect but the windproof coating will stop this happening © Pearson Energy transfers 8Kc Controlling transfers Student Book 1: 8Kc Controlling transfers L4 1 a Thermal conductors Thermal insulators aluminium foil wool copper plastic wood paper feathers L4 b wool, feathers L4 2 Students' own descriptions, which should include a method (cover the
containers with different materials, fill both containers with hot water and record the temperature at specified time intervals for a specified time), how to make the test fair (use same starting temperature, use same volume of hot water, use same thickness of each material) and an indication of how to judge the results (the best insulator is the one
around the container with the highest water temperature at the end) L4 3 add insulation inside the walls, replace the windows with double-glazing/improve the insulation of the windows L6 4 a the black one, because dark colours absorb infrared radiation better than light colours L6 b the black one, because dark colours are the best emitters of
infrared radiation L5 5 If the water is cooler than their bodies, energy will be transferred to the water from their bodies. Some of the water will also evaporate, which will cool the remaining water and so help to cool the elephant. L5 6 a It reduces evaporation from the hot drink and it stops convection currents removing air warmed by energy from the
liquid. L5 b It reduces energy transfers between the contents of the mug and the outside. If there is a cold drink in it, it reduces the energy transferred in from the outside air. If there is a hot drink in it, it reduces the energy transferred from the drink to the surroundings. L6 7 Some energy is transferred from the radiator by radiation, the foil will
reflect energy radiated from the back of the radiator back into the house instead of it being absorbed by the wall. L6 8 a the silver coatings on the glass walls, because shiny/light surfaces are poor at absorbing and emitting radiation L5 b the glass walls and plastic stopper, as these materials are poor thermal conductors; the vacuum between the glass
walls, as conduction only transfers energy through a medium © Pearson L5 c the vacuum between the glass walls, as convection only transfers energy through a medium; the stopper, as it stops warmed air above the liquid rising L5 d the stopper, as not much liquid will be able to evaporate into the air space above the liquid 2: 8Kc Accuracy and
precision L4 1 a The important difference is that the oven thermometer (photo A) has a scale marked in tens of degrees, the clinical thermometer (photo B) has scale intervals of 0.1 degree. The other relevant difference is the range (50–300 °C for the oven thermometer, only 35–42 °C degrees for the clinical thermometer). L5 b Ovens can be used at a
wide range of temperatures, and the temperature only needs to be controlled to something like the nearest 10 degrees. Body temperature needs to be measured to the nearest 0.1 degree, but the overall range of temperature of (live) human bodies is only a few degrees. L6 2 a They are precise, as they are all within 0.2 minutes of each other. L5 b The
true value is likely to be close to the mean obtained by the rest of the class, so this implies that the measurements in part a are not accurate. L4 3 a X = 63 °C and Y = 58 °C L5 b 63 °C L7 c Always look at an instrument from the same angle, preferably with a line of sight perpendicular to the scale. L6 4 a random errors L6 b systematic errors, e.g.
holding the ruler with the zero in the wrong place L5 5 Sally will need to use the most accurate measuring instrument, because the change in length of the brass rod will be very small. Ben does not need such an accurate instrument and the water will move much further up the tube than the brass will expand. Activity Pack 8Kc-1 Controlling energy
transfers Statements can be in any order: L5 The flask keeps hot drinks hot…because it reduces the energy transferred…from the drink to the surroundings. L5 The flask keeps cold drinks cold…because it reduces the energy transferred…from the surroundings to the drink. L5 The vacuum between the walls reduces… energy being transferred by
conduction and 545 8 K Energy transfers 8 K convection…because there are no particles to move or pass on vibrations. L6 The silvered surfaces reduce…energy being transferred by radiation…because light shiny surfaces are poor emitters and absorbers of radiation. L5 The glass walls reduce…the energy transferred by conduction…because glass is
a thermal insulator. L5 The plastic stopper reduces…energy being transferred by evaporation and convection… because it stops warmed air and evaporated liquid escaping. L5 The plastic stopper reduces …energy being transferred by conduction…because plastic is a thermal insulator. 8Kc-2 Radiation and colours L6 6 a The one painted black,
because black absorbs more heat. b The one painted white, as this absorbs less heat. c The one painted black, because black absorbs more heat. L6 7 If there are any errors with the measurements, you can spot them with a series of readings (or similar answer). L6 8 Air is a poor conductor, and convection would tend to transfer the energy upwards
(it will eventually circulate around the whole room, but the energy from a small bulb like this would not significantly raise the temperature of the air in the room). An alternative answer is that energy transferred by conduction or convection would be likely to increase the temperature of both thermometers by the same amount. 8Kc-5 Traditional
homes L4 1 A and C – hot; B and D – cold L5–6 2 A: white paint reflects infrared radiation from the Sun; narrow streets mean most of the walls of houses are in the shade; thick walls and tiled floors take a long time to warm up; louvred shutters allow breezes through without allowing sunlight in L5 B: thick walls with earth filling will reduce
conduction; warmth from the animals will help to heat the house; lack of a chimney means convection is reduced (although smoke often escaped through the thatch) L5–6 C: stilts allow breezes beneath the house; the overhanging roof shades the walls; palm trees shade the houses; lack of internal walls, slatted outer walls and slot in the roof allow
breezes through the house L5 D: sleeping level is higher as warmer air will be 546 near the top of the igloo; sunken entrance prevents convection letting warm air out (the air vent will let some warm air out, but occupants would suffocate without it!); packed snow contains trapped air and is a good insulator L5–7 3 Double roofs and walls shade the
inner wall of the house from solar radiation. Underground – rock takes a long time to warm up/is a good insulator. Covered verandas shade the walls and allow doors/ windows to be left open without allowing solar radiation in. Wet screens – evaporation of the water has a cooling effect. Black chimneys – the black absorbs radiation and heats the
chimney, which creates a convection current that draws air through the building. Windcatchers are structures on the roofs of buildings in hot countries that act to draw air through the building. If the air is forced to flow over water, the cooling effect of the draught is increased. Courtyards provide shaded outdoor areas, and fountains provide some
cooling by evaporation. 8Kc-6 Keeping warm L4 1 temperature differences are: 20, 11, 10, 9, 8 °C L4 2 correctly drawn bar chart L5 3 same volume of water in each beaker, same starting temperature L4 4 The greater the number of layers of fleece, the better the insulation. L6 5 It traps air, which is a poor conductor of heat. L4 6 B: White reflects
radiation/is not good at absorbing radiation so the water in that can will not heat up as much 8Kc-7 Accuracy and precision L6 1 a B: it can measure smaller quantities more accurately than the kitchen scales. C is more accurate, but this degree of accuracy is not needed in school experiments. b A: you often need more than 200 g of an ingredient, and
this is cheaper to buy and sufficiently accurate for baking. c C: very small amounts of drugs are often needed, together with high accuracy. L6 2 a make a series of readings of the same object, and see how close the results are b C is likely to be the most precise – the higher cost means it is probably better made/made to be more precise as well as
accurate. L7 3 Two people are needed to use a tape measure, but the laser instrument can be used © Pearson Energy transfers by one person. It will also be easier to use this to measure the height of the walls. It doesn't cost much more than the tape. L6 4 C: scientists carrying out research on chemical reactions/pharmacists measuring out drugs,
etc. F: surveyors/mapmakers/other people needing to make detailed accurate plans. These people need high levels of accuracy and precision, so they are prepared to pay the higher cost of the instruments. 8Kc-8 Wetsuits L6 1 It has lots of tiny air pockets in it. L6 2 It traps a layer of water between the suit and the skin. Body heat warms the water,
which stays warmer because of the insulating material the suit is made from. L6 3 so the water warmed by the body cannot escape (if it was too loose), and so it does not restrict circulation of blood in the body (if it was too tight) L5 4 a for suits intended to be used in very cold water L5 b Thicker material might make the suit too warm in some
circumstances, and it would also be heavier and restrict movement more. It would also be more expensive. L5 5 The trapped air in the neoprene makes it less dense than water, so the neoprene floats. L5 6 Air is a better insulator than water, and energy from the body does not have to be used up heating the layer of water. L5 7 The diver wears
insulating clothing under the drysuit. 8Kc-9 Thermal mass L4–5 1 The inside temperature fluctuates in a similar way to the outside temperature, but never gets as hot or as cold. Also the peaks and troughs inside are later than the ones outside. L6–7 2 During the day the walls warm up as they absorb energy from the Sun and from the warm air inside
the house. They must therefore be colder than the air inside the house at the start of the day. At night when the outside air is colder, the walls are warmer than the air inside the house. They emit energy into the house which helps to keep the air warm. The ventilation allows some of this warm air to escape, allowing the walls to cool further. The walls
are then cool enough to start absorbing energy when the air warms up again during the day. L7 3 The changes in the air temperature inside the house would be closer to the outside air temperatures, as there is not as much thermal mass to store energy. © Pearson L4 4 a warmer during the day than at night L6 b The slab will warm up when the Sun
shines on it during the day. At night the slab will be warmer than the air temperature inside the house, so it will emit energy and help to keep the air warm. L6 c Energy can escape through the window more easily than through the walls, so the small size of the window helps to reduce heat transfers. The Sun never shines on the north side of the
house so it is no use for absorbing energy. L6 5 The Sun is higher in the sky in summer, so the overhanging eaves will prevent the Sun shining into the house. The floor slab will remain cooler and so it will absorb energy from warm air and help to keep the house cool. 8Kd Power and efficiency Student Book 1: 8Kd Power and efficiency L4 1 a any
three heating appliances, e.g. kettle, cooker, oven, tumble dryer, hairdryer L4 b any three appliances whose primary purpose is not heating, e.g. TV, DVD player, radio, fridge, computer, electric drill, lawnmower L4 2 a 10 000 W L5 b 10 kW L5 3 a 3 kJ or 3000 J L6 b It does not need to heat as much water as quickly. L6 4 a efficiency = useful energy
÷ total energy × 100% = 9 ÷ 20 × 100% = 45% L6 b Students' own Sankey diagrams with 20 J on the left-hand side of the arrow, '9 J light' as an arrow approximately one-third the size of the main arrow on the right, '11 J transferred by heating' as an arrow approximately two-thirds the size of the main arrow on the right; arrows should be labelled
L6 5 a 80% of 200 kJ = 160 kJ L6 b Students' own Sankey diagrams with 'useful energy' arrow approximately four times the width of 'wasted energy' arrow, both on the right; labelled with 'energy used by a kettle', 'useful energy stored in hot water' and 'wasted energy stored in kettle and surroundings' L5 c Kettles have lids/are enclosed so less
energy is transferred from the water by evaporation and convection while the water is heating up. Activity Pack 8Kd-1 Power and efficiency L6 1 a quantities in watts circled: 3000 watts, 1000 watts L6 b the fan heater 547 8 K Energy transfers 8 K L6 c It has a higher power rating of 3000 watts. L5 2 electric shower – 10 000 J efficient light bulb – 20 J
electric kettle – 3000 J L6 3 a A b A c B L5 4 a light b heating 8Kd-2 Sankey diagrams and efficiency 1 L5 1 the percentage of the total energy that is transferred as useful energy L6 2 a the number of joules of energy transferred each second L5 b 2 J L6 c 2 J/16 J = 12.5% L5 3 a light and sound L5 b TV 2. The wasted energy/heating arrow is narrower.
OR It wastes less/a smaller proportion of the energy. L5 4 a kettle and electric shower – high power TV and radio – low power L5 b Heating appliances need more power. 8Kd-3 Sankey diagrams and efficiency 2 L5 1 a 10 kJ L6 b efficiency = 40 kJ/50 kJ ¥ 100% = 80% L5 2 a 48 J L6 b efficiency = 12 J/60 J ¥ 100% = 20% L6 c If left side of arrow is 3
cm, the light arrow should be 5 mm wide, the sound one 1 mm wide and the wasted energy arrow should be 24 mm wide. L5 3 a 650 MJ L6 b 350 MJ/1000 MJ ¥ 100% = 35% L6 c Sankey diagram should have arrows in correct proportions. For instance, if the left side of arrow is 5 cm, the electricity arrow should be 1.75 cm wide and the heating arrow
3.25 cm. 8Kd-4 Kettles and bulbs L6 1 a the number of joules of energy transferred each second L5 b electric shower, kettle, TV, radio The shower and kettle both heat water, so they will need more power than the other two items. The shower needs to heat water faster than the kettle so will be more powerful. The TV needs to transfer energy by both
light and sound, so will need more power than the radio. 548 L6 2 a 80 kJ L5 b It is transferred to the kettle or the surroundings (as thermal energy). L5 3 a the top two arrows (thermal energy in kettle and surroundings and energy stored in the remaining hot water) L5 b 50% L6 c 50% L5 4 a 16 W L5 b 2 J L6 5 a efficiency can never be more than
100%, as you can never get out more energy than you put in. L6 b Efficiency = 2 J/16 J ¥ 100% = 12.5% 8Kd-5 Power, energy and time L6 1 3 kW = 3000 W, 2 minutes = 120 seconds energy = 3000 W ¥ 120 s = 360 000 J L6 2 850 W ¥ 5 x 60 s = 255 000 J L6 3 a 36 000J/20 W = 1800 s b 1800 s/60 = 30 minutes L6 4 energy = 300 000 J, time = 5 ¥ 60
= 300 s power = 300 000 J/300 s = 1000 W (or 1 kW) L6 5 40 minutes = 2400 s power = 7 200 000 J/2400 s = 3000 W (or 3 kW) L6 6 150 000 J/850 W = 176 s 8Kd-6 Efficient heating L5 1 a (chemical) energy stored in gas or oil L5 b stored (as thermal energy) in the hot water flowing through the pipes L5 c stored (as thermal energy) in the hot gases
that leave the boiler L7 2 Gas particles have more energy than particles in a liquid, even when they are at the same temperature. When a gas condenses to form a liquid this energy is released (as thermal energy). L7 3 The energy stored in the movement of the particles of water vapour would normally escape into the atmosphere, and so be wasted. In
a condensing boiler some of this energy is instead used to heat the water going into the boiler. L6 4 a Efficiency is defined as the useful energy transferred as a percentage of the total energy supplied to a device or system. As energy cannot be created or destroyed, the energy transferred by a machine can never be more than the energy supplied to it,
so the efficiency can never be more than 100%. L7 b The useful energy produced by the ground source heating system comes partly from energy stored in the ground outside and partly from the electricity used to run the pump (and also © Pearson Energy transfers from gas or electricity used to make washing water hotter). However only the
electricity or gas has to be paid for, so if the useful stored energy in the hot water in the house is compared to the paid for energy transferred to the system, then the efficiency will come out as greater than 100% because some of the input energy has been ignored. L5–6 b L5 conduction – use insulating materials; convection – trap air (or other fluid)
so it cannot move, such as by putting a lid on a container L6 c A yes or no answer is acceptable if accompanied by a sensible explanation. L5 2 a Energy refers to the energy stored in something and cannot be measured directly. Temperature is how hot or cold something is and can be measured with a thermometer. Yes – if someone is considering the
cost of running a heating system, then the 300% 'efficiency' is a useful piece of information. No – it is misleading as it is using the word 'efficiency' incorrectly. L6 radiation – use silvered surfaces L5 evaporation – put a lid on/cover the liquid L6 b Power is the energy transferred in a certain time. Energy can be stored or transferred, it does not depend
on time. L7 5 Some energy that was originally stored in the gas used by the power station is wasted at the power station. The amount wasted at the power station must be more than is wasted by a gas boiler, as the electric fire is less efficient overall than the boiler. L5 3 a it is cheaper, it contributes less to climate change/global warming L7 6
Normally energy stored in warm air in the rooms of a house is counted as useful energy. However if only one room in the house is being used, then the warm air in the other rooms could be thought of as wasted energy. 8Ke-1 Paying for energy L5–6 1 joules – energy; watts – power; kilojoules – energy; kilowatt-hours – energy; kilowatts – power 8Ke
Paying for energy L6 b divide the useful energy transferred by the total energy supplied (× 100%) Activity Pack L5 2 kilowatt-hour, electricity one hour, one kilowatt unit Student Book joules, big 1: 8Ke Paying for energy L5 1 a 5 kWh L5 b The numbers they use are very big. less, gas, more L5 2 A more efficient appliance uses less energy to transfer
the same amount of useful energy. L5 b to save money on running costs L5 c It might cost more than they would save in running costs. L5 3 to see if the more efficient appliance will save you money overall L6 4 a £150 ÷ £150 per year = 1 year L6 b £50 ÷ £15 per year = 3.3 years L6 5 At least two factors may affect energy use in a house, e.g. cost of
energy, type of house, size of house, external temperature, internal temperature. L6 6 difference in running costs is £5 per year, difference in price is £30 payback time for buying fridge B instead of fridge A is £30 ÷ £5 = 6 years L5 3 a top label – more efficient; bottom label – less efficient 8Ke-3 Warmer homes L5 1 a with carpet and loft insulation
the total percentages come to (30 + 15 + 10 + 15 + 12) = 82% b with carpet, loft insulation, double glazing and draught excluder, the total is (30 + 8 + 10 + 8 + 12) = 68% c with cavity wall insulation, loft insulation and draught excluder, the total is (15 + 15 + 15 + 8 + 12) = 65% A fridge should last longer than 6 years, so it is worth Mrs Holman
spending extra to buy fridge B. L5 2 Insulation Saving 2: 8Ke Keeping warm L5–6 1 a L5 Conduction transfers energy through solids, convection transfers it through fluids, evaporation cools liquids. cavity wall filling 15% double glazing 7% carpet 5% draught excluder 7% loft insulation 13% L6 Radiation transfers energy through empty space and
transparent materials. © Pearson L4 3 cavity wall filling 549 8 K Earth and space 8 L L6 4 Suitable diagram. Energy loss is 53% of that lost by the uninsulated house. L5–6 5 Leaflets should summarise the different insulation methods. Bar charts can be drawn using the information supplied on the worksheet and should have a title. 8Ke-4 Energy true
or false L4 1 False – Temperature is measured using a thermometer. L6 2 True L6 3 False – Radiation can transfer energy through transparent materials and empty space. L5 4 True L5 5 True L5 6 False – Some insulating materials contain trapped air. L6 7 False – Dark, dull materials are good at absorbing radiation. OR Light shiny materials are poor
at absorbing radiation. L6 8 True L5 9 False – When part of a liquid evaporates, what is left is cooler than before. L6 10 True L5 11 True L5 12 False – An efficient machine does not waste a lot of energy. 8Ke-5 Saving in the kitchen L5 1 a 750 ¥ 2 ¥ 60 = 90 000 J (or 90 kJ) L5 b 750 ¥ 2.5 ¥ 60 = 112 500 J (or 112.5 kJ) L5 2 3000 ¥ 10 ¥ 60 = 1 800 000 J
or 1800 kJ 3 This answer assumes the oven is actually using power for about half the time it is switched on. Refer to students' assumptions in their answer to question 5 to check their calculations. L5 a 3000 ¥ 15 ¥ 0.5 ¥ 60 = 1 350 000 J (or 1350 kJ) L5 b 3000 ¥ 20 ¥ 0.5 ¥ 60 = 1 800 000 J (or 1800 kJ) L5 4 a 3150 000 J (or 3150 kJ) L5 b 3600 000 J
(or 3600 kJ) L5 5 that the oven is only using power for half the time once it has reached its desired temperature (accept any other reasonable assumptions) L5 6 3060 kJ L6 7 payback time = cost/savings per week = £45/£0.75 = 60 weeks 8Ke-6 Carbon capture and storage L5 1 It traps the carbon dioxide emitted by power stations or other large
industrial plants and stores it so that it cannot enter the atmosphere. 550 L7 2 It would reduce it. As energy is needed to capture and compress the carbon dioxide, less of the energy originally stored in the fossil fuels would be usefully transferred by electricity. L6 3 one from: pipelines would need to be built to take the gas to the places where it was
to be stored; storage containers at ports for the gas that is to be taken to oil fields by ships; suitable oil fields, coal seams or aquifers would need to be identified; possibly more research done into the effects of injecting carbon dioxide into saline aquifers L6 4 a Gas, as only a small percentage of thermal energy is lost through the flue. Electric fires are
more efficient in themselves, but not when the much lower efficiency of the power station is taken into account. L7 b Gas – the addition of CCS at the power station would reduce the overall efficiency of using electricity for heating even more. L7 c Electricity – in spite of the overall lower efficiency, only a very small proportion of the carbon dioxide
produced will enter the atmosphere. It is not practical to capture the carbon dioxide produced by a domestic gas boiler, so all of this would enter the atmosphere. L6 5 a Less carbon dioxide will be put into the atmosphere. L6 b They will be able to get more oil and/ or natural gas from their oil field, and so would probably make money overall. L6 c
Although most of the carbon dioxide is being stored, it is also helping the oil company to produce even more fossil fuels, which will produce carbon dioxide when they are burnt. L7–8 6 Oil field advantages: geology is known; possibly more likely to happen as oil companies can get a return on money used to store the carbon dioxide. Disadvantages:
often results in more fossil fuels being produced; not many suitable locations, so gas might have to be transported long distances which would cost more. Saline aquifer advantages: plenty of suitable places, so gas would not have to be transported long distances. Disadvantages: more research needed on long-term effects. 8L Earth and space 8La
Gathering the evidence Student Book 1: 8La Changing ideas L3 1 spherical L4 2 a any three from: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune © Pearson Earth and space L4 b a planet orbits the Sun, a moon orbits a planet L4 3 a The Earth spins once every 24 hours, and this is what gives us night and day. L4 b The Sun can only
shine on half of the Earth at any one time. As New Zealand is on the opposite side to the UK, it is dark in the UK when the Sun is shining on New Zealand. L4 4 The shadow of the edge of the staircase moves across the curved scale as the Sun appears to move across the sky. 2: 8La Gathering the evidence L4 1 They were the only ones that could be
seen with the naked eye/without telescopes. L5 2 The Sun moved around the Earth, so it was day when the Sun was above a particular part of the Earth and night when the Sun had moved around the other side of the Earth. L4 3 a half of it L5 b The lit-up half is always facing the Sun, so we see different parts of the lit up half as the Moon moves
around the Earth. L5 4 He had information observed using telescopes/better instruments. L5 5 a In Copernicus' model the orbits of the planets were circles. In Kepler's model they are elliptical. L5 b Ptolemy's model had the Earth at the centre, the modern model has the Sun at the centre. Ptolemy's model had circular orbits, the modern one has
elliptical orbits. Ptolemy's model only had six planets (including the Earth), the modern one has eight. L6 c it fits observations/can explain observations L5 6 any three suitable answers, e.g. telescopes in space; space probes landing on planets/moons; space probes flying past planets/moons; bringing back Moon rocks to study; astronauts visiting the
Moon 3: 8La Scientific arguments L5 1 a All the heavenly bodies are perfect spheres with no blemishes. L5 b All the heavenly bodies revolve around the Earth. L8 2 a, b, which must include these key ideas and evidence: Venus must move around the Sun, because the different shapes/phases observed can only be explained this way; the Moon is not a
perfect, unblemished sphere because I have observed mountains and craters on it; not everything revolves around the Earth, as I have seen moons moving around Jupiter © Pearson L8 3, e.g. [key idea] The Moon is not a perfect sphere [evidence] as it has mountains and craters on it. [how evidence was gathered] I have observed these using my
telescope. [Church's objection] You say that all heavenly bodies are perfect, unblemished spheres [counter argument] but my observations show this is not true. L8 4, e.g. [key idea] Jupiter has moons moving around it [evidence] as I have observed using my telescope. [Church's objection] You say that all heavenly bodies revolve around the Earth
[counter argument] but I have shown this is not true because these moons revolve around Jupiter. Activity Pack 8La-1 Gathering the evidence L5 Ptolemy's model: B, C, F, G, H or J, K, O modern model: A, D, E, H or J, I, L, M, N 8La-2 Astronauts or probes? L4–5 1 and 2 [Key point] G Other planets can be explored by sending humans or space probes.
[Evidence for key point] E Astronauts visiting the Moon made many scientific observations and brought back rock samples. [Objection] A Many people say it will be too expensive to send astronauts. [Reason for objection] D It does cost much more to send people than to send space probes. [Counter argument] B However, the public are more
interested in human stories. [Explanation for counter argument] C They will be more willing to allow tax money to be spent on sending astronauts than on sending space probes. [Conclusion] F So sending astronauts would be best. L4–6 3 Possible answers: In favour of sending humans [Key point and evidence] (Likely to be similar to that above.)
[Objection] Space travel is dangerous and astronauts will have to be protected against radiation and the effects of weightlessness. [Counter argument] However there are plenty of volunteers willing to accept a risky journey if it means they can visit Mars. [Conclusion] Therefore sending astronauts is best/ acceptable. In favour of sending space probes
[Key point] Other planets can be explored by sending humans or space probes. [Evidence] Space probes have been sent to many other planets and have returned information. 551 8 L Earth and space 8 L [Objection] Astronauts can make decisions on the spot if anything goes wrong. [Counter argument] Although we can afford to send many space
probes to different parts of Mars for the same cost as sending one team of astronauts. [Conclusion] So we can find out much more about Mars by using space probes. 8La-3 Solar System questions L4 1 a Ptolemy's L5 b Kepler's/modern L5 c both L4 d Ptolemy's L4 e Kepler's/modern L4 f Ptolemy's L6 g Kepler's/modern L4 h Kepler's/modern L4 i
Kepler's/modern L5 2 Ptolemy's model: E in centre, then M then S top right Kepler's/modern model: S in centre, then E and then M top right L4 3 a The Earth spins on its axis, so we have day when our part is facing the Sun and night when it is facing away. L4 b The Sun goes around the Earth, so we have day when the Sun is above our part of the
Earth. 8La-4 Phases of the Moon L5 1 2 8La-5 Measuring the Earth L4 1 about 2200 years ago, or 200 BCE L4 2 shadows had different lengths at different places L4 3 a midsummer's day L4 b because the Sun was overhead at Syene. L4 4 the angle of the shadow (Sun) at Alexandria, and the distance between Alexandria and Syene L5 5 a Suggestions
could include more accurate instruments, making measurements from satellites, using lasers for distance measurement, etc. Earth; computer – to control the probe and its instruments; Huygens probe (strictly speaking, Cassini did not need this, Cassini was the means of transporting Huygens); thrusters – to make it point in the correct direction for
sending information to Earth or for taking images or scientific readings; spare engine – in case the main engine failed; main engine – to put it into orbit around Saturn or one of its moons, or to change its orbit; nuclear power supply – to provide electricity to work the computer/instruments/camera/radio; cameras – to take pictures of Saturn or its
moons; scientific instruments – to make other scientific measurements. L4–5 2 L4 radio transmitter – to send information back to the Earth; scientific instruments – to take measurements; battery – to provide electricity for the instruments and radio; parachute – to slow it down so it does not break when it lands; L5 heat shield – to protect it when it
goes through the atmosphere. L5 3 Huygens only had to operate for a few days, so a battery would provide enough electrical power for this. Cassini had to operate while in transit to Saturn, and was intended to send back data for a long time, so a nuclear generator was needed to provide power for this length of time. L5 4 a Huygens only needed to
transmit data as far as Cassini, in orbit around Titan. Cassini had to transmit data to Earth – a much greater distance. L5 b So the radio waves could be focused towards Earth, which would give a stronger signal. L7 5 Advantages: makes long space voyages possible; cheaper than a crewed mission; obtains more detailed information than telescopes on
Earth or orbiting Earth; including being able to measure atmospheric conditions on Titan directly (in the case of Huygens). Disadvantages: can only examine one planet closely; difficult to fix faults with no people there; Huygens probe can only be used once. There may be other sensible answers. 8La-7 Moon origins L5 1 samples of moon rocks, and
information from moonquakes about the internal structure of the Moon L5 2 a diameter of Moon should be approx. onequarter the diameter of Earth. b Suggestions could include measuring the angle a planet makes in a telescope and working out the diameter from the magnification, or using information from space probes. L5 b Earth's core approx.
half of radius L5 c about half the radius of the Moon, if they assumed it would have similar proportions to the Earth and its core 8La-6 Cassini and Huygens L4 1 radio dish – to send information back to L5 d Moon's core much smaller than half its radius 552 © Pearson Earth and space L6 3 Theory Evidence for: Evidence against: The Moon was a
passing asteroid that was captured by the Earth's gravity. If this was the case, the composition of the rocks on the Earth and Moon would probably be different, but in fact they are very similar. The Earth and Moon formed from the same cloud of dust and gas. The Earth and Moon have very similar rocks. The Moon formed from material flung up from
the Earth by a collision. The Moon would consist of similar materials to the Earth, and it does. The Moon's small core could be explained if mainly rocks from the surface of the Earth had been flung into space. L7 4 Students' own answers. You would also expect the cores to be similar sizes, but they are not. 2 tilted 8Lb Seasons 3 northern hemisphere
at the top, southern hemisphere at the bottom Student Book 4 northern, northern 1: 8Lb Seasons L3 1 any two sensible suggestions, e.g. no snow on the beach, warmer/people wearing fewer clothes, people sunbathing, people swimming higher, more L3 2 a Daylight lasts longer in the summer than in the winter. L3 b It is warmer in the summer than
in the winter. L4 3 half of a sphere L4 4 a spring L4 b autumn L4 c They are the seasons between summer and winter. L4 5 We spend more time in the zone lit by the Sun in the summer. L5 6 as in figure D but the lit-up section with the UK is smaller and the dark zone (night time) is larger – the North Pole should be in the dark area L4 7 winter L6 8 a
24 hours more 8Lb-2 Hours of daylight 1 L4 1 in order: 16, 14, 13, 11, 9, 8, 8, 10, 12, 14, 16, 17 L4 2 bar chart correctly drawn with labelled axes L4 3 a December L4 b June/July L4–5 c L4 November to January, the Sun is shining for longer. L5 This is summer, so the Sun will also be higher in the sky and so its rays will be more concentrated. L4 d
southern hemisphere – it is hot when it is winter in Britain (the values are adapted from those for Stanley in the Falkland Islands) 8Lb-4 Explaining the seasons L4–5 Summer: L6 b showing 24 hours of darkness occurs at the North Pole in winter sunrise time: 03:44 L7 9 similar to figure E showing that the heat from the Sun is more concentrated at
the Equator than in the UK angle of Sun above horizon at midday: 61° Activity Pack Winter: 8Lb-1 Seasons L4 1 from left to right: winter, Sun, summer sunrise time: 08:16 © Pearson sunset time: 20:34 energy from Sun: 195 J each second on 1 m^2 The northern hemisphere is tilted towards the Sun. sunset time: 15:55 angle of Sun above horizon at
midday: 14.1° 553 8 L Earth and space 8 L energy from Sun: 24 J each second on 1 m^2 The northern hemisphere is tilted away from the Sun. Spring and autumn: sunrise time: 06:08 sunset time: 18:22 angle of Sun above horizon at midday: 38° energy from Sun: 95 J each second on 1 m^2 The northern hemisphere is not tilted towards or away from the
Sun. 8Lb-5 Different seasons 1 L4 1 a summer b winter c summer d summer 2 Ray of light from the Sun at a steeper angle, and shorter shadow drawn. 3 a It was still dark when Sal had to get up for school. She put on a t-shirt under her school blouse to make sure she stayed warm during the day. After breakfast she pulled on her thick coat and woolly
hat and gloves before leaving the house. The path outside was slippery with frost. Sal walked around the playground at lunchtime. The Sun was low in the sky and didn't feel very warm, so she didn't stay out long. The Sun was just setting when she waited for the bus to go home after school. b Possible answer: It was light and sunny when Sal had to
get up for school. After breakfast she picked up her school jumper in case she needed it, but the weather was warm. Sal walked around the playground at lunchtime. The Sun was high in the sky and felt very hot, so she enjoyed being outside. The Sun was still quite high in the sky when she waited for the bus to go home after school. 8Lb-6 Lines of
latitude L6 1 In some parts of Norway the Sun can shine at midnight in the summer. L6 2 June L6 3 It would be completely dark for one day in June, and the Sun would not set on one day in December. L6 6 The Sun is directly overhead on the June solstice/midsummer's day/21st June on the Tropic of Cancer and directly overhead on the December
solstice/midwinter's day/21st December on the Tropic of Capricorn. 8Lb-7 Different seasons 2 L4 1 East–west. If it ran north–south, then the town would always get some sunshine in the middle of the day when the Sun is to the south shining up the valley. L4 2 The Sun is higher in the sky in the summer, so will be high enough to shine over the
mountains on the south side of the valley. L5 3 a Mirrors drawn near the top of whichever side of the valley has been marked as the northern side. b The Sun is in the south, so the mirrors need to be on the northern side to reflect sunlight back down into the valley (or similar explanation). L4 4 a The Sun moves across the sky from east to west each
day, so the angle of the mirrors needs to be adjusted so the reflection still hits the town square (or similar explanation). b The height of the Sun changes as it moves across the sky, and also the height of the Sun changes from day to day, being higher in the sky in spring and autumn than it is in winter. L5 5 The Sun is highest in the sky in June, which
is the middle of summer for the northern hemisphere. L5 6 a The Sun will be higher in the sky at all times. b There won't be very much difference between the maximum height of the Sun throughout the year. c The graph will have the highest altitude in December and the lowest in June (or similar description). 8Lb-8 Milankovitch cycles L7 1 The tilt
of the axis. The Earth is closer to the Sun when it is winter in the UK, and it is colder in the winter when the North Pole is tilted away from the Sun. If the change in the distance to the Sun had more effect, it would be warmer in winter than in summer. L6 4 September to March, because it is summer it is lighter for longer. L4 2 In summer the days are
longer, the Sun is higher in the sky, and so the Sun's rays are more concentrated. L6 5 Student's letters could describe what it feels like to go to bed when it is light all night in the summer, or extra activities they might enjoy in the extra daylight. In the winter, they might describe what it feels like on the days when it never gets light, or how strange it
is to see the Sun very near the horizon in the middle of the day. L7 3 a If the Earth's orbit becomes more elliptical, the Earth could be even closer to the Sun when it is winter in the UK, so winters may become milder/warmer as the Earth will get more energy from the Sun. The Earth will be further away when it is summer in the UK, so summers could
become cooler. 554 © Pearson Earth and space b If the tilt increases the days will be even longer in summer and shorter in winter, the Sun will be even higher in the sky in summer and lower in winter, and the Sun's rays will be even more concentrated in summer and less concentrated in winter. All these will make summers hotter and winters
colder. L6 4 The greater the tilt, the larger the area near the poles where there will be midnight Sun. If the Arctic Circle is moving north, the area is getting smaller so the tilt must be decreasing at the moment. L7 5 Almost half of the Earth would have continual daylight in summer and continual darkness in winter. This would make the summers very
much hotter and the winters colder, especially at the poles. L7 6 Uranus is much further from the Sun than the Earth, and so gets much less energy from the Sun. So both summers and winters will be very much colder. 8Lc Magnetic Earth Student Book 1: 8Lc Magnetic Earth L4 1 a magnet that can swing to point north L4 2 because that is the end
that will point towards the north L5 3 use iron filings or a plotting compass L4–5 4 of a magnetic field around a bar magnet – it should look similar to figure C (L4 for the basic shape of the field, L5 for showing the direction) L5 5 Place the magnets close to each other and then use iron filings or a plotting compass. L5 6 The north-seeking pole of a
magnet will point towards the Earth's North Pole. As opposite poles attract each other, the North Pole must have the equivalent of a south-seeking pole there. L6 7 a We know the shape of the magnetic field of a bar magnet, and the Earth's magnetic field is similar. It helps us to understand how compasses work. L6 b The magnetic field is not formed
in the same way as in a bar magnet, so the model might lead people to misunderstand this. Activity Pack 8Lc-1 Magnetic Earth L4 1 a compass b north-seeking pole c magnetic field d north magnetic pole © Pearson 2 a field lines completed correctly b arrows from north to south 3 a drawing correctly labelled, clockwise from top left: magnetic north
pole, North Pole, magnetic south pole, South Pole b Arrows in compasses drawn to point along field lines away from the Earth's South Pole towards its North Pole. 8Lc-4 Magnetic questions L4–5 1 a attract b repel c repel d attract 2 If the magnet is free to swing it will point north. 3 magnetic field 4 compasses all pointing along field lines from N to S
(as figure C in the Student Book) 5 The Earth has a magnetic field/the Earth acts like a magnet. Accept similar answers, but not 'the Earth has a bar magnet inside it'. 8Lc-5 True north and magnetic north L5 1 True north is the direction that points to the North Pole; magnetic north is the direction that points to the north magnetic pole 2 because the
north magnetic pole is not in the same place as the North Pole. 3 the angle between true north and magnetic north 4 a They can work out which direction they want to go from the map, and the compass helps to make sure they go in the correct direction. b They would not be walking exactly in the correct direction, and might get lost. 5 a They are
printed with magnetic north at the top (they also use different symbols and often a larger scale). b So the runners do not have to waste time adjusting their compasses. 8Lc-6 Animal navigation L4 1 sketch of field lines from pole to pole (similar to figure E in the Student Book) L5 Arrows on field lines pointing away from North Pole, or bar magnet
drawn inside the Earth with the S pole of the magnet near the Earth's North Pole. L4 2 The Sun, or the Earth's magnetic field. L5 3 a Pigeons from group B had never seen the direction of the Sun in the morning but they still managed to find their way home. b As a control to make sure it was possible 555 8 L Earth and space 8 L for pigeons to find
their way home from the place they were released. L5 4 The magnets on their backs prevented them using the Earth's magnetic field, and they got lost. L5 5 The position of the Sun in the sky changes during the day. L5 6 Some clues may not always be available; for example, the Sun cannot be used at night. L4–6 7 Students' own answers. 8Lc-7 More
about compasses L7 1 It is the angle between the horizontal and the direction of the magnetic field. 2 No, the magnetic field slopes at different angles in different parts of the world. 3 The south end. The dip is down towards the north in the northern hemisphere, so the opposite end of the needle needs to be weighted to keep it level. 4 It will be
weighted at the opposite end, the north end. A suitable diagram may reproduce the top figure on the worksheet, pointing out the dip in the northern and southern hemispheres. 5 The difference between magnetic north and the direction the compass is pointing. 6 a They do not normally have significant amounts of iron or steel/magnetic materials with
them. that far, Neptune would fly off into space instead of staying in orbit around the Sun. 2: 8Ld Making comparisons L4 1 Either answer is acceptable, as long as it is accompanied by a sensible reason, e.g. the models in the photograph are a better comparison because you can see the relative sizes; the ratio calculation is a better comparison
because it gives you a number to compare the two sizes. L4 2 g for Mars ÷ g for Earth = 3.7 ÷ 9.8 = 0.377 L5 3 0.377 ¥ 100 = 37.7% L4 4 a diameter of Mercury ÷ diameter of Jupiter = 4880 km ÷ 142 838 km = 0.034 L4 b 0.034 ¥ 100 = 3.4% L4 5 a g for Mercury ÷ g for Jupiter = 3.7 ÷ 23.2 = 0.159 L5 b 0.159 ¥ 100 = 15.9% L4 6 35 ÷ 100 = 0.35
L5 7 1:290 000 000 (make sure you use the same units, 1 km = 100 000 cm) Activity Pack 8Ld-1 Gravity and the solar system L5–6 The Moon is kept in its orbit…by gravity. The force of gravity between two objects…is bigger if the objects have more mass. b If they are standing next to an iron gate or other large objects made of iron or steel. If two
objects are moved apart…the force of gravity between them gets weaker. 7 Ships are often made from steel. The gravitational field of the Earth…is the space around it where its gravity affects other things. 8 By placing magnets around the compass to cancel out the effects of the ship, or using a table of corrections. 8Ld Gravity in space Student Book
1: 8Ld Gravity in space L5 1 It has a larger mass. L5 2 a weight = 2 kg ¥ 10 N/kg = 20 N L5 b weight = 2 kg ¥ 1.6 N/kg = 3.2 N L5 3 The force of gravity on Callisto will be less than on Mercury because its mass is less (and it has the same diameter). L6 4 a the force of gravity between the Sun and the Earth The gravitational field strength of Earth…is
10 N/kg. The gravitational field strength is…the force of gravity on every kilogram of mass. Gravitational field strength describes…the force of gravity on every kilogram of mass. If you take an object to the Moon…its weight changes but not its mass. Gravity on Earth pulls things…towards the centre of the Earth. 8Ld-4 Ratios and percentages L5 1 a
1:1.5 (to 1 d.p) b 1:3.4 (to 1 d.p) L6 b the force of gravity between the Earth and the Moon 2 a Mars is 1.5 times further from the Sun than the Earth. L6 5 If there was no gravity, the ISS would not stay in orbit around the Earth/would fly off into space. 3 a 1:1.9 L6 6 If the Sun's gravitational field did not extend 556 b Jupiter is 3.4 times further from
the Sun than Mars. b 1:6.2 © Pearson Earth and space 4 A year on Mars is nearly twice as long as a year on Earth. A year on Jupiter is more than six times longer than a year on Mars. 5 1 a 0.65; 1 b 0.29; 3 a 0.53; 3 b 0.16 6 1 a 65%; 1 b 29%; 3 a 53%; 3 b 16% 7 Answers depend on planets chosen. 8Ld-5 Solar System questions 1 L4 1 An arrow with

each figure, pointing towards centre of Earth. L6 2 a W, they are closer together b Z, their masses are greater L4 3 a newtons (N) b kilograms (kg) L5 4 a Yes, because mass does not depend on gravity/measures the amount of substance in something. b No, weight depends on gravity, and gravity is different/less on the Moon. L5 5 the force of gravity on a kilogram of mass 8Ld-6 The Vomit Comet L4 1 a towards the centre of the Earth (accept 'down' for part a but not for parts b and c) b towards the centre of the Moon c towards (the centre of) the Earth L4 2 By flying in aircraft that can produce a feeling of weightlessness. (They also train in large tanks of water, but this does not produce the same feeling of weightlessness.) 8Ld-7 Solar System questions 2 L5 1 a Sun b Earth c the force of gravity between the Sun and the Earth L5 2 The string would need to be shorter, as Mercury is closer to the Sun than the Earth. Some students may also add that the wooden block should be smaller, as Mercury is smaller than the Earth. L5 3 a 0.5 kg ¥ 10 N/kg = 5 N b 0.5 kg ¥ 4 N/kg = 2 N L6 4 a The Earth would have to be closer to the Sun (halving the distance would not halve the length of year, but accept answers that say the Earth should be half the distance to the Sun as students are not expected to know how distance and orbital period are related other than 'further out → longer year'). b The Earth's axis would not be tilted at all. A very good answer will also state that the Earth's orbit should be circular. c The Moon would have to be closer to the Earth. L6 5 a No effect – the length of a day depends on how fast the Earth spins. b A year would be longer (approximately twice as long) as it would take longer for the Earth to go around the Sun. c There would be more days in a year, as day length does not change but the year is longer. L4 3 Because most people feel sick when they ride in it! d It would be less, as the two bodies are further apart. L4 4 a 32 800 ft – 24 000 ft = 8800 ft b 52 s – 26 s = 26 s × 10 = 260 s e It would be colder, as the Earth would get less energy from the Sun. L5 5 a The Moon has a force of gravity/they are not in orbit around the Moon but on it. b The Moon's gravitational field is not as strong as the Earth's. L5 6 a 70 kg ¥ 10 N/kg = 700 N b 70 kg ¥ 9 N/kg = 630 N L5 7 a Because it looks (and feels) as though the astronauts have no weight. b Weight is the force of gravity on something, and there is still a force of gravity between the astronauts and the Earth. L6 8 Because they are falling at the same speed as their spacecraft, so the floor does not push up on them. L6 9 Yes, because the Moon itself is kept in orbit around the Earth by the Earth's gravity (more correctly, by the gravitational force between the Earth and the Moon). © Pearson 8Ld-8 Kepler's model L5 1 a They were circular. b Each planet has a constant speed in its orbit. L4 2 a The speed of Mars at different places in its orbit. L5 b He did not assume a constant speed or a circular shape. L6 3 a Diagram with arrow pointing directly towards the Sun. b Its orbit keeps it moving around the Sun. c It changes the direction of its movement. (At A it only changes the direction, because at A the planet is actually moving at right angles to the direction of the Sun's pull, so the Sun's gravity cannot change its speed.) L6 4 It is further away from the Sun. 557 8 L Earth and space 8 L L8 5 a It will tend to slow it down. b E Y X+Y D Activity Pack F Y X X c The component of the Sun's gravity along the direction of the orbit is against the direction of motion, so the planet will slow down. d The component of the Sun's gravity along the direction of the orbit is in the same direction as the planet's motion, so the planet will speed up. 8Le Beyond the Solar System Student Book 1: 8Le Beyond the Solar System L4 1 a huge ball of gas that gives off large amounts of energy L4 2 It is much closer. L4 3 They are not bright enough compared with the Sun. L4 4 The Earth is spinning on its axis. L6 5 distance L6 6 a He could only see 100 objects with the telescopes/instruments available at the time. L6 b Astronomers today have much more powerful telescopes than Messier had, so they can see many more galaxies. L6 7 It is our galaxy – a collection of millions of stars. We cannot see its shape directly because we are inside it. 2: 8Le Studying space L4 1 a a star gives out a lot of energy/shines, a planet does not; a planet orbits around a star L4 b a planet orbits around a star, a moon orbits around a planet L4 2 only the Moon (and Earth!) L5 3 a their position in the sky, the appearance of their surface, whether or not they have moons L5 b any two sensible suggestions, e.g. better telescopes to make more detailed observations; sending space probes to other planets to get more detailed images/make other measurements; returning rock samples from the Moon L5–6 4 L5 a the masses of the objects and the distance between them L6 b It keeps them orbiting around the Sun instead of them flying off into space. 558 8Le-1 Beyond the Solar System L4 1 a star, a huge ball of gas that gives out energy L4 2 a pattern of stars in the sky L4 3 millions of stars together L4 4 the name of our galaxy, the name for a bright band of stars in the sky L6 5 distance L4 6 it is much closer L4 7 the Sun appears much brighter than the other stars. L6 8 we are inside it 8Le-2 Sizes in space L5 F, C, B, A, D, H, E, G, I 8Le-3 What can we find out? L6 Non-scientific questions: E (although science can inform the discussion), H, M, R Scientific questions: Can be answered now: A, B, C (although a suitable probe would have to be built and sent), D, F (for the larger ones), G (for large planets), K, O (if they would put the money in to sending a probe). Can be answered in the future: F (for smaller ones), G (for smaller ones that are harder to detect), L, N. Will never be answered completely: I, J, Q, P, S, T (although scientists do have a pretty good idea how many of them formed, by analogy with similar features on the Earth). 8Le-4 Spending – for or against? L4 1 For: A, B, E, F, G, J Against: C, D, H, I L5 2 and 3 Students' own answers. 8Le-5 Starry questions L4 1 a a pattern of stars in the sky b millions of stars grouped together c all the galaxies L4 2 3rd box ticked L4 3 Milky Way L4 4 The Earth spins on its axis, so the stars appear to move around the sky. L5 5 planet, star, galaxy, Universe L5 6 Two from: stars are bigger than planets, stars make their own light/give off energy, planets orbit around stars. © Pearson Earth and space L6 7 10 million million km 8Le-6 Constellations and star names L4 1 a To help them find a particular star they needed for navigation. L4 b To divide up the sky into different areas. L5 2 Betelgeuse, Rigel, Bellatrix, Mintaka L5 3 a Aldebaran, Elnath, Ambrosia b Castor, Pollux, Alhena L5 4 C – the Greek letters only tell you about the brightness of the stars in that constellation. They don't tell you how bright the stars in one constellation are compared to another. 8Le-7 The Milky Way L4 1 The ancient Greeks had a story that it was milk from a goddess. © Pearson L5 2 No one has travelled outside the Milky Way to take a photo. L5 3 a 4 b Sketches of two different galaxy shapes (spiral – similar to drawing on worksheet, or without the central bar; elliptical – ellipse shaped; lenticular – like a convex lens; irregular – any irregular shape) L6 4 No, some will be hidden behind nearer stars. (There is also a lot of dust which can block the view, but students are not expected to know this.) L6 5 Students' own diagrams, showing that if you look in the direction of the spiral arm you see lots of stars. But, if you look in other directions away from the spiral arm then you only see the stars between you and the edge of the arm. L6 6 Stars would be more evenly spread across the whole sky. 559 8 L

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