

Answers to questions

Chapter 6: Variety of life

1 Arachnid; mollusc; bird; mammal; insect **2 a i** mammal; **ii** fungus; **iii** reptile; **iv** insect; **v** bacterium; **vi** virus; **vii** bird
b i Respiration **ii** Excretion **iii** Sensitivity/irritability **3 a i** B; parallel veins on leaf **ii** D; worm with body divided into segments **iii** E; body in two parts/ four pairs of legs **iv** G; armoured exoskeleton/more than four pairs of limbs/limbs very specialised **b** Magnification = measured/actual length so magnification = $50/5 = \times 10$ **4 a i** antennae/three parts to body (head, thorax and abdomen)/three pairs of legs **ii** gills (extract oxygen from water) **b** A = Ecdyonurus; B = Potomanthus; C = Ephemera; D = Paraleptophlebia; E = Centroptilum **5 a** C is the smallest J is the largest **b** A, D, F, G and I (all arthropods) **c i** A, G and I **ii** Wings, three pairs of legs **6 a** Include 'body not covered by a shell' as second alternative to Q.2 and add 'go to 4'; Q.3 front legs 'with claws'/ front legs 'like paddles'; Q4. Has legs *Shinisaurus crocodilurus* Has no legs *Ophiophagus Hannah*
b Scaly skin **7 a i** Fresh mass is greater because it includes water **ii** water content is very variable **iii** data is more reliable since 'rogue' results can be discarded **b i** Fresh mass increases from 0.46 g to 0.64 g **ii** seed is absorbing water from the soil **c i** falls from 0.46 g to 0.24 g **ii** food stores are being used up (e.g. in respiration) **d** growth (cell division)/respiration/excretion/sensitivity

Crossword

ACROSS: 1, reproduction, 6, protoctist, 9, sensitivity; 10, gene; 12, animal; 13, development, 16; respiration, 21; variation; 22, movement; 23, kingdom; 24, fungi; 25, energy.
DOWN: 2, excretion; 3, Panthera; 4, Homo Sapiens; 5, acterium; 7, binomial; 8, Linnaeus; 11, organisation; 14, nutrition; 15, growth; 17, taxonomy; 18, plant; 19, species; 20, key

Chapter 7: Viruses, bacteria and fungi

1 a i C **ii** DNA as a thread (not a nucleus)/cell wall but no chloroplasts **iii** A (virus) **iv** An organism that can only carry out its life processes inside the cells of another living organism (its **host**) **b i** C and E **ii** B would be a **producer** as it is able to photosynthesise and so trap light energy **2 a** protease
b amino acids **c** Fungi **d** Hypha **e** Ensure oxygen concentration on x axis, uptake on y axis/axes labelled with quantities and units/points plotted clearly/join points with smooth curve **f** Two methods of uptake, one method of uptake is dependent on oxygen concentration: oxygen affects aerobic respiration and so energy available for active transport **g** Temperature (affects activity of respiratory enzymes) **h** Could make sure that soil is aerated/temperature is appropriate for enzymes of respiration
3 a F; **b** T; **c** T; **d** F; **e** F; **f** F; **g** T; **h** T; **i** T; **j** T

Chapter 8: Cells, tissues and organs

1 a C (1, 2, 3), B (1, 2, 3), F (1, 4, 5, 6, 7), I (1, 4, 5, 8), G (1, 4, 5, 6, 7) **b i** Red blood cell – transport of oxygen from lungs to tissues **ii** lymphocyte – production of antibodies as part of immune response **iii** macrophage – engulfing and destroying pathogens **2 a** cell wall = A, cytoplasm = B, vacuole = E
b nucleus **c** plant cell has chloroplasts/cellulose cell wall/ large permanent vacuole – animal cell has none of these **d** nucleus
e tissue **f** no cytoplasm/ no cell membrane **3 a** A = nucleus, B = cell membrane **b** Photosynthesis (absorption of light energy to produce carbohydrates) **c** Plant cells have a cellulose cell wall/ large permanent vacuole – animal cell does not **d** $50 \times 20 = 1000$ i.e. one cell is $1000 \mu\text{m}^2$. $1 \text{ mm}^2 = 1000 \times 1000 \mu\text{m}^2$. Therefore, 1000 plant cells could fit into 1 mm^2 . **4 a** Cells

listed from top to bottom: 1 – carries oxygen around the body; 2 – moves dust and bacteria up the bronchi; 3 – absorbs water and minerals from soil for the plant; 4 – transports water and minerals; 5 – contracts to cause movement within animals
b Heart is made up of more than one tissue e.g. muscle/nerve/epithelium

Fill in the missing words

a Cells; tissues; epidermis/xylem/phloem; organ; Systems; excretory system. **b** Specialised; red blood cell; division of labour; nervous; endocrine. **c** Palisade cell; chloroplasts; leaf; epidermis; xylem.

Chapter 9: Movement of molecules in and out of cells

1 a Osmosis **b** Partially permeable (or differentially permeable) **c**. Water has been absorbed **d** It has the same water potential as the contents of cell **e** Add vacuole, and refer to Chapter 8, question 3 **2 a** Concentration on x axis, percentage change on y axis/labels on axes/include negative change to mass of potato
b At crossover on x axis i.e. around 0.24 molar **c** There is no change in mass as there is no net water gain or loss since cytoplasm and surrounding solution have the same water potential **d** To allow calculation of a mean change (more reliable) **e** To remove surface water which would affect the accuracy of the measurement of mass **f** Expected loss of 20% from 10 g suggests new mass of 8.0 g **3 a i** as raw material for photosynthesis/ to dissolve soluble molecules for transport/to provide support through turgor **ii** salty soil solution has lower water potential than cell contents. Water leaves by osmosis down the water potential gradient, so cells die as less water available to them **b i** active transport **ii** growth rate might fall as active transport uses up energy, which might otherwise be used for growth **iii** nitrate – production of amino acids and proteins/magnesium – part of the chlorophyll molecule

Fill in the missing words

Cytoplasm; partially permeable membrane; swell; lower; cell wall; glucose/amino acids; diffusion; concentration; active transport; energy; against; carbon dioxide; diffusion; photosynthesis.

Chapter 10: Biological molecules and food tests

1 a A, F, G, H **b** Dissolve sample in water/add equal volume of Benedict's Reagent/heat in a water bath/look for colour change from blue to orange-red **2 a** 1: iodine solution – starch
2: Benedict's Reagent – simple sugar/glucose 3: alcohol – fat or oil 4: Biuret – protein **b** Test 1 – straw-brown colour Test 2 – blue Test 4 – blue **c i** Milk/cheese/butter **ii** fish/meat/beans/cheese **3 a** A **b** B **c** D **d** E **e** C **4 a** mark for accuracy/labelling/key **b** pie chart – easier to see the differences than when shown in a table **c i** Water **ii** protein **iii** water **iv** fat **v** vitamins **vi** bones and teeth **5 a** blue-black **b** Biuret solution **c** D **d** As controls – to show that distilled water gives no colour change **e** Dissolve fat in alcohol/shake/pour suspension into distilled water/cloudy suspension indicates presence of fat **f** Cardiovascular disease (arteries become narrowed)/becoming obese – damage to joints

Crossword

ACROSS: 2, water; 4, starch; 6, biuret; 8, blood; 9, orange; 10, glucose; 11, cholesterol; 14, DNA; 15, condensation;

16, emulsion; 18, blue/black; 20, lipid; 21, vitamins; 22, haemoglobin. DOWN: 1, purple; 3, amino acid; 5, hydrolysis; 7, protein; 12, sucrose; 13, Benedict's; 17, milky; 19, urine

Chapter 11: Enzymes control biological processes

1 proteins; pathways; catalysts; specific; denatured
2 a Temperature **b** pH (use buffer solution), concentration of enzyme (use identically-sized pieces of potato), concentration of substrate (fix the concentration of hydrogen peroxide)
c rate of oxygen production – measure volume produced as the fluid is pushed around the manometer scale in a fixed period of time **d** repeat the experiment with boiled potato pieces (enzymes would then be denatured) **e** mean improves **reliability** of data (each individual value has less effect on the result). **Validity** is improved by carefully controlling variables so that there is only one input variable. **3 a** temperature on x axis, oxygen consumption on y axis. Curve represents the effect of temperature on enzyme action, with peak corresponding to the optimum temperature **b** input = temperature, outcome = oxygen consumption, fixed might be pH of environment, mass of maggots, age of maggots, food availability for maggots
4 a an enzyme is a protein which acts as a biological catalyst
b i Substrate – the stain/dirt to be removed – molecules fit onto enzyme's active site. These molecules are then broken down more quickly than they would be without the enzyme present. Breakdown would be able to go on at lower temperatures, so lowering the energy cost for the process. **ii** enzymes are sensitive to temperature – too low and the molecules do not collide with the active site with enough energy, too high and the enzyme could be denatured so that the active sites would lose their shape **iii** 35 – 40°C: low energy cost but close to optimum temperature of enzyme **c** microbes grown in fermenter/bioreactor under optimum conditions of temperature and pH. Microbes will produce more of the enzymes if the expected substrate (e.g. fats) is present. Collect microbes and crush to release enzymes; separate enzymes from the solution – dry. **5 a i** potato: 4.3, 6.3, 0.0, 0.0 liver: 8.0, 10.0, 0.0, 0.0 **ii** sample/treatment on x axis, volume on y axis; is key suitable; bars should not be touching **iii** potato has a lower output of oxygen – 4.3 compared with 8.0 cm³ **iv** sample B has potato in smaller pieces, so larger surface area of enzymes exposed to the substrate **b** they are controls which demonstrate that an enzyme is responsible for the process, since boiling denatures the enzyme **c** oxygen will relight a glowing splint **6 a** it is fixed onto some form of support, such as a plastic grid **b** oxygen concentration will fall as it reacts with glucose **c** converts one form of 'energy' e.g. peroxide concentration into another form of energy e.g. the display on the monitor

Crossword

ACROSS: 1, denaturation; 5, metabolism; 8, hydrogen; 9, cyanide; 10, substrate; 13, inhibitor; 15, protease; 16, catalyst; 17, and; 18, lock; 19, pepsin; 20, optimum
 DOWN: 2, temperature; 3, lipase; 4, amylase; 6, active; 7, key; 10, site; 11, activator; 12, catalase; 14, product.

Chapter 12: Food and diet in humans

1 a A b A c C d D e A 2 a 0.05 (i.e. $10 \times 0.1/20$) **b C c** It reduces it, by a factor of 4 (4 times as many drops are needed to decolourise the DCPIP) **d** To prevent scurvy **e** Some leafy vegetables, potato **3 a i** Boy requires as he is still growing: producing more cells, especially muscle, requires protein **ii** girl is menstruating so is losing blood each month: replacing the blood requires iron **iii** the pregnant woman requires extra calcium for producing the bones of her developing child **b** vitamin C prevents scurvy, by helping the body to make fibres

of an important protein needed for healthy gums and skin
4 a Quorn provides good quantities of protein (for growth) and carbohydrate (as an energy supply) as well as fibre to help formation of the faeces, but low quantities of harmful fat and cholesterol **b** Quorn would provide $250/100 \times 355$ kJ of energy. Olive oil would provide $10/100 \times 3600$ kJ. Assume that the potato has a mass of 100 g and so supplies 575 kJ. Total energy content is 1882.5 kJ. **5 a** blue-black **b** Biuret solution **c D d** As controls – to show that distilled water gives no colour change **e** Dissolve fat in alcohol/shake/pour suspension into distilled water/cloudy suspension indicates presence of fat **f** Cardiovascular disease (arteries become narrowed)/becoming obese – damage to joints

Crossword

ACROSS: 1, scurvy; 3, salt; 4, calcium; 7, carbohydrate; 9, steroid; 10, protein; 11, fat; 13, respiration; 14, balanced; 15, iron; 16, membrane
 DOWN: 2, rickets; 3, sucrose; cholesterol; 6, baked beans; 8, malnutrition; 12, fibre

Chapter 13: Digestion and absorption

1 a Tongue **b** A pushes food backwards, and mixes it with saliva from B. This makes the food more 'slippery'/better lubricated and so it is easier to swallow **c** It closes off the trachea so that food does not enter the lungs **d** Show longitudinal and circular muscles – circular muscles contracting behind bolus and relaxing ahead of bolus **e** It is long – up to 6 m – and it is folded **f i** Glycogen **ii** hepatic portal vein **iii** hepatic vein **iv** bile emulsifies fat (increases the surface area of fat globules), and has its effects in the duodenum/small intestine **g i** Along the pancreatic duct **ii** amylase (starch – glucose), lipase (fat – fatty acids and glycerol), protease (peptides – amino acids)
h E: reabsorbs water/synthesises vitamins e.g. vit K
F: stores faeces before defaecation **2 a** A would be blue-black, B would be straw-brown **b** In A the amylase had been boiled and so was denatured: the starch had not been digested. In B the starch would have been digested and so could not react with the iodine. **c** Test contents of A and B with Benedict's Reagent. Heating should make contents of B turn from blue to orange-red. **d i** Surface epithelium, capillary, lacteal **ii** lining the small intestine (especially the ileum) **iii** part X **iv** to transport absorbed lipids/fatty acids **3 a i** Molar, canine, incisor **ii** X crushes food, Z bites off pieces of food before they are ingested **b** calcium and vitamin D **c i** bacteria convert sugar in food to acid/acid eats away the enamel/bacteria (in plaque) can now enter the dentine **ii** brush teeth carefully/reduce intake of sugary or acidic foods/drink water treated with fluoride **4 a** lipase **b** fatty acids **c i** Falls by 1 pH unit over 4 minutes, so an average of 0.25 pH units per minute **ii** bile increases the surface area of the fat globules so that the lipase enzyme can work more quickly **5 a i** Protease **ii** amino acids **b** pH on x axis/rate on y axis/labels include quantity and units/ title could be 'The effect of pH on the activity of a protease/curve should have an optimum at pH 2.0 **c** stomach **d** too large to be absorbed/cross the lining of the ileum

Matching terms

A-12; B-22; C-21; D-17; E-3; F-13; G-19; H-1; I-20; J-18; K-2; L-14; M-9; N-16; O-6; P-8; Q-7; R-5; S-4; T-15; U-11; V-10

Chapter 14: Useful microbes

1 a half of the water = 42.35 g, all of the carbohydrate = 5.1 g so a total of 47.45 g is removed as whey so that 52.55 g of soft cheese would be made **b** 90 kJ (5.0×18) **c** 1 – F; 2 – B; 3 – A; 4 – C; 5 – E; 6 – D **2 a** This temperature is high enough to make sure that molecules have enough energy to react together, but not high enough to denature the enzymes in

the microbes **b** To mix the contents – nutrients and microbes in particular **c i** Time on x axis, mass of product on y axis/ labels on axes to include quantities and units/points joined in smooth curve **ii** 90% of maximum is $90/100 \times 3.50 = 31.5$ kg. This quantity is reached at approximately 22.5 minutes.
3 a i Suitable temperature (approximately 35°C), availability of water **ii** amylase **b** *Saccharomyces* **c i** Temperature on x axis/rate on y axis/labels to include quantities and units/points joined with smooth curve/maximum value at 40°C **ii** 0.7 units of alcohol per hour **iii** the fermenting enzymes in the yeast are denatured and so become inactive **d** to remove any potentially harmful microbes **e** carbon dioxide **4 a i** In the presence of oxygen **ii** as a raw material for respiration to supply the energy needed for growth **iii** it is easier to transport (water is heavy) **b** penicillin **c i** Mutation **ii** Natural selection **d** an antiseptic kills bacteria *on the surface of an organism* (or structure, such as a table), an antibiotic kills bacteria (or slows down their reproduction) *inside an organism* **5 a** gene cut from human DNA using restriction enzyme/bacterium containing plasmid is opened with lysozyme/plasmid is extracted/plasmid is opened with the same restriction enzyme/factor 8 gene is stitched into opened plasmid using ligase enzyme/'new' recombinant plasmid is inserted into bacterial cell in the presence of calcium ions **b** it is a factor involved in the efficient clotting of blood **c** human growth hormone – can help to overcome slow growth rates/ insulin – can be used in the treatment of diabetes **d** they are worried that the GMO might 'escape' into the environment, with unforeseen consequences/they believe that this is an unnatural process **6 a** show steep rise in concentration between 20 – 40 minutes, close to maximum from 80 – 120 minutes **b** nutrients are used up by the mould as it grows **c** they are inversely related – the concentration of nutrient falls as the concentration of amoxicillin rises **d** to control the growth of colonies of bacteria inside their patients, as the bacterial growth may cause disease **7 a** ampicillin column - $\sqrt{}$, x , $\sqrt{}$; tetracycline column - x , x , $\sqrt{}$ **b** Yes. The bacteria have been formed by binary fission (like mitosis) and so their DNA, including the gene for Human insulin, has been copied

Crossword

ACROSS: 1, biogas; 4, sewage; 8, chymosin; 9, GMO; 10, acid; 13, bacteria; 15, mycoprotein; 16, vector; 17, restriction; 19, antibiotic; 20, lipase; 22, acetic acid; 23, alcohol; 24, lactobacillus

DOWN: 1, brewing; 2, plasmid; 3, whey; 5, protease; 6, dioxide; 7, lactic; 11, carbon; 12, fermentation; 14, amylase; 15, methane; 18, gasohol; 21, yeast

Matching terms

Distillation; fermentation; bioreactor; lactobacillus; carbon dioxide; whey; hops; yeast; alcohol; pasteurisation; chymosin; acetobacter; sterilisation; mycoprotein; bacterium.

Chapter 15: Photosynthesis and plant nutrition

1 a i/ii (A) Purple (carrying out more photosynthesis than respiration so removing carbon dioxide), (B) Red as photosynthesis will be balanced by respiration (non-chlorophyll areas cannot photosynthesise but can respire), (C) yellow, as no photosynthesis can go on but respiration continues and so produces carbon dioxide **b i** Leaf is killed by submerging in boiling water/decolourised by warming in alcohol (CARE! Use a water bath and no naked flames nearby!)/decolourised leaf is covered with iodine solution/presence of starch is indicated by leaf turning a blue-black colour **ii** (A) – whole leaf is blue-black; (B) chlorophyll areas are blue-black; (C) no part of the leaf is blue-black **2 a** either by adding/removing more lamps or by moving the lamp to different distances from the plant **b** remove the lamp/remove plant from the beaker

c temperature/carbon dioxide concentration in the water/ species of plant/wavelength of light **d i** Light intensity on x axis/rate on y axis/labels to include quantities and units/points joined with smooth curve/maximum reached between 60 – 70 units **ii** 26 /27 bubbles (cannot have half bubbles!) **iii** rate of photosynthesis is proportional to light intensity up to about 60 units of light intensity. Beyond this, light intensity has less effect as some other limiting factor is 'controlling' the rate of photosynthesis (e.g. carbon dioxide concentration) **iv** less carbon dioxide/more oxygen **v** measure volume of gas given off, as bubbles may not all be of the same size. **e** input variable would be colour/wavelength (vary by using different filters or coloured papers), outcome variable would be rate of photosynthesis, fixed variables would be temperature, carbon dioxide concentration and MUST include light intensity **3 a** carbon dioxide + water chlorophyll and light → glucose + oxygen **b** photosynthesis **c** rises when light intensity increases, as more photosynthesis possible/falls as light intensity falls and sugar is used up in respiration faster than it can be produced **d** light intensity was lower that day (e.g. it was cloudy) **e** raises temperature (affects enzymes of photosynthesis)/ provides more carbon dioxide as fuel is burned **4 a i** A – upper epidermis, B – palisade mesophyll, C – spongy mesophyll, D – guard cell of stomata, E – xylem **ii** palisade mesophyll – B **iii** xylem – E **b** as sucrose (in the phloem) **c i** Starch **ii** add iodine solution – blue-black colour is a positive result **iii** could be respired to release energy for growth/could be converted to cellulose in cell walls **d i** 1.4 mm (measured thickness is 70 mm, scale has 5 mm representing 0.1 mm, $70/5 = 14$ and $14 \times 0.1 = 1.4$ mm **ii** approx 0.4 mm – same reasoning. **5 a** light intensity/ temperature/volume of water available/species of plant/ age of plant at start **b i** Stem and roots are smaller/some leaves yellowed/plant cannot manufacture proteins and other compounds needed for growth **ii** leaves pale green or yellow/ plant cannot produce chlorophyll as magnesium is a part of this molecule **c i** Plants had absorbed/removed the nitrate ions; nitrates had been washed out of the soil; nitrates converted to nitrogen gas by denitrifying bacteria **ii** plant nitrogen-fixing plants (e.g. peas and beans)/add nitrate fertiliser/ add organic compost which bacteria could break down to nitrate **d** some may capture insects and obtain nitrates from insects' bodies/ some may have root nodules containing nitrogen-fixing bacteria

Matching terms

A-4; B-10; C-15; D-1; E-13; F-8; G-5; H-14; I-12; J-6; K-2; L-9; M-11; N-7; O-3

Chapter 16: Plant transport

1 a key point here is that RATE is proportional to 1/time taken. Rates are 2.0, 0.63, 10, 0.59, 0.40. On bar chart the bars should not touch; environmental condition on x axis, rate on y axis. **b** At high light intensity plants will photosynthesise so stomata are open – water vapour can leave easily so rate of bubble movement is quite high. **c** (2) air is humid so water potential gradient is not steep; (5) low humidity means that some water loss can take place from the few stomata that are open in the dark (little photosynthesis so no light available) **d** (3) wind removes moist envelope of air from leaf surface so that water potential gradient is steep; (4) in the dark most of the stomata are not open as no photosynthesis can take place, so even windy conditions will not lead to a high rate of bubble movement. **2 a i** Lower surface – look at leaf C compared with B **ii** yes – look at D compared with C **b i** X is stomatal pore, Y is guard cell **ii** lower surface of leaf has more stomata, so more water vapour can be lost. Vaseline blocks these stomata so loss of mass from B is very much reduced **3 a** stomata **b** more complex diagram of simplified one on p.60 **c i** Evaporation **ii** diffusion **iii** helps in cooling plant in direct sunlight, BUT means that large volumes of water must be

replaced by the roots **d** leaf X (18, 18,000), leaf Y (8, 8,000) – there are 1000 mm² in an area 5 cm x 2 cm **e** leaf Y – fewer stomata from which water vapour can be lost so less need to replace this lost water **f** thick, waxy cuticle/hairs on leaves/leaves may be rolled with stomata on inside surface **4 a i** 1: stomata are kept in a humid environment so no water potential gradient down which water vapour will move 2: water cannot move through the waxy layer **ii** 1. Can absorb water from great depths in the soil 2: fleshy stem has cells which can store large volumes of water when water is available **b** less opportunity for light absorption for photosynthesis, so fewer materials available for growth **c i** Osmosis/photosynthesis/evaporation(transpiration/diffusion) **ii** water potential of soil solution/light intensity/temperature, wind speed

Fill in the missing words

Osmosis; hairs; surface area; ions; nitrate; diffusion; active transport; support; solvent; photosynthesis; xylem; phloem; vascular.

Chapter 17: Transport in animals

1 a Jack – more red blood cells to help when oxygen concentration is very low **b** James – more white blood cells for defence **c** Jack – has more platelets (which increase blood clotting) and red blood cells (which would increase the viscosity of the blood) **d** Julian – has fewer red blood cells which are responsible for the transport of oxygen. Less oxygen means cells would be less able to release energy, and sufferer would be fatigued. **e** It has removed age and gender as possible variables from the investigation. **2 a** C **b** C **c** A **d** A **e** B **f** B **g** B **h** B **i** B **j** C **3 a** 120 000 (male and female) **b** 245 000 **c** 120 000/500 000 = 24% **d** Pie chart makes it more obvious which is the largest contributor to deaths **4 a i** Hepatic vein – vena cava – right atrium – right ventricle – pulmonary artery – pulmonary vein – left atrium – left ventricle – (aorta) – coronary artery **ii** pulmonary vein – left atrium – left ventricle – aorta – hepatic artery – hepatic vein – vena cava – right atrium – right ventricle – pulmonary artery **b i** Plenty of exercise (preferably aerobic)/diet low in saturated fats **ii** diet high in salt/smoking (accept mixture from i. And ii.) **5 a i** 0.8 seconds **ii** 60 seconds/0.8 seconds per beat = 72 beats per minute **b i** maximum in left ventricle = 130 mm mercury, so maximum in right ventricle = 130/5 = 26 mm mercury **ii** left wall is much more muscular **c** pressure in ventricle is greater than in aorta so blood can flow out of heart into the aorta **d** X: left atrioventricular (bicuspid) valve – prevent backflow from ventricle to atrium as pressure in ventricle rises. Y: left semilunar valve – prevent backflow from aorta to left ventricle as pressure in ventricle falls **6 a i** Oxygen/glucose/amino acids **ii** carbon dioxide **b i** Muscle **ii** it will contract (the fibres will shorten) **iii** they are put under pressure so will be forced out along the aorta **c i** diet high in saturated fats and/or cholesterol/low level of exercise / smoking **ii** shade areas after the blockage (i.e. downwards on the diagram) **d** they have thin walls/ wide lumen so that they can carry large volumes of blood; they have valves to help return of blood at low pressure to the heart

Crossword

ACROSS: 1. Cholesterol; 3, pacemaker; muscle; 7, blood pressure; 9, arteries; 10, coronary; 11, semilunar; 15, tendons; 16, ventricle; 18, left; 19, pulmonary; 21, atrium; 22, veins
DOWN: capillaries; 2, valve; 5, smoking; 6, vena cava; 8, exercise; 11, diastolic; 13, systolic; 14, aorta; 17, bypass; 19, heart rate; 21, right

Chapter 18: Defence against disease

1 a phagocyte/macrophage **b** phagocytosis **c** it can detect an antigen (foreign protein) on the surface of the bacterium

d digestive enzymes are added **e** cholera/pneumonia/syphilis/gonorrhoea/TB and many others **f** antibiotics can be prescribed **2 a** a product which can stimulate the immune response **b** a protein made by a B-lymphocyte which can recognise and bind to an antigen **c** it is larger, quicker and lasts for longer **d** the vaccine is less likely to cause unwanted side-effects if given in two smaller doses. The second vaccination stimulates the production of more memory cells. **e** A: active; B: active; C: passive; D: passive; E: passive **3 a i** A – 3; B – 1; C – 4; D – 2 **ii** AIDS – unprotected sex/sharing needles for drug users; cholera – drinking infected water; athlete's foot – contact with fungal spores e.g. on a towel; malaria – being 'bitten' by an infected *Anopheles* mosquito **b i** These are the nutrients for the growth of the bacterial culture **ii** to sterilise it (make sure that there are no microbes present in it) **iii** 4 – the ring of killed bacteria has the greatest area **iv** bacteriocidal would show bacteria being killed (so population falls to zero), bacteriostatic would show population stable, no longer increasing **v** any bacterial diseases e.g. *Salmonella* infection/cholera/TB/syphilis **4 a** it could be heated to a high temperature/the genetic material could be removed **b** T-cells recognise the antigen on the viral surface/instruct B-cells to make antibodies/some B-cells become memory cells and 'remember' how to produce these antibodies if another infection occurs **c** The Sabin method uses only a single injection (so more likely to be up-to-date), the response is quicker, and the antibody level remains higher than the minimum needed for protection **d i** Both methods take a long time to build up immunity – by the time the antibody level is high enough the virus may have caused the disease **ii** the person may be given an anti-viral drug, or an injection of ready-made antibodies **5 a i** The gene for the surface antigen **ii** the surface antigen **b** whole virus might have not been 'killed' and so would have the potential to cause disease. The engineered virus antigen should not be able to multiply in the host, and so should not cause disease.

Fill in the missing words

Blood loss; pathogens; disease; platelets; proteins; fibrinogen; fibrin; red blood cells; anaemia.

Chapter 19: Breathing and gaseous exchange

1 A – d; B – c; C – a; D – e; E – b **2** energy; respiration; oxygen; carbon dioxide; surface area; thin; moist; ventilation; blood; amoeba; spiracles; tracheoles; gills **3 a** intercostal muscles contract to move the ribs upward and outwards. The diaphragm contracts and moves downwards. These two movements increase the volume of the chest (and the lungs) so the pressure inside the lungs falls: this causes air to move in from the atmosphere. **b i** The total volume of air breathed increases steadily up to 5.5% carbon dioxide, then it increases very rapidly to a maximum of 55 litres **ii** because the total volume depends on the volume per breath (tidal volume) as well as the breathing rate **4 a** cigarettes per day/period since smoking on x axis, annual death rate on y axis; check the scales on the axes to make full use of graph grid; check key to distinguish two curves **b** 7.5 **c** 4 years **d** Nicotine **e** Carbon monoxide in tobacco smoke reduces the ability of haemoglobin to transport oxygen, so lips look less red as less oxyhaemoglobin is formed **f** Emphysema/bronchitis/lung cancer/bladder cancer/mouth cancer **5 a** Before: 10 after: 13 **b** 0.9 dm³ per minute **c** The student is still repaying an oxygen debt. During the exercise the muscles produce lactic acid – getting rid of this requires oxygen even when no further exercise is going on. **6 a i** The random movement of molecules down a concentration gradient (until an equilibrium is reached) **ii** there is a higher concentration of oxygen in the alveoli – the gas moves down a concentration gradient **iii** they are thin, moist, have a large surface area, are well-ventilated and are close to a good blood supply **b i** The

concentration gradient from alveoli to blood would be less steep, so it would be more difficult for oxygen to be taken up
ii more red blood cells increases the oxygen-carrying ability of their blood. This provides more oxygen for respiration, and so more energy can be released and the athlete can perform better.

Fill in the missing words

Pulmonary; respiration; energy; carbon dioxide; hydrogencarbonate; capillaries; thin; surface area; alveoli; carbon dioxide; oxygen; diffusion; pulmonary; left atrium.

Chapter 20: Respiration

1 Sensitivity/locomotion/growth/reproduction/nutrition/growth and development **2 a** activity on x axis, value on y axis/keep bars separate/label bars correctly **b** 5150 kJ (450 + 1000 + (4x650) + 1100) **c** To keep heart beating/digestion operating/maintain body temperature/keep breathing **d** Water is more dense than air, so resistance to movement is greater **3 a i** 50°C (79 – 29) **ii** 8.4 kJ per g **iii** should be in the form of a bar chart, bars separate and clearly identified/type of food on x axis/energy value on y axis **iv** fat (closest to value for energy content of seed) **b** Benedict's Test: crush seed and suspend in water/heat sample with equal volume of Benedict's Reagent/look for colour change: blue to orange-red if reducing sugar is present **4 a i** Carbon dioxide **ii** respiration **iii** cell division/movement/synthesis of molecules/maintaining body temperature **b** absorbed onto crystals of soda lime (potassium or sodium hydroxide), or could be passed through limewater **c** size reflects the number of respiring cells. Same size is removing 'number of cells' as a variable in this experiment **d** mouse feeds on radioactive glucose/respires glucose and so releases radioactive carbon dioxide/carbon dioxide reacts with lime water to form calcium carbonate/calcium carbonate solid is collected on filter paper **5 a** False **b** True **c** False **d** True **e** True **f** True **g** False **h** True **i** True **j** True **k** False

Fill in the missing words

living cells; glucose; oxygen; energy; aerobic; growth; movement; heat.

Chapter 21: Excretion and osmoregulation

1 a Total water gain = 2700 cm³. Water loss = 450 + 500 + 150 + loss in urine. Therefore loss in urine = 2700 – 1100 = 1600 cm³ **b** Receptors in brain measure water potential of blood. Changes in water potential alter the amount of ADH (Anti Diuretic Hormone) released. This hormone then controls the amount of water 'saved' by the kidney and so not lost in the urine. This demonstrates negative feedback, since a reduction in water intake eventually causes greater saving of water and so 'cancels out' the original change. **c i** It does not depend on the availability of a kidney for transplant/it should not challenge the patient's immune system/drug treatment can go on through the dialysis fluid entering the body **ii** it is inconvenient – the patient must spend long periods on the machine/long-term treatment is very expensive **2 a i** The protein molecules are too large to cross the filtration membrane and enter the urine **ii** glucose molecules can cross the filtration membrane, but it is possible for them to be selectively reabsorbed and returned to the blood **b** Training on a hot day means that much water will be lost in sweat/reduces the water potential of the blood/osmoreceptors in brain detect this change/more ADH is released to 'instruct' the kidney to recover more water from the urine. **3 a i** Excretion is the removal from the body of toxic materials, the waste products of metabolism **ii** Egestion is the removal from the body of food materials that have not been digested and absorbed from the gut **b i** in the liver **ii** from excess amino acids (by the process

of deamination) **c** Q = renal artery; R = vena cava; S = ureter; T = urethra **d** Glucose (X); red blood cells (X); salts (✓); water (✓) **4 a** Urea is still being formed but it is not being excreted **b** It will take more time before the urea concentration reaches dangerous levels **c** The patient may be treated with drugs which suppress the activity of their immune system, so that the body's defences no longer attack the donor kidney/the donor kidney may be treated so that it has no antigens on its surface and so it is not recognised by the host defences

Crossword

ACROSS: 2, urine; 3, urea; Henle; 5, bladder; 8, filtration; 9, renal artery; 10, sphincter; 13, excretion; 14, plasma; 15, glucose; 16, Bowman's; 18, urea; 19, kidney; 20, dialysis
 DOWN: 1, nephron; 2, urethra; 3, ureter; 6, renal vein; 7, diuretic; 11, hormone; 12, amino acids; 14, protein; 17, anti

Chapter 22: Hormones and the endocrine system

1 a The cattle will gain weight more quickly, produce more milk and will have less of their 'meat' as fat **b** An increase in the number of infertile cattle **c** Humans may receive BST from the meat, and this may affect the Human's growth **d** Otherwise the BST could be digested in the intestine before it has been absorbed **e** Chickens would appear to be a cheap food source for the body builders, but the chickens would retain oestrogen in their tissues. The body builders might receive this oestrogen, and since this is a female hormone the males body builders become feminized. **2 A** – 5; **B** – 1; **C** – 8; **D** – 6; **E** – 2; **F** – 7; **G** – 3; **H** – 4 Adrenaline can therefore prepare working muscles for longer periods of greater activity, and can make sure that the brain makes the decisions necessary to deal with the issue (e.g. 'shall I fight or shall I run away?') **3 a** Time on x axis/glucose and insulin levels on y axis/check appropriate scales for the two dependent variables/check that 'activity' periods are indicated **b** Glucose level falls, as glucose is removed to muscles for respiration to release energy. The insulin level falls as it is no longer necessary to 'instruct' the liver to remove glucose and store it as glycogen. Half an hour later the insulin level rises following the increase in glucose level, and the need to remove glucose for storage. **c** Glucagon (increases breakdown of glycogen to glucose)/adrenaline (increases availability of glucose for respiration) **d i** This reduces the likelihood that any unreliable single result will affect the overall result **ii** it can be assumed that they will have a normal glucose/insulin response **e** 1 hour **4** Insulin/oestrogen/progesterone **5 a** A chemical, produced by an endocrine organ, released into the blood where it travels to affect the activity of a target organ **b** A rise in blood glucose level is detected by the Islets of Langerhans in the pancreas. These glands release insulin. Insulin increases the uptake of glucose by the liver, and the storage of excess glucose as glycogen. As a result the blood glucose levels return to normal. This is an example of negative feedback. **c** Insulin would be digested to peptides and amino acids, and so its function would be lost. (Insulin can be wrapped in a gel coat to partially overcome this problem) **6 a i** Insulin increases the uptake of glucose by the liver, and the storage of excess glucose as glycogen. As a result the blood glucose levels return to normal. **ii** Insulin increases the uptake of glucose by the liver, and the storage of excess glucose as glycogen. As a result of too much the blood glucose levels fall below normal. **iii** glucose (sugar) is removed from the blood by the working tissues, so that it can be respired and release energy **b** sugar is absorbed more quickly, as starch has to be digested before it can provide sugar. **c** A fall in blood glucose level is detected by the Islets of Langerhans in the pancreas. These glands now release less insulin. As there is less insulin there is a fall in the uptake of glucose by the liver, and the storage of excess glucose as glycogen. As a result the blood glucose levels return to normal. This is an example of

negative feedback. **d** In negative feedback, a change from normal conditions (e.g. an increase in blood sugar level) sets off a process to cancel out the change (in this case, the release of insulin from the pancreas)

Fill in the gaps

Hormones, endocrine organ, blood, target organ.
Adrenaline, trachea.

Chapter 23: The nervous system and coordination

1 a A (accept E) **b** C **c** E **d** E **e** D **f** B **2 a** 4 **b** 4 **c** 80 mg corresponds to 5 units of alcohol. 3 cans of cider plus 1 glass of wine = 10.6 units of alcohol. This corresponds to 175 mg per 100 cm³, so the person would be 95 mg per 100 cm³ over the legal limit **d** Reduces coordination/increases reaction time/affects judgement of distance **e** Five and a half to six hours **f** Cirrhosis **3 a i** Road traffic accidents **ii** 5/20 = 25% **iii** meningitis is an infection that can affect the spinal cord **b** she may have damaged her sensory nerves, or the dorsal root of the spinal nerve (so she can't feel things) but the motor nerves are unaffected (so she can write)/senses from the feet may enter the spinal cord at a different level to motor impulses leaving the spinal cord for the hands **4 a** A = sensory neurone; B = grey matter; C = relay neurone; D = motor neurone; E = synapse **b** Show gap/neurotransmitters **c** Caffeine : stimulant – allows neurotransmitter to act for longer; marijuana: sedative – neurotransmitters cannot cross the synapse and continue an impulse; Heroin: sedative – copies the effect of a natural sedative chemical; cocaine: allows neurotransmitter to act for longer; stimulant - copies the effect of a natural stimulant chemical **5 a i** 73, 75, 79, 79, 83, 87 **ii** number of cups on x axis, rate on y axis – probably best shown as a bar chart **iii** yes – coffee appears to increase the heart rate **iv** cups contained the same volume of coffee/coffee always the same 'strength'/volunteers had similar background (e.g. age/gender/basic heart rate) **b** examine heroin use by all women giving birth/look for relationship between birth weight and heroin use by mother. This is necessary since it is unethical to give heroin to mother and see what happens to the birth weight of her child! **6 a** relay neurone – transfers nerve impulse from sensory to motor neurone **b** synapse **c i** As an electrical impulse(wave of depolarisation) **ii** as molecules of neurotransmitter **d** spinal (knee jerk/withdrawal); cranial(pupil reflex/accommodation reflex); conditioned (salivation when thinking of tasty food) **e i** It would be lost **ii** it would be unaffected **f** no – the dorsal root is not itself sensitive (the receptor is the part of the reflex arc that 'detects' the stimulus) **g** C = axon; D = myelin sheath; E = cell body; F = (accept nodes of Ranvier); G = dendrite. Two differences from motor neurone: cell body nearer middle of neurone/neurone attached to receptor cell/ impulses travel towards the CNS

Matching terms

A-5; B-9; C-1; D-10; E-2; F-3; G-6; H-4; I-7; J-8

Chapter 24: The eye as a sense organ

1 a i Before: small pupil/large iris; after: large pupil, small iris **ii** pupil in middle/iris around pupil/sclera = 'white' of eye **b** light is detected on retina, motor impulse to radial muscle of iris, muscle contracts, iris becomes narrower, pupil larger **c** shapes rely on black and white vision, which is possible because rod cells operate well at low light intensity. Colour depends on cones, which do not operate well at low light intensity **2 a** cornea and lens **b** A would contract, ligaments would loosen, lens would become shorter and fatter, light would focus more onto retina **3** A – 5; B – 9; C – 1; D – 10; E – 2;

F – 8; G – 4; H – 3; I – 6; J – 7 **4 a** A: ciliary muscle; B: contracts to make pupil smaller in bright light **b i** Voluntary: under conscious control; antagonistic: with opposite effects **ii** the eye would look to the right **iii** D would contract and C would relax **c** cornea – aqueous humour – pupil – lens – vitreous humour **d** rods: monochrome/low intensity – throughout retina, especially at the edges. Cones: colour/high intensity – at the centre of the retina (yellow spot) **5 a i** Light receptors convert light energy to electrical energy, as nerve impulses **ii** rods – sensitive to light at low intensity/black-and-white vision; cones – sensitive to light of high intensity/colour vision **b** a neurone/ relay neurone – has many dendrites to connect to other cells **c** cornea – aqueous humour – pupil – lens – vitreous humour **d i** Biceps contracts/triceps relaxes/forearm is pulled so that the elbow flexes **ii** optic nerve(sensory nerve) – brain – spinal cord – motor neurone – muscles in arm

Crossword

ACROSS: 2, retina; 5, balance; 6, eye; 7, coughing; 9, sight; 11, cones; 12, ligaments; 15, reflex; 18, rods; 19, nose; 22, touch; 25, thermo; 26, stretch; 28, ciliary muscle; 31, stimulus; 32, skin; 33, iris; 34, choroid
DOWN: 1, receptor; 3, tongue; 4, lens; 8, fovea; 10, hearing; 13, integration; 14, taste; 16, smell; 17, auditory; 20, optic; 21, ear; 23, cornea; 24, blind spot; 26, sensory; 27, tears; 29, pain; 30, pupil

Chapter 25: Sensitivity and movement in plants

1 a growth. Stimulus **b** gravity **c** positive, photosynthesis **2** c; it is the tip which produces the growth hormone, auxin, responsible for the phototropism **3 a** concentration on x axis, curvature on y axis/correct labels with quantity and unit/check that scale is correct/accuracy of plot **b** 12 degrees **c** Positive phototropism **d** Auxin **4 a** Shoot B has not increased in length. Auxin cannot reach shoot B as the tip has been removed. Auxin is needed for growth, so no auxin means no growth. **b i** Auxin has moved down the shoot and towards the non-illuminated side of the shoot **ii** R **c** Plant hormones can make flowers act as though they have been fertilised, and so produce seedless fruits/plant hormones can be used as selective weedkillers/ plant hormones can be used to control growth of hedges/ plant hormones can coordinate the formation of fruits so that harvesting is more efficient **5 a** A suitable temperature for enzyme action/availability of water/availability of oxygen for aerobic respiration **b** So that light could reach the shoot tip **c i** Shoot would be growing upwards after a short 'horizontal' length/root would be growing downwards after a short 'horizontal' length **ii** root: positive geotropism – auxin pulled to bottom surface of horizontal root – cells grow less – root curves downwards. Shoot: positive phototropism – auxin diffuses to bottom of horizontal shoot – cells grow more – shoot curves upwards. Note that auxin has a different effect on the root cells than the shoot cells **iii** the continuous rotation means that the seedling was experiencing light and gravity stimuli from continuously differing directions

Matching terms

A-5; B-7; C-6; D-9; E-3; F-10; G-4; H-1; I-8; J-2

Chapter 26: Human reproduction and growth

1 a A: sperm duct/vas deferens; B: urethra; C: testis; D: scrotum/ scrotal sac; E: penis **b** Testis/C **c** Prostate gland/F **d** Testis/C **e** Urethra/B **f** Sperm duct/A **2** Ovulation – ejaculation – fertilisation – implantation – development – birth **3 a** A = oviduct/fallopian tube; B = ovary; C = womb; D = uterus/wall

of uterus; E = cervix; F = vagina/birth canal **b** X in oviduct, Y in lining of uterus **c** Diaphragm covers cervix, pill prevents release of eggs from ovary? ovulation **4 a i** Carbon dioxide, urea **ii** villi give a large surface area, very close to mother's blood supply **iii** gut/intestine: will absorb digested food; lungs: will carry out exchange of carbon dioxide and oxygen **b i** Provides a cushion for the developing fetus **ii** Downs syndrome (Trisomy-21) **c i** Age of mother on x axis, frequency on y axis/bars can be touching/ check accuracy of plot **ii** percentage difference = change/original $\times 100$ i.e. percentage difference = $(27.2 - 4.9)/4.9 \times 100 = 455\%$ **iii** advantage: prevent 'hot flushes'/limit deterioration of bones; disadvantage: tenderness of breasts/irregular menstrual bleeding/nausea **5 a i** A chemical, released from an endocrine organ, carried in the blood to have an effect on a target organ **ii** in the bloodstream **b** the green light gives an indication that there has not been a recent ovulation, so there is no egg cell to become fertilised **c** oestrogen controls the repair of the lining of the uterus; luteinising hormone stimulates ovulation and controls the development of the corpus luteum after ovulation **d** the timing of starting a family can be controlled until parents are ready (e.g. until mother is healthy following an illness)/unwanted pregnancies can be avoided/ some people may use this contraception to become sexually promiscuous/there are side-effects of hormonal contraception, including increased possibility of dangerous blood clotting **6 a** head: relative size of forehead decreases/ears become visible/mouth becomes visible; foot: separate toes become visible **b i** A: 8 mm; B: 94 mm **ii** 12X (actually 11.75X) **7 a** P = ovary, Q = cervix, R = vagina/birth canal **b** Oviducts are closed, so no ova can be reached by sperm so no fertilisation can take place **c i** in the lining of the uterus **ii** could make sure that the fertilisation has been successful/could make sure that the zygote has begun to divide **d** 21 – 26 days as highest levels of progesterone

Matching pairs

A-13; B-9; C-8; D-1; E-3; F-18; G-15; H-2; I-10; J-20; K-5; L-6; M-7; N-4; O-17; P-11; Q-14; R-12; S-16; T-19

Chapter 27: Reproduction in plants

1 a i Pollination **ii** bee picks up pollen from anther of flower A, then transfers it to stigma when visiting flower B **b i** Fertilisation **ii** the ovary **c** they will be similar because they are receiving genes from the same two parents, but not identical because the production of gametes involves meiosis (random assortment of chromosomes) and fertilisation involves random fusion of gametes. **2 a** M : sum of lengths/10 = 247 mm; N = 132 mm **b** 247 – 132 = 115 mm **c** The plants may be genetically different/there may be different nutrients or water levels in the soil **d** This method of reproduction copies the genetic make-up of a plant and so the resistance to the weedkiller could be transmitted to offspring **3 a** Sexual involves two parents and there can be very great variation between offspring/asexual has only a single parent and there is no variation between the offspring **b** sexual – variation means that new environmental challenges can be met, BUT two parents are needed and many of the offspring may not be adapted to their environment/ asexual – no variation means that offspring are suited to an unchanging environment BUT may not be adapted if environment changes in any way, only one parent needed means that this is a good method of colonising new environments where very few individuals may be found **c** bud which is close to ground undergoes mitosis (copying division) and so grows out sideways. Where stem touches the ground it forms roots (adventitious roots), then runner can break as a new plant has now been formed. **4 a** 2: stamens are almost hidden – stamens are obvious 3: five petals – six petals 4: style is longer – style is shorter 5: anthers large and elongated – anthers small and spherical 6: sepals are visible – sepals not visible **b i** P produces

male gametes (pollen), Q receives pollen grains after pollination **ii** reproduction in flowers involves fertilisation, which is part of sexual reproduction **c** petals are large/ and colourful/stamens do not hang out of flower/stigma does not hang out of flower/ stigma is not branched to increase surface area

Crossword

ACROSS: 4, stigma; 7, fruit; 9, hermaphrodite; 10, wind; 12, seed; 13, anther; 15, nectar; 17, ovary; 18, dispersal; 19, pollination; 20, insect; 22, variation; 23, filament; 24, tuber
DOWN: 1, egg; 2, competition; 3, sepal; 5, asexual; 6, fertilisation; 8, runner; 11, petal; 14, germination; 16, pollen; 21, style

Chapter 28: Germination and plant growth

1 a A = testa (seed coat); B = cotyledon; C = radicle; D = plumule; E = embryo **b** FAT : reagent – alcohol – add alcohol to crushed cotyledon/shake/pour suspension into distilled water/ cloudy suspension indicates that fat is present **STARCH**: reagent – iodine solution – add iodine solution to crushed cotyledon – blue-black colour indicates that starch is present **2 a** B and D – A has no water, C has no oxygen. B has both oxygen and water, at the correct temperature – the black cover is irrelevant since light is not a requirement for germination. D also has oxygen, water at an appropriate temperature **b i** Temperature on x axis, percentage germination on y axis/labels on axes include quantities and units/plot is smooth curve with maximum at 35°C **ii** shape indicates that enzymes are involved – the shape indicates an optimum temperature typical of enzymes **iii** the hole means that it is easier for oxygen and water to enter the seed, and so germination will be quicker **3 a i** Starch **ii** Protein **b** enzymes **c** these are the areas of cell division, and amino acids are needed to produce the proteins needed for the building of new cells **d** oxygen, water, an appropriate temperature for the action of enzymes **e i** Positive phototropism **ii** this means that the shoot, with leaves, will be in the best position to absorb light for photosynthesis **4 a** A – no; B – yes; C – no; D – yes **b i** Check accuracy of plot **ii** 20 **iii** 30 **5 a** oxygen and an appropriate temperature for the activity of enzymes **b i** In dish A, most of the seeds have germinated, with long radicles already showing the growth of root hairs. In dish B, just over half of the seeds have begun to germinate, but the radicles are short and none of them has root hairs **ii** labels should include testa, radical and root hairs **c i** some factor in tomato juice inhibits the germination of tomato seeds **ii** use the juice from the tomato seeds, and repeat the experiment but with seeds from other species.

Crossword

ACROSS: 3, fertilisation; 4, amylase; 5, embryo; 7, testa; 8, radicle; 9, ovule; 10, cotyledon; 13, flower; 15, plumule; 16, enzymes; 17, water
DOWN: germination; 2, gamete; 6, oxygen; 11, dormancy; 12, fruit; 14, lipase; 15, pollen

Chapter 29: DNA and characteristics

1 a nucleus **b** white **c** B **d** Identical twins **e** Check the DNA fingerprints of individuals which are to be bred together. Look for the greatest difference in DNA fingerprints – this will ensure the greatest genetic variation in the offspring **2 a** Letters in top line : T, C, T; short strand – (G); letters in bottom line: C, T, A, C, A; short strand: C, T **b** A – adenine, G – guanine, C – cytosine, T – thymine **c** Mitosis is copying division, and replication provides two identical copies of the cell's DNA **d** Gene **e i** Methionine – tyrosine – glycine – alanine – histidine **ii** TAC – ATG – CCG – CCG – TA **iii** methionine – tyrosine –

proline – proline **iv** mutation **v** sickle cell anaemia/Huntington's disease/cystic fibrosis **vi** the change may enable the organism to adapt to a new environment, e.g. to resist a particular disease
3 a A = DNA, B = nuclear membrane, C = messenger RNA, D = cytoplasm, E = amino acid, F = transfer RNA, G = ribosome
b i Amylase/lysozyme **ii** keratin **iii** haemoglobin **iv** pepsin
4 a meiosis **b** gamete has half of the total DNA (the haploid number of chromosomes) **c** DNA (deoxyribonucleic acid) **d** Top half: G, C, left strand: G, A; right strand A – T, G – C, A – T)
e Mutation **f** X-radiation, u.v. radiation **g** sickle cell anaemia/Huntington's disease/cystic fibrosis **5 a i** Mitosis – amount of DNA doubles and then returns to normal amount as cell divides into two **ii** DNA codes for the production of proteins, which give the cell its characteristics **b** mutation **c** a restriction enzyme can be used to cut a useful gene from donor DNA, and the same restriction enzyme can be used to 'open' a plasmid from a bacterium. Ligase can then 'stitch' the useful gene into the plasmid, and the recombined plasmid can be returned to a bacterial cell. The cell can be allowed to multiply and form a clone – a set of identical cells all being able to produce a valuable protein.

Crossword

ACROSS: 2, amylase; 4, protein; 5, genotype; 7, mutagen; 10, chromosome; 13, messenger; 14, bases; 15, amino acid; 16, replication; 18, phenotype; 19, haemoglobin; 20, gene
 DOWN: 1, bacterium; 3, mutation; 6, nucleus; 8, translation; 9, ribosomes; 11, radiation; 12, double helix; 17, allele

Chapter 30: Cell division and the human life cycle

1 a a string of genes, found in the nucleus of a cell **b i** 46
ii 23 **iii** 0 **iv** 0 **c** meiosis **d** mitosis **2 a** 46, 23, 23, 46, 46 **b** It suggests that egg and sperm are from the same adult **c** In the reproductive organs – ovary in female and testis in male **d** They must become haploid, because they fuse to form a zygote. If gametes were not haploid, zygotes would be tetraploid (4n) and the number would double with every generation **3 a** To make it easier to squash the tip and separate the cells **b** To separate the cells **c** To stain the chromosomes **d** A, B, C, D, E, F **e** Show centromere, two chromatids **f** 8 **g** 4 **4 a** Genes, and some factor in the environment **b** When they contact another cell nearby **c** Mitosis **d** Bone marrow/skin/lining of gut/liver **e** A mutagen **f** Surgery, chemotherapy, radiotherapy **5 a i** Meiosis **ii** it is haploid/ it has a tail **iii** zygote **iv** to be female, the zygote must receive an X chromosome from her father as well as one from her mother **b i** Ovary **ii** oviduct **iii** uterus

Matching pairs

A-7; B-5; C-8; D-6; E-1; F-9; G-2; H-10; I-3; J-4

Chapter 31: Patterns of inheritance

1 a phenotype **b** allele **c** Mendel **d** Gene **e** Genotype
f Heterozygote **g** Dominant **2 a** Rr, Rr; gametes would be R, r and R, r; A = RR normal), B = Rr (carrier), C = Rr(carrier), D = rr (with cystic fibrosis) **b** $\frac{1}{4}$ (1 in 4, 0.25) **c** White blood cell – red blood cell does not have a nucleus and so cannot provide DNA for the probe to detect **3 a** A – male, haemophilic; B – female, carrier **b** $X^N X^n$ x $X^N Y$ Gametes X^N X^n X^N Y Offspring $X^N X^N$, $X^N X^n$, $X^n Y$, $X^N Y$ - a haemophilic son **c i** The female must receive the 'n' allele from both parents **ii** girls could bleed to death when they menstruate **4 a** Gametes will be N, S and N, S A = NN, B = NS, C = NS, D = SS **b** Low ability to transport oxygen, so less aerobic respiration so less energy **c** Malaria **d** Mutation **e** X-radiation, u.v. radiation **5 a i** Recessive – each parent must have given the recessive allele to their cystic fibrosis child, but neither parent shows the condition themselves **ii** see

Q. 2 : probability is $\frac{1}{4}$ (0.25, 1 in 4) Rr, Rr; gametes would be R, r and R, r; A = RR normal), B = Rr (carrier), C = Rr(carrier), D = rr (with cystic fibrosis) **b** enzymes replace those that cannot enter the gut from the pancreas, antibiotics control the multiplication of bacteria which might colonise the mucus in the lungs **c i** Show removal of viral genes (by restriction enzyme), introduction of 'correct' gene – stitch with ligase, infection of sufferer with 'correct' gene **ii** they fell that the process is not 'natural'/they worry about the risks of GMOs escaping into the environment/they worry about the genes entering other, possibly harmful, organisms

Fill in the gaps

Mendel; garden pea; stamens; stigma; insects; tall; height; homozygous; tall; dominant; 3:1; mendel; DNA; genes; chromosomes; nucleus.

Chapter 32: Variation and selection

1 1. A 2. A 3. A 4. N 5. N 6. N 7. N 8. A 2 a 110
b B, because the number of individuals providing information for the mean data is greater. This means that any anomalous result will have less of an effect. **c** Area 1: more of the snails are in the groups with large diameter bases. The larger the diameter of the base, the tighter the limpet can attach to the rocks to avoid being dislodged by the powerful waves. **d** Continuous **e** Height/body mass/hand span **3 a** 3, 2, 1 **b i** The snails were 'protected' inside cages, so the predators couldn't reach them **ii** the paint on their shells would have been more faded **iii** this means that the position of the spot on the shell would not be an input (independent) variable **iv** the dark colour is a better absorber of heat energy, so the snails could be more active even though the area is cool and shady **4 a** a desert/dry environment: it has leaves reduced in size to spines (less water loss by evaporation), it has both shallow roots and deep roots (able to absorb any water from any depth) **b** it has leaves reduced in size to spines (less water loss by evaporation), it has both shallow roots and deep roots (able to absorb any water from any depth), it has a stem swollen with water (water storage cells) **c** 1 – D, 2 – B, 3 – F, 4 – A, 5 – E, 6 – C

Fill in the gaps

Discontinuous; blood grouping; continuous; body mass; discontinuous; genes; continuous; environmental; genotype; phenotype; phenotype; genotype; effects of environment; mutation; crossing over; independent assortment; fertilisation; evolution; natural selection; genes.

Chapter 33: Ecology and ecosystems

1 a A pyramid of numbers **b** Beetle, small bird **c** There is a loss of energy between level 2 and level 3, so there is not enough energy to support as many organisms in level 3 (also, the level 3 organisms are usually bigger) **d** The level for the oak tree is shorter, since there is only one oak tree (even though this has millions of leaves) **2** Tertiary consumers – tawny owl; secondary consumers – willow warbler, great tit, beetle; primary consumers – winter moth larvae, oak egg caterpillar, field mouse; producer – oak tree **a** Tertiary (2), secondary (14), primary (100) **b** Check accuracy, using the 100 primary consumers to arrange the scale **c** The owls can fly to other trees for feeding i.e. they are part of a pyramid with many oak trees at its base **3 a** So that the student wasn't biased in the counts he made **b** So that the sample size was a fixed variable (otherwise the number of organisms could vary if different sample sizes were used) **c** Lamp provides heat and dryness which drives the organisms downwards; wire mesh allows organisms through but holds soil back **d** Woodland – 26, parkland – 10 **e** Temperature: measure with a thermometer or sensor and data logger; eliminate acidity as a factor by moistening the leaves

with a buffer solution; eliminate water availability by moistening both samples to the same extent; eliminate availability of food by providing food other than decomposing leaves **4 a** They release digestive enzymes, especially amylase, onto the dead remains. Amylase hydrolyses starch to sugars. Lipase may also be released, and hydrolyses fats to fatty acids and glycerol. The decomposers use some of the sugars and fats in respiration, and release energy and carbon dioxide. **b i** 1025 **ii** active transport of ions/cell division/synthesis of large molecules **c i** Percentage efficiency = $1.8/6000 \times 100 = 0.03$ **ii** food input can be controlled more easily/cattle do not use up so much energy in movement **iii** a possibility of disease spreading quickly/difficult to remove wastes **5 a i** June **ii** april **iii** the leaves on the trees absorb and reflect the light **b i** there is more light available to them for photosynthesis **ii** very little light reaches them, so it would be wasteful to keep the leaves **c i** May – once pollination has occurred, fertilisation is possible and the petals are no longer needed **ii** May to October shows the petal fall (fertilisation) then the maximum number of fruits which fall (corresponding to dispersal)

Crossword

ACROSS: 3, joule; 5, ecosystem; 6, quadrat; 9, consumer; 10, heterotrophy; 12, community; 14, food chain; 17, herbivore; 18, habitat; 19, omnivore

DOWN: 1, autotroph; 2, producer; 4, population; 7, transect; 8, carnivore; 11, sunlight; 13, carbon; 14, food web; 15, biomass; sample

Chapter 34: The cycling of nutrients

1 a i Carbon compounds in living animals **ii** C, D or E **iii** B **iv** A **b i** arrow labelled P from carbon dioxide to carbon compounds in plants **ii** carbon dioxide + water $\xrightarrow{\text{light energy, chlorophyll}}$ glucose + oxygen **2 a** protease **b** amino acids **c** Fungi **d** Hypha **e** Ensure oxygen concentration on x axis, uptake on y axis/axes labelled with quantities and units/points plotted clearly/join points with smooth curve **f** Two methods of uptake, one method of uptake is dependent on oxygen concentration: oxygen affects aerobic respiration and so energy available for active transport **g** Temperature (affects activity of respiratory enzymes) **h** Could make sure that soil is aerated/temperature is appropriate for enzymes of respiration **3 a** Nitrogen **b** X – nitrogen fixation, Y – denitrification, Z – nitrification **c** Nitrate **d** Amino acids/protein/plant hormones **e** Urea/uric acid **4 a** To dissolve solutes for transport/to break down large molecules in digestion/as a raw material for photosynthesis/to lubricate dry surfaces/as support e.g. in turgor **b** Nitrate **c i** Year on x axis – bars should not be touching/check key to distinguish oxygen from nitrate **ii** percentage decrease = $\frac{\text{decrease}}{\text{original value}} \times 100$, so percentage decrease = $2.0/5.9 \times 100 = 33.9$ **d i** Eutrophication **ii** the availability of nitrate and phosphate **iii** protein

Crossword

ACROSS: 1, denitrification; 3, photosynthesis; 4, carbon dioxide; 5, nitrification; 8, fixation; 9, nodules; 12, respiration; 14, fungi; 15, bacteria; 16, decomposer; 17, excretion; 18, active; 19, amino acid

DOWN: 2, eutrophication; 6, enzymes; 7, leaching; 10, protein; 11, competition; 13, nitrate

Chapter 35: Human impact on the environment

1 a G **b** Limpet (looks triangular) **c** The limpet is definitely not the most common over the whole of the area, so the transect has given misleading information **d** There are 30 limpets in five quadrats i.e. 6 per m^2 . Total area = $10 \times 10 = 100 \text{ m}^2$, so estimated population = $6 \times 100 = 600$. **e** 30 **f** No – the

estimated population would still be 600 **g** Yes. Perhaps the number of quadrats in the sample was not high enough **2 E** – A – G – B – C **3 a** Other must be 23%. Bar graph will have type of waste on x axis, percentage of total on y axis. Bars should not be touching. Check that scale makes best use of the graph grid you use. **b** This means that a material can be broken down by the activities of living organisms (usually decomposers). Paper/wood/garden waste. **c** Methane. **d** Paper and board + food and garden rubbish = 56, total = 77. Percentage which is biodegradable = $56/77 \times 100 = 72.7\%$ **4 a** Diagram should show solar radiation reaching Earth's surface, being reflected away but then back towards the Earth by a layer of greenhouse gases. **b** Methane/carbon dioxide **c i** Would rise, as ice caps melt more quickly **ii** would spread further North and South as temperature will be higher further from the Equator and insects can breed in these warmer areas. **iii** become more severe, as heat evaporates water from the seas and gradients of temperature (which cause winds) become much steeper **5 a i** Visible light **ii** photosynthesis **b** over a twenty year period there has been a rise in carbon dioxide concentration (of about 20 parts per million); each year there is a fall early in the year and a rise later in the year **c i** The temperature will rise, as the carbon dioxide traps the heat reflected and radiated from the Earth's surface **ii** burning less fossil fuel/trapping carbon dioxide in special traps beneath the Earth's surface/planting more trees to absorb carbon dioxide **6 a** to supply wood for building/to provide land for crops to be grown/to provide land for domestic animals **b i** Loss of trees reduces the removal of carbon dioxide during photosynthesis/there may be less fallen material for decomposers **ii** soil is deprived of nutrients as the trees are removed/soil can dry out more as wind blows across it/soil can be eroded by wind and water **iii** fewer breeding sites so some species will decline/fewer feeding opportunities so some species will decline/less shelter for many species

Fill in the gaps

Infra-red; methane; CFCs; carbon dioxide; pests; photosynthesis; CFCs; ultraviolet; cancer; mutation; ozone; mesophyll; nitrates; pesticides; acid rain; batteries; motor oil; CFCs.

Chapter 36: Farming and food production

1 Increase yield: cutting down hedges – more space for crop/easier to use machinery; increased use of nitrate fertilisers – nitrate is a limiting factor for many crop plants. Damage the environment: burning stubble – smoke/carbon dioxide enters the environment; drainage of wet fields – loss of habitat for wading birds; repeated growth of same crop – removes same mineral nutrients from soil each time the crop is harvested/can increase chances of disease organisms breeding in one habitat **2 a** approximately 9% **b** female **c** 5% **d** 25 – 29 **e** B: high proportion of children, very small proportion reach 60+ **f** 2 400 000 **g** Food produced more efficiently, so fewer children die and family size increases. More people survive to breeding age. **3 a i** Potatoes – fallow – sprouts – peas **ii** growing a series of different crop species so that the soil is never allowed to deteriorate (do not remove same nutrients every year/include crops which can 'fix' nitrogen) **b i** Two separate blocks of bars – peas and sprouts – on x axis, nitrate level on y axis **ii** mean for sprouts = $(54 + 44 + 52)/3 = 50$; mean for peas = $(82 + 88 + 80)/3 = 83.3$. Increase = $(83.3 - 50)/50 \times 100 = 67\%$ increase **4 a** suitable temperature helps to avoid loss of energy from cattle/light can affect growth rates by making more time available for feeding. **b** High protein/low fat/correct minerals and vitamins/cheap to produce/easy to distribute to animals **c** To know when the optimum weight gain has taken place – do not wish to continue expensive feeding if there is no further weight gain **d** Contains nitrates and phosphates which

could lead to eutrophication of local water sources (so oxygen concentration falls and many aerobic organisms die out) **e** Avoid disease (antibiotics/vaccinations) which can make animals grow more slowly

Matching terms

A-E; B-I; C-J; D-G; E-A; F-C; G-D; H-B; I-H; J-F

Chapter 37: Conservation

1 a 60 divided by 12 years = 5% per annum **b** The sample is very small, and may not accurately represent the whole population **c** DDT makes eggshells thinner, so fewer eggs hatch (parents break many eggs as they incubate them) **d** It is at the top of a food chain, and the DDT from organisms lower in the chain will accumulate in the body of the top predator **e** Eats insects from DDT treated trees, so probably picks up DDT from the surface of the insects as well as from the contents of the insects. It will be easy for the roller to catch insects killed/slowed down by DDT. **f** DDT is now banned in the UK, but remains in use in Uganda as there are few alternative methods for insect control **2 a i** A smooth, moist skin **ii** fish/reptiles/birds/mammals **b** They are from the same genus, *Bufo* **c** Their favoured habitat of sand dunes is under threat – from building camp sites and from the growth of woodland trees which cool the sand surface below the temperatures the Natterjack toads prefer **d** Restrict development of camp sites, and keep sand dunes clear of trees **e i** Secondary consumers/carnivores **ii** adult insects and insect larvae **iii** common toad has a wider range of food types, so can adapt to a loss of one or two food types **3 a** feathers (e.g. on tail) and beak **b i** Binomial system means two-part name (Genus first, then species) e.g. *Oxyura jamaicensis* for the Ruddy duck **ii** They belong to the same genus (*Oxyura*) and

they are capable of cross-breeding **c i** The Ruddy duck is also found in other parts of the world **ii** the Ruddy duck might be a more efficient feeder than the White-headed duck and so removes food sources from the White-headed duck. **d** There are two different food sources for the duck, and there are two predators which feed on the duck. This could not be shown in a single food chain. **4 a** They have fur, and feed their young on milk from mammary glands **b** Loss of habitat e.g. for cattle ranching, so the Tamarins cannot find food and are more easily captured by predators. They breed very slowly, with small litters, and are often captured for the fur trade. **c** They will be removed from the wild as they are difficult to breed, the populations will become inbred and any animals that are produced cannot learn the skills they need to survive in the wild. **d** They are protected, so might be reintroduced to new habitat if it becomes available/biologists can study them and find out the best conditions for breeding them/they are attractive and might help to raise funds for conservation (Flagship species) **e** Cites controls the trade of endangered species and their products between different countries e.g. ivory from elephants cannot be sold from African countries to other parts of the world **f** they are attractive and might help to raise funds for conservation. Saving their habitat will help other species that live there. **5 a** 5000 miles per year in 1968 **b** The UK is able to import much of its food and so needs less land to grow crops to feed its population **c** Support: i., iv, v, vi.; Argue against: ii., iii., vii., viii.

Crossword

ACROSS: recreation; 4, panda; 6, food web; 8, reclamation; 9, CITES; 13, creation; 14, habitat; 16, breeding; 17, tiger; 18, resources; 19, zoo; 20, elephant
DOWN: 2, captive; 3, species; 5, agriculture; 7, flagship; 10, rhinoceros; 11, management; 12, mollusc; 15, DDT