Answers to the Workbook

Exam-style questions and sample answers have been written by the author. In examinations, the way marks are awarded may be different. References to assessment and/or assessment preparations are the publisher's interpretation of the syllabus requirements and may not fully reflect the approach of Cambridge Assessment International Education.

Please note: some questions may have alternative answers which may be correct but are beyond the requirements of the syllabus. They have therefore not been included.

1 Characteristics and classification of living organisms

Core

1 nutrition – taking in materials for energy, growth and development

respiration – the chemical reactions in cells that break down nutrient molecules and release energy for metabolism

excretion – the removal of waste products of metabolism

sensitivity – the ability to detect and respond to changes in the internal or external environment

reproduction – making more of the same kind of organism

growth – a permanent increase in size

movement – an action by an organism or part of an organism causing a change of position or place

2 Respiration is the chemical reactions in cells that break down nutrient molecules and release energy for metabolism. Breathing is the process of ventilation of the lungs.

3 ref. to faeces being undigested food; which has not been formed through metabolic processes

4 (*fish and amphibians*)

Common features – Any two from: cold blooded; have eyes; produce jelly-covered eggs (in water);

Differences: ref. to gills/lungs; fins/legs; scales/moist skin;

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(*amphibians and reptiles*)

Common features – Any two from: four legs; eyes and ears; cold blooded; lungs;

Differences: ref. to moist skin/scales; jelly-covered eggs/waterproof shell;

(*birds and mammals*)

Common features – Any two from: eyes and ears; warm blooded; lungs;

Differences: ref. to feathers/fur; two legs/four legs; eggs with hard shell/live young; beak/no beak (or ref. to teeth); ears/ears with pinna; no mammary glands/mammary glands

5 **A** insect, **B** arachnid, **C** myriapod, **D** crustacean

6

Plant	1a	1b	2a	2b	3a	3b	Name of plant
A	–	✓	–	–	–	✓	(*Primula vulgaris*)
B	✓	–	–	✓	–	–	*Narcissus pseudonarcissus*
C	–	✓	–	–	✓	–	*Ranunculus ficaria*
D	✓	–	✓	–	–	–	*Hyacinthoides non-scripta*

Supplement

7 **a** **i)** Any three from: multicellular; have roots/stems/leaves; ref. to seed production;

ii) Any three from: (cellulose) cell wall; sap vacuole; nucleus; cytoplasm; cell membrane

b leaf shape – broad; leaf veins – parallel; cotyledons – two; grouping of flower parts in threes

8 protoctists, fungi, plants, bacteria

Exam-style questions

Core

1 Any three from: movement; excretion; nutrition (feeding); sensitivity (irritability) [3]

2 **a** movement; sensitivity [2]

b Any two from: growth; reproduction; respiration [2]

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3 Sensitivity; nutrition; growth; [3]

4 **A –** *Nucella lapillus*; **B –** *Calliostoma ziziphinum*; **C –** *Patella vulgata*; **D –** *Littorina obtusata*; **E –** *Cerastoderma edule* [5]

Supplement

5 **a** The DNA is made up of a sequence of bases; each species has a unique sequence of bases in its DNA; this makes it identifiable/distinguishable from other species. [3]

b reference to the study of the base sequences in the DNA of the organisms; groups of organisms which are closely related have base sequences which are more similar than those which are more distantly related [2]

2 Organisation of the organism

Core

1 **a** – F; **b** – F; **c** – T; **d** – T; **e** – F; **f** – T; **g** – T; **h** – F; **i** – T; **j** – T

2 **a** **A** membrane, **B** cytoplasm, **C** cell wall, **D** chloroplast, **E** sap vacuole, **F** nucleus

b chloroplast, cell wall, sap vacuole

3 chromosome, nucleus, cell, tissue, organ, organ system, organism

4 **a** magnification = image size/actual size

b $\frac{12}{2.8} = \times 4.3$

5 $100 = \frac{15}{\text{actual size}}$; actual size $= \frac{15}{\mathbf{100}} = 0.15$ mm

6 **a** A group of cells with similar structures; working together to perform a shared function;

b Animal cells and functions – Any two examples, e.g. ciliated cells – waft mucus with dust or bacteria away from the lungs; muscle cells – can contract to cause movement; red blood cells – transport oxygen around the body;

Plant cells and functions – Any two examples, e.g. root hair cells – absorb water and mineral salts/anchor the plant into the soil; xylem cells – transport water and mineral ions from roots to leaves/provide strength for the stem; palisade mesophyll cells – photosynthesis;

7 **a** **cytoplasm:** contains cell structures, site of chemical reactions

b **cell membrane**: prevents cell contents from escaping, controls the passage of substances into and out of the cell

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c **nucleus**: controls cell activities, controls cell division/development

8 Any one plant cell, e.g. root hair cell, on surface of young roots, absorption of water/absorption of mineral salts/anchorage of plant into the soil

Any two animal cells, e.g. neurone, found in the peripheral nervous system, transmit electrical impulses; sperm cell, produced in testes, fertilisation of egg/reproduction; ciliated cell, found in respiratory tract, waft mucus with bacteria away from the lungs

Supplement

9 [1] mark for calculating the width of the cell; [1] mark for converting mm to μm; [1] mark for the calculation:

The width of the cell is 6 × 5 = 30 mm

In micrometres, this is 30 × 1000 = 30 000

magnification = image size/actual size

30 000 ÷ 60 = ×500

Exam-style questions

Core

1 **a** cell membrane; cytoplasm; nucleus [3]

b **i)** chloroplast [1]

ii) chlorophyll; traps/absorbs/transfers light energy for photosynthesis [2]

2 **a** Any two from: cell wall; chloroplast; sap vacuole [2]

b controls cell activities and development – **B**; contains cell structures and is the site of chemical reactions – **D**; waft mucus and bacteria away from the lungs – **A**; controls what substances enter and leave the cell – **C** [4]

3 organ – several tissues grouped together to make a structure with a special function, e.g. heart, leaf [2]

organ system – a group of organs with closely related functions, e.g. circulatory system, flower [2]

tissue – a group of cells of similar structure that work together to perform a special function, e.g. muscle, xylem [2]

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Supplement

4

Cell	Cell structure (s)	More/less/none	Explanation
(red blood cell)	(nucleus)	none	provides more space for haemoglobin
(upper epidermal cell)	(chloroplasts)	none	makes the cell transparent so light can pass through
(xylem vessel)	(nucleus)	none	allows water to flow freely through the vessel

[6]

5 The leaf contains a number of different tissues; which work together to carry out photosynthesis/transpiration. [2]

3 Movement into and out of cells

Core

1 Net movement of particles from a region of their higher concentration; to a region of their lower concentration/down a concentration gradient; as a result of their random movement.

2 **a** **i)** oxygen

ii) Any three from: short distance; big concentration gradient; large surface area; higher temperature

b **i)** Rate of diffusion would drop; because the molecules have a lower kinetic (movement) energy/molecules move more slowly.

ii) Rate of diffusion would increase; because the concentration gradient would increase or be maintained.

3 The movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration; against a concentration gradient; using energy from respiration.

Supplement

4 **a** **P**lant **A**: diffusion only – roots have absorbed nitrate; until there is no concentration gradient;

Plant **B**: diffusion and active transport/uptake – the roots have absorbed nitrate against a concentration gradient; building up a higher concentration than that present in the soil

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b Plants need energy from respiration to carry out active transport; cyanide prevents respiration.

5

Substance	Diffusion	Osmosis	Active transport
(oxygen)	✓	×	×
(water)	(accept) ✓	✓	×
(phosphate ions)	✓	×	✓
(carbon dioxide)	✓	×	×

6 Zone **A** – as the sugar solution becomes less concentrated, more water enters the potato cells by osmosis, so the tissue gains mass. The more dilute the sugar solution, the more mass is gained.

Zone **B** – as the sugar solution becomes more concentrated, more water leaves the potato cells by osmosis, so the tissue loses mass. The more concentrated the sugar solution, the more mass is lost. Between 0.6 mol dm^{-3} and 1.0 mol dm^{-3}, there is no additional mass lost as the potato cells have become fully flaccid in each case.

Zone **C** – at this point there is no net gain or loss of mass by the potato core as the water potential inside the cells is the same as the water potential of the surrounding sugar solution.

Exam-style questions

Core

1 D [1]

Supplement

2

Type of cell	Substance absorbed	Process(es) used	Gradient: high to low/low to high?	Energy used?
(root hair cell)	(water)	osmosis	high to low	no
	(nitrate)	1 diffusion 2 active transport	1 high to low 2 low to high	1 no 2 yes

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Type of cell	Substance absorbed	Process(es) used	Gradient: high to low/low to high?	Energy used?
(villus cell in small intestine)	(glucose)	1 diffusion 2 active transport	1 high to low 2 low to high	1 no 2 yes

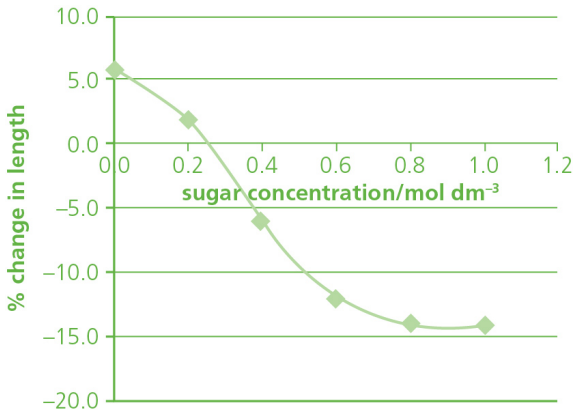
[15]

3 **a** and **b**

Sugar concentration/mol dm^{-3}	Start length/cm	Length after 1 hour/cm	Change in length/cm	% change in length
(0.0)	(5.0)	(5.3)	0.3	6.0
(0.2)	(5.0)	(5.1)	0.1	2.0
(0.4)	(5.0)	(4.7)	–0.3	–6.0
(0.6)	(5.0)	(4.4)	–0.6	–12.0
(0.8)	(5.0)	(4.3)	–0.7	–14.0
(1.0)	(5.0)	(4.3)	–0.7	–14.0

[4]

c



1 mark for axes labelled; 1 mark for units on *x*-axis; 1 mark for points plotted correctly; 1 mark for smooth line through points [4]

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d **i)** 0.26 mol dm^{-3} [1]

ii) The concentration of sugar in the potato cells is the same as the concentration in the surrounding solution; so there is no net movement of water molecules. [2]

e Any two from: leave all the cores in the solutions for the same amount of time; use the same volume of solution in each test tube; cut all the cores to the same diameter [2]

f Any one from: set up two or more cores for each concentration; measure the length of the cores in millimetres; weigh the cores instead of measuring length [1]

4 Biological molecules

Core

1 **a** carbon, hydrogen, oxygen

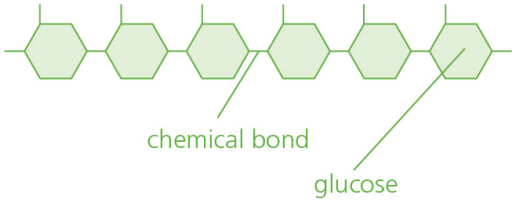
b carbon, hydrogen, oxygen

c carbon, hydrogen, oxygen, nitrogen

2 **a** **i)** starch/carbohydrate/any named carbohydrate

ii) obtaining energy

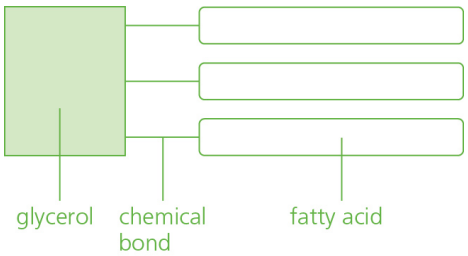
iii)



b **i)** fat/lipid;

ii) energy/insulation/formation of cell membranes/hormone formation

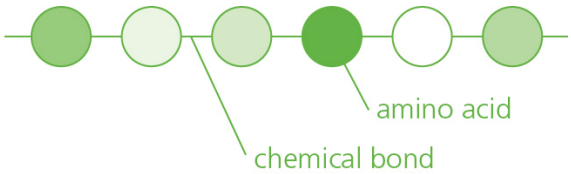
iii)



c **i)** protein

ii) growth/tissue repair/enzymes/cell membranes/hormone formation

iii)



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3 vitamin C – DCPIP – colourless;

reducing sugar – Benedict's solution – brick red;

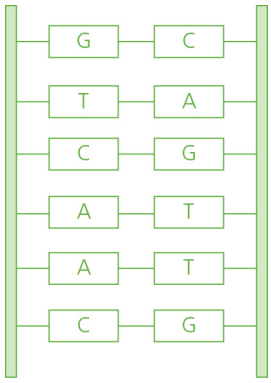
fat – ethanol – white emulsion;

protein – Biuret solution – purple;

starch – iodine solution – blue–black

Supplement

4 **a**



b double helix

c 1 mark for statement about base pairing; 1 mark for calculating total percentage for **A** + **T**; 1 mark for calculating % **C** bases

Base **A** pairs with base **T**, so there will be 28% **T** bases.

28 + 28 = 56%

The remaining % of bases must be **C** + **G**.

100 – 56 = 44 (**C** + **G**)

44 ÷ 2 = 22 **C** bases

Exam-style questions

Core

1 **a** Mix or grind the fish with ethanol; filter the mixture; pour the filtrate into water; [3]

b milky/white emulsion forms [1]

Supplement

2 C [1]

3 Any four points from: two strands; each strand is a chain of nucleotides; reference to the presence of bases; bases are A, C, G, T; bonds hold pairs of bases together; A pairs with T, C pairs with G [4]

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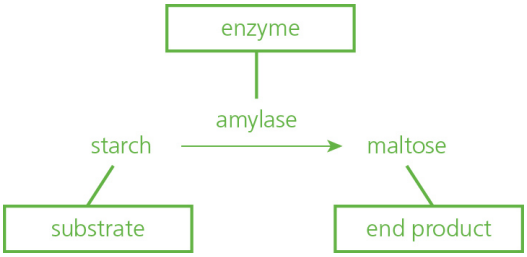
5 Enzymes

Core

1 a A catalyst is a substance that increases the rate of a chemical reaction and is not changed by the reaction.

b Enzymes are proteins that are involved in all metabolic reactions, where they function as biological catalysts.

2 a

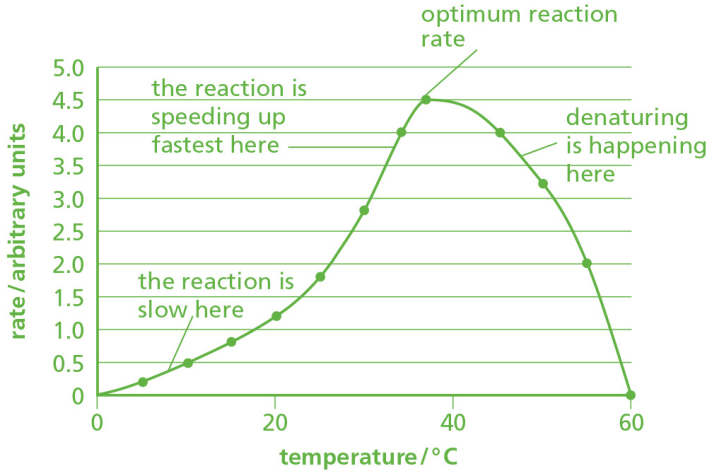


b Any two points from: starch is a larger molecule; starch is insoluble while glucose is soluble; starch is a polysaccharide/polymer while glucose is a monosaccharide/monomer

c **Enzymes increase the reaction rate + in cells/systems;** so that processes happen fast enough to sustain life.

Supplement

3 a



b i) The reaction would speed up because the substrate and enzyme molecules would move faster/gain more kinetic energy; so there would be more collisions.

ii) There would still be no reaction; because all the enzyme molecules have been denatured by the high temperature.

4 temperature; pH; concentration of substrate

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Exam-style questions

Core

1 **a** Any two points from: an enzyme is a protein, but a catalyst can be an inorganic molecule or element; an enzyme can be denatured by high temperature, but a catalyst is not damaged by high temperatures; an enzyme has an active site, but a catalyst does not; enzymes are produced inside living organisms [2]

b Any three points from: the enzyme has an active site; the active site has a complementary shape to the substance it breaks down; the substance it breaks down is called the substrate; after the reaction, products are formed; the enzyme molecule can continue to break down more substrate molecules [3]

Supplement

2 **a** Any five from: the food molecule is the substrate; the enzyme has an active site; which combines temporarily with the substrate to form an enzyme–substrate complex; bonds are broken in the substrate molecule; the products are formed; the products are small and soluble [5]

b Enzymes have a specificity; they have a complementary shape to the substrate molecule they work on; so the active site and substrate fit closely together to allow the reaction to happen. [3]

6 Plant nutrition

Core

1 **a**

$$\text{carbon dioxide} + \text{water} \xrightarrow[\text{chlorophyll}]{\text{sunlight}} \text{oxygen} + \text{glucose}$$

b **i)** sucrose

ii) starch

c chlorophyll traps/absorbs/transfers light energy

d **A** – (waxy) cuticle – waterproofs the leaf; **B** – upper epidermis – allows light to pass through/acts as a barrier to microbes; **C** – palisade (mesophyll) – main site of photosynthesis; **D** – xylem – transports water and mineral salts; **E** – phloem – transports products of photosynthesis/carries out translocation; **F** – guard cell – controls exit of water vapour from the leaf/controls gas exchange;

2 **a** palisade (mesophyll) cells

b guard cells

c (upper) epidermis cells

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d xylem cells

e phloem cells

3 Boil the leaf in water: to kill the leaf – this makes it permeable.

Boil the leaf in ethanol: to decolourise the leaf, since chlorophyll dissolves in ethanol.

Rinse the leaf in water: boiling the leaf in ethanol makes it brittle, so the water softens it.

Spread the leaf out on a white tile: so the results will be easy to see.

Add iodine solution to the leaf: to test for the presence of starch.

4 **a** Nitrate ions are needed to form amino acids, to build proteins; proteins are needed for growth.

b Magnesium ions are needed to make chlorophyll; chlorophyll is needed to trap light energy for photosynthesis.

5 **a** **i)** violet and orange/red

ii) green/blue

b Use a bright light to shine on the *Elodea* in a beaker of water. Measure the light intensity using a light meter, or measure the distance between the lamp and the plant. Allow the plant to adjust to the light intensity. Count the number of bubbles produced by the plant over a fixed time period (e.g. 1 minute). Move the lamp further away from the plant. Measure the new light intensity or the new distance between the lamp and the plant. Allow the plant to adjust to the light intensity. Count the number of bubbles produced by the plant over the same time period. Repeat the process for at least five different light intensities or distances. Keep the temperature of the water the same, use the same plant, use the same beaker, use the same time period for counting bubbles. Alternatively, the oxygen could be trapped in a graduated container such as an inverted gas cylinder, so the volume of gas could be measured.

Supplement

6 Nitrate is needed for protein synthesis; protein is needed for growth.

7 1 mark for all the correct formulae; 1 mark for all correct balancing;

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light energy}} C_6H_{12}O_6 + 6O_2$$

8 1 mark for each limiting factor; 1 mark for the reason;

light intensity – light energy is needed for the reaction

amount of carbon dioxide – substrate needed to form glucose molecules

temperature – provides reacting molecules with kinetic energy for collisions to form glucose

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Exam-style questions

Core

1 De-starch two similar potted plants, by keeping them in the dark for 48 hours. Place them in sealed bell jars/large transparent containers. To one container add a CO_2 absorber/named absorber e.g. soda lime or sodium hydrogencarbonate solution. Expose both plants to the same, optimum conditions, e.g. light, warmth. Leave for 2 days. Test a leaf from each plant for the presence of starch. Only the control plant leaf (without CO_2 absorber) will turn blue–black, indicating the presence of starch. [8]

2 **a** **i)** **A** – guard cells; **B** – upper epidermal cell; **C** – spongy mesophyll cell; **D** – palisade mesophyll cell [4]

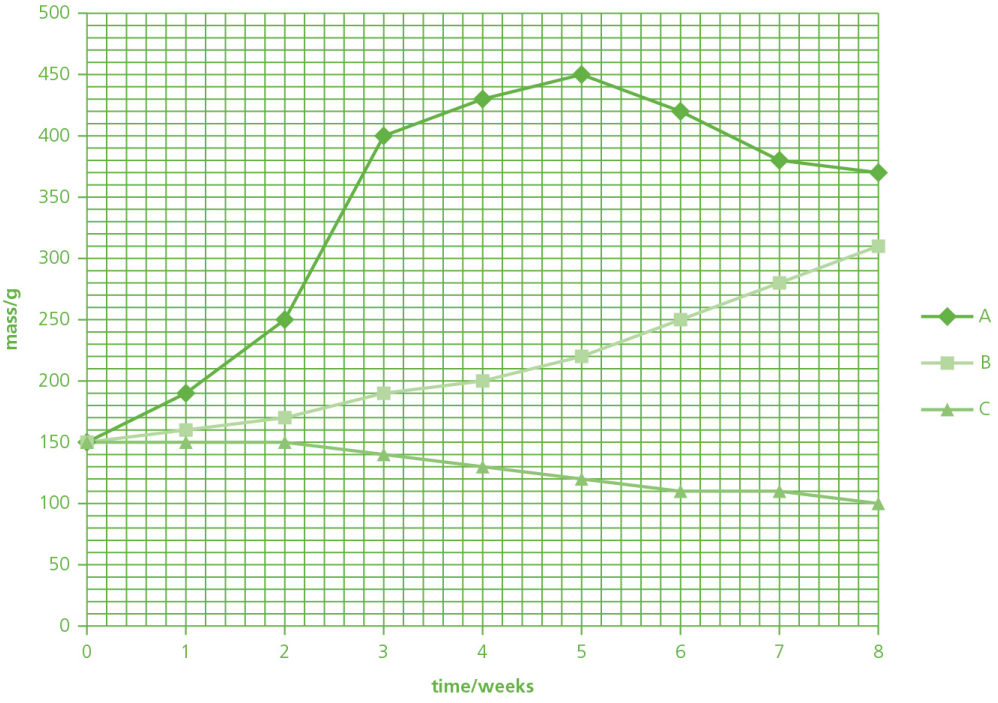
ii) **B**, **D**, **C**, **A** [2]

b xylem – transports water and mineral salts; from roots around the plant;
phloem – transports sucrose and amino acids; from leaves to storage or growth regions of the plant [6]

3 **B** [1]

Supplement

4 **a** *x*- and *y*-axis scales suitable and correct; *x*-axis label and units correct; *y*-axis label and units correct; points all plotted accurately; accurate, clean lines drawn between points; lines labelled correctly [6]



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b 1 mark for calculation; 1 mark for the correct answer;

300/150 × 100

= 200% *[2]*

c 1 mark for each container, from:

(*container **A***)

reference to the depletion of mineral ions;

reference to seeds released or due to disease;

reference to shortage of CO_2 or the plant has reached the end of its lifecycle;

(*container **B***)

reference to continued photosynthesis or growth or no limiting factors or food stored; *[2]*

d container **C**;

one point from:

least or no photosynthesis happening;

respiration is greater than photosynthesis;

the plant has died so bacteria are active, using up oxygen *[2]*

7 Human nutrition

Core

1 **a** calcium

b water

c fibre/roughage

d vitamin C

2 **a** Any two advantages from: high carbohydrate level – for energy; source of calcium – for strong bones and teeth/to prevent rickets; protein present – for growth/repair

Any two disadvantages from: high in animal fat – can cause heart disease/atherosclerosis/obesity; lack of fresh fruit/vegetables – which contain fibre to prevent constipation; three foods contain no vitamin C – to prevent scurvy; iron levels appear to be low – iron can prevent anaemia

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b Any two from: constipation; risk of obesity/scurvy/anaemia; risk of heart disease/atherosclerosis

c **i)** A diet that contains all the main nutrients; in the correct amounts and proportions.

ii) fibre/roughage

3 **A** – mouth; **B** – oesophagus/gullet; **C** – stomach; **D** – large intestine/colon; **E** – rectum; **F** – anus; **G** – small intestine/ileum; **H** – duodenum

4

Name	(incisor)	canine	(premolar)	molar
Description	chisel-shaped	(slightly more pointed than incisors)	two points/cusps one/two roots	(four/five cusps two/three roots)
Function	(biting off pieces of food)	biting off pieces of food	(tearing and grinding food)	chewing and grinding food

5 **a** The breakdown of large insoluble molecules; into small soluble molecules.

b

Enzyme	**Where the enzyme is secreted**	**The substrate on which the enzyme acts**	**The product(s) of digestion of the substrate**
amylase	1 mouth 2 duodenum	starch	glucose/maltose
lipase	duodenum	fats/lipids	1 fatty acids 2 glycerol
protease	1 stomach 2 duodenum/ileum	protein	amino acids/peptides

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Supplement

6 **a** (*physical digestion*) Any two points from:

emulsifies fats;

breaking them up into smaller droplets;

with a larger surface area;

b (*chemical digestion*) Any two points from:

bile is slightly alkaline;

enzymes in the small intestine work best in alkaline conditions;

bile contains sodium hydrogencarbonate;

which neutralises acid from the stomach

Exam-style questions

Core

1 Any two from:

incisor – biting off pieces of food

canine – biting off pieces of food

premolar – tearing or grinding food

molar – chewing or grinding food [4]

2 **a** **i)** **A** – enamel; **B** – dentine; **C** – pulp cavity; **D** – gum; **E** – cement; **F** – jaw bone; **G** – nerve [7]

ii) molar/premolar; two cusps visible/two roots visible [2]

b **i)** enamel [1]

ii) (*vitamin*) D; (*mineral*) calcium [2]

3 **A** [1]

4 **a** **i)** amylase [1]

ii) reducing sugar **[**1]

iii) **Any** two from: energy source; to convert to cellulose; convert to materials for growth [2]

iv) Starch is a large, insoluble molecule; while maltose is smaller and soluble. [2]

b Enzymes are only active in water; cells become turgid – leading to expansion. [2]

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Supplement

5 **a** **A** – oesophagus/gullet – moves food from mouth to stomach

B – ileum/small intestine – digestion of maltose/peptides; absorption of products of digestion or water [4]

b protein [1]

6 **a** Any two reasons and appropriate explanations from: less saturated fat; so less risk of heart disease/atheroma; more fibre; so less risk of constipation; more calcium; to maintain healthy bones/teeth/to prevent rickets [4]

b **i)** Any one from: other red meat; liver; kidney; eggs; green vegetables; chocolate; etc. [1]

ii) needed for the formation of haemoglobin; in red blood cells [2]

iii) ref. to anaemia; constant tiredness, lack of energy [2]

8 Transport in plants

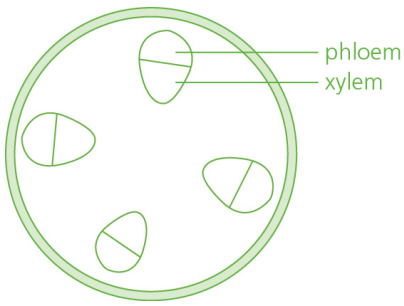
Core

1 **a** Any two from: anchoring the plant in the soil; absorption of water; absorption of mineral salts; food storage organ

b Root hair cells have a cell extension; increasing the cell's surface area to make it more efficient for absorbing water and mineral ions.

c root hair cell; cortex; xylem

2 **a**



b xylem – transport of water and mineral ions; phloem – transport of sucrose and amino acids

Supplement

3 Any three from: long, thin vessels; cells lack end walls; lack cell contents such as cytoplasm and nucleus; walls may be lignified to provide strength/waterproofing

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4 Transpiration – the loss of water vapour from the leaves through the stomata by diffusion. Translocation – the movement of sucrose and amino acids from sources to sinks/from regions of production or storage to regions of use for respiration or growth.

5 1 – high temperature; 2 – high wind speed

Exam-style questions

Core

1 **C** [1]

2 **D** [1]

3 Any five points from: reference to transpiration; water enters the leaf through xylem; water forms a layer on surface of mesophyll cells; water evaporates into the air spaces in the spongy mesophyll; this creates a high concentration of water molecules; lower concentration in the air surrounding the leaf; reference to diffusion of water molecules; through the stomata [5]

Supplement

4 Diffusion – the net movement of particles from a region of their higher concentration to a region of their lower concentration/down a concentration gradient, as a result of their random movement; oxygen diffuses from the air into a leaf, carbon dioxide diffuses out of a leaf, mineral salts diffuse from soil into root hairs

Osmosis – the net movement of water molecules from a higher water potential to a region of lower water potential, through a partially permeable membrane; osmosis is used to absorb water by roots, cells absorb water by osmosis to become turgid, which keeps young stems rigid

Active transport – the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration; against a concentration gradient, using energy from respiration; plants obtain mineral ions by active transport when the concentration of ions in the soil is lower than in the root cells

Transpiration – the loss of water vapour from the leaves; transpiration results in more water being drawn through the plant, carrying mineral ions from the roots [12]

5 **a** Water enters the leaf in the xylem vessels (**A**), then passes into the surrounding spongy mesophyll cells (**B**). A thin layer (**C**) forms on the surface of the cells, which evaporates and saturates the air in the air spaces (**D**), then the water molecules diffuse into the atmosphere through the stomata (**E**). [6]

b Transpiration from the leaves loses more water than is being taken in by the roots; cells in young stems lack water; become flaccid and stop pressing against each other; so stems and leaves lose their rigidity and wilt. [4]

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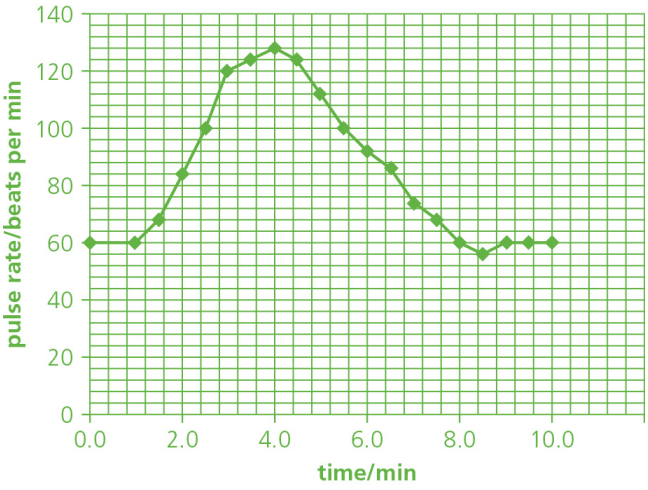
9 Transport in animals

Core

1 **a** left atrium; left ventricle

b aorta; pulmonary vein; coronary artery

2 **a** *x*-axis drawn and labelled 'time/min'; *y*-axis drawn and labelled 'pulse rate/beats per minute'; points plotted accurately; line drawn between points



b **i)** 60 beats per minute

ii) at 1 minute

iii) at 8 minutes

iv) Rate starts higher than 60 bpm; reaches a higher peak; takes longer to return to normal

c Any three of the following answers (the cause and the preventative measure must be given for each mark): smoking – stop smoking; obesity – go on a controlled diet/take regular exercise; stress – find ways of relaxing/identify causes of stress and reduce them; inherited factors – make sure other factors are reduced/monitor health

Supplement

3 **a** A tissue is a group of cells with similar structures, working together to perform a shared function.

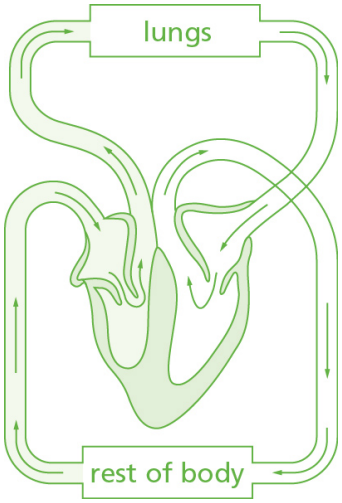
b (cardiac) muscle tissue

c it can contract

d It needs to build up enough pressure; to move blood around the body to all organs; while the right ventricle only moves blood to the lungs.

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4 **a, b** and **c**



5 Any three from: permeable wall – to allow diffusion of materials between the capillary and surrounding tissues; wall is one cell thick – allows fast diffusion/allows white blood cells to squeeze between cells of the wall; lumen is one blood cell wide – slows down blood flow to allow diffusion of materials and transfer of tissue fluid; valves are absent – blood pressure is high enough to keep blood flowing.

6 **a** Any three from: the heart has one atrium and one ventricle; blood goes to the gills for oxygenation; then through the organs of the body; blood passes through the heart once for each complete circulation of the body.

b Any two from: double circulation maintains a high blood pressure; to all organs of the body; so the system is more efficient in supplying organs with oxygen;

7 Heart must beat faster to circulate more oxygen; exercising muscles need more oxygen, more glucose; and produce carbon dioxide (or lactic acid), which needs to be removed.

Exam-style questions

Core

1 **B** [1]

2 **a** **A** – aorta; **B** – pulmonary vein; **C** – left atrium; **D** – (semilunar) valve; **E** – (bicuspid) valve; **F** – left ventricle; **G** – septum; **H** – right ventricle; **J** – right atrium; **K** – vena cava; **L** – pulmonary artery [11]

b **i)** right atrium

ii) pulmonary vein

iii) **(**semilunar) valve

iv) left ventricle

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v) septum

vi) vena cava

vii) aorta

viii) coronary artery [8]

3 **a** **i)** transport of dissolved substances to cells/removal of wastes from cells

ii) transport of oxygen

iii) produces antibodies to fight disease or engulfs bacteria to fight disease

iv) forms blood clots [4]

b **i)** biconcave disc shape/no nucleus/contains haemoglobin (pink colour)

ii) large nucleus or lobed nucleus or can change its shape [2]

Supplement

4 **C** [1]

5 **a** Blood passes through the heart twice, for each complete circulation of the body; once on its way to the body and once on its way to the lungs. [2]

b artery: Any two from: thick and tough wall; narrow lumen; valves absent;

vein: Any two from: thin wall; large lumen; valves present;

capillary: Any two from: permeable wall; wall one cell thick; lumen one red blood cell wide; valves absent; [6]

10 Diseases and immunity

Core

1 **a** A disease-causing organism

b Any three from: direct contact, e.g. through blood or other body fluids; indirectly, e.g. from contaminated surfaces; from food; from water; from animals; from the air;

c skin or hairs in nose – acts as a mechanical barrier

mucus or stomach acid – acts as a chemical barrier

blood cells – phagocytosis or antibody production by white blood cells

Supplement

2 vaccination

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3 **a** Antibodies are produced by lymphocytes; formed in lymph nodes; antibodies make bacteria clump together; so that phagocytes can digest them; they also neutralise toxins produced by bacteria; and remain in blood to provide long-term protection.

b Phagocytes can move out of capillaries; to the site of an infection; they engulf pathogens; and kill them by digestion.

4 Any three from: harmless pathogen given, which has antigens; antigens trigger an immune response by lymphocytes; lymphocytes produce antibodies; memory cells are produced to provide long-term immunity;

5 Any four from: passive immunity – short-term defence against a pathogen by antibodies acquired from another individual; e.g. mother to infant through breast-feeding or to the fetus through the placenta; active immunity – longer-term defence against a pathogen; gained after an infection by a pathogen, or by vaccination;

Exam-style questions

Core

1 **a** A disease in which the pathogen can be passed from one host to another [2]

b **i)** *(direct contact)* Any one from:

use of dirty needles for injections; direct contact with blood; unprotected sex;

(*indirect contact*) Any one from:

food preparation e.g. same surface used for raw meat and vegetables or not washing hands after using toilet; sneezing or coughing; reference to intensive methods of rearing animals; [2]

Supplement

2 Any six from: bacteria multiply in the small intestine; invade epithelial cells; release poisons; which irritate the intestinal lining; cause secretion of large amounts of water and salts; this increases the osmotic potential of the gut contents; more water is drawn in from surrounding tissues by osmosis; faeces becomes watery or reference to diarrhoea; body becomes dehydrated; [6]

11 Gas exchange in humans

Core

1 **a** (mouth), trachea, bronchus, bronchiole, alveolus, (red blood cell)

b **i)** diffusion

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ii) thin surface; large surface area; good blood supply; good ventilation with air

2 **a** **G** to alveoli; **A** to trachea; **M** to edge of diaphragm or any intercostal muscle

b rate increases; depth increases

c **i)** increases; from 0.04% to about 4%

ii) Any **three** points from: pour limewater into a container, e.g. test tube; insert straw; breathe gently out through the straw; limewater turns milky

3 **a** **A** alveolus/air sac; **B** capillary; **C** red blood cell

b **i)** arrow from inside the alveolus to a red blood cell

ii) arrow from blood plasma to inside the alveolus

iii) arrow along capillary from pulmonary artery to pulmonary vein

c **i)** diffusion

ii) ref. to breathing to keep oxygen levels in the alveoli high; ref. to blood constantly moving through capillaries, bringing blood low in oxygen;

Supplement

4 (external intercostal muscles contract), ribcage moves up and out, diaphragm muscle contracts, diaphragm moves down, volume in the lungs increases, air pressure in the lungs decreases, air moves in to fill the lungs

5 **a** **1** keeps the trachea open/prevents trachea from collapsing/allows free movement of air between mouth and lungs;

2 protects the lungs and heart/moves to increase or decrease the volume of the thorax;

3 contract to force air out of the lungs during exhalation;

4 moves down to increase volume of the thorax during inhalation/moves up to decrease volume of the thorax during exhalation;

b (*goblet cell*) secretes mucus; (*ciliated cell*) beats backwards and forwards to move mucus towards the throat; (*mucus*) traps dust and pathogens;

6 **a** (*oxygen*) used up in respiration to provide energy; (*carbon dioxide*) produced as a waste product during respiration; (*water vapour*) evaporates from the surface of the alveoli/produced as a waste product during respiration;

b carbon dioxide diffuses into the blood; increased concentration is detected by the brain; brain instructs thorax to increase breathing rate;

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Exam-style questions

Core

1 **a** Volume of air per breath increases; from normal tidal volume, e.g. from 0.5 litres; rate of breathing increases; from 12 to over 20 breaths per minute; [4]

b **i)** Before exercise: pour limewater into two containers, e.g. test tubes; insert straw into one; breathe gently out through the straw; count the number of breaths needed to turn limewater; from colourless to milky; then carry out exercise. After exercise: breathe through straw into second test tube; count the number of breaths needed to turn limewater milky. [5]

ii) Results: after exercise fewer breaths needed; to turn limewater milky; [2]

Explanation: during exercise; rate of aerobic respiration increases; so more carbon dioxide produced; [3]

Supplement

2 **a** **A** – spinal cord; **B** – left lung; **C** – heart; [3]

b **i)** lung [1]

ii) Any four from: contains many alveoli; contains many blood capillaries; for gas exchange; ref. to oxygen and carbon dioxide; ref. to diffusion; [4]

c Any six from: external intercostal muscles relax; ribs move downwards and inwards; diaphragm muscle relaxes; diaphragm moves up; volume of thorax decreases; air pressure in thoracic cavity increases; to become higher than atmospheric pressure; so air moves out of the lungs; [6]

12 Respiration

Core

1 **a** glucose + oxygen → carbon dioxide + water

b Any three uses from: muscle contraction; protein synthesis; cell division; active transport; growth; passage of nerve impulses; maintaining a constant body temperature

c **i)** lactic acid/lactate

ii) less energy production; lactic acid produced

2 1 carbon dioxide – breadmaking

2 ethanol – production of biofuels

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Supplement

3 $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Exam-style questions

Core

1 **D** [1]

2 **a** **i)** respiration

ii) carbon dioxide

iii) turns from colourless to milky

iv) ethanol/alcohol [4]

b Any five from: respiration of yeast is very slow at low temperatures; as molecules have little kinetic energy so few collisions; as the temperature is increased to 30 °C the rate of reaction increases; because the kinetic energy of the reacting molecules increases; 30 °C is optimum temperature for yeast respiration; as molecules have lots of kinetic energy to collide; enzymes in yeast begin to denature at 45 °C; so respiration slows down; all yeast enzymes denatured at 100 °C, so no respiration; [5]

Supplement

3 **a** muscles produce lactic acid/lactate; yeast produces ethanol; and carbon dioxide; [3]

b **i)** muscles respire anaerobically; producing lactic acid/lactate; [2]

ii) continued rapid/deep breathing; to provide oxygen; to break down the lactic acid/lactate; [3]

13 Excretion in humans

Core

1 (aorta), renal artery, capillary, kidney, ureter, bladder, urethra

Supplement

2 blood, water, glucose, reabsorbed, more, concentrated, osmosis, diffusion, active uptake

3 **a** Surplus amino acids are removed from the blood by the liver; and broken down into urea; by the process of deamination.

b Any two from: controlling levels of glucose in the blood; making bile; deamination of amino acids

4 **a** **i)** **V** – cortex, **W** – medulla, **X** – renal vein, **Y** – ureter

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ii) cortex contains glomeruli; ureter transfers urine to the bladder

b **i)** filters the blood; Any two named contents of filtrate from water, glucose, urea, salts

ii) reabsorbs; Any two named substances from glucose, most water, some salts

iii) passes urine; to ureter

Exam-style questions

Core

1 **a** **i)** **A** – renal vein; **B** – left kidney; **C** – ureter; **D** – bladder; **E** – urethra [5]

ii) Any **three** from: amino acids; and glucose will be present in part **A**; also fewer salts; less urea in **A** than part **C**; [3]

iii) Any two from: smaller volume; more concentrated; urea more concentrated; salts more concentrated; [2]

b Vena cava (**X**) has a thinner wall; larger lumen; contains valves; [3]

Supplement

2 **a** Any six from: renal artery brings blood into the kidney; divides into capillaries; each capillary forms a knotted glomerulus; which filters blood; filtrate collects in a capsule; filtrate passes through a tubule; reabsorption takes place; reabsorbed materials pass back to capillaries; return blood to renal vein; remaining filtrate is urine; [6]

b Any three from: the kidney is an excretory organ; it removes urea from the blood; urea is toxic; the kidney controls water levels in the blood; reference to homeostasis; [3]

3 **a** amino acids dissolve in blood plasma

carried in the hepatic portal vein [2]

b amino acids are converted to proteins [1]

c the nitrogen-containing part of the amino acids is removed

to form urea [2]

14 Coordination and response

Core

1 **a** Central nervous system: made up of brain and spinal cord; which have the role of coordination; peripheral nervous system: made up of nerves; which connect all parts of the body to the central nervous system;

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b **i)** A group of receptor cells; responding to a specific stimulus, e.g. light, sound, touch, temperature, chemicals;

ii)

Sense organ	**Stimulus detected**
1 (ear)	sound/body movement
2 eye	(light)
3 (nose)	chemicals/smell
4 tongue	(chemicals (taste))
5 skin	(temperature, pressure, touch, pain)

2 Any three from: sensory neurone has dendron present/very long dendron/motor neurone has no dendron; sensory neurone has no axon/very short axon/motor neurone has a long axon; cell body is near the end of the sensory neurone/cell body is at the start of the motor neurone; dendrites are present at the end of the sensory neurone/motor end plates are at the end of the motor neurone;

3 **a** A hormone is a chemical substance; produced by a gland; carried by the blood; that alters the activity of one or more specific target organs.

b causes heart rate to increase; breathing rate increases; pupils widen

4 **a** **i)** **A** – sensory neurone; **B** – relay neurone; **C** – motor neurone;

ii) muscle

iii) arrows go from pain receptor along sensory, relay and motor neurones to muscle

b it contracts

c synapse

5 **a** A response in which parts of a plant grow towards or away from gravity.

b **i)** grows towards gravity – root; grows away from gravity – shoot

ii) (*root advantage*) access to water/access to mineral ions/better anchorage

(*shoot advantage*) access to light (for photosynthesis)

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Supplement

6 **a** and **b** **D**: circular muscles; contracted; **E**: radial muscles; relaxed; **F**: pupil; constricted;

7

Feature	**Nervous**	**Hormonal (endocrine)**
(form of transmission)	electrical impulses	chemical/hormones
(transmission pathway)	nerves	blood vessels
(speed of transmission)	fast	slow
(duration of effect)	short term	long term

8 **A** – ciliary muscles; contract; **B** – suspensory ligaments; slacken; **C** – lens; thickens;

9 **a** auxin

b **i)** The shoot bends/grows towards the light.

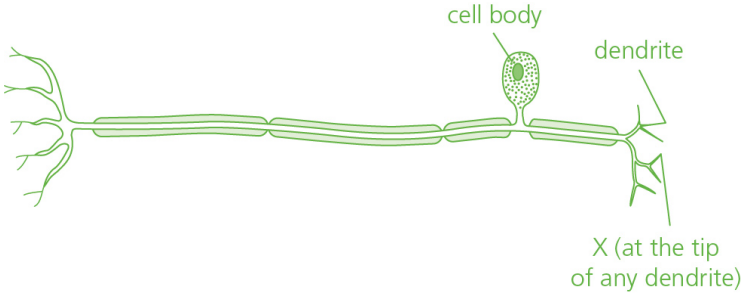
ii) Any **four** points from: when a shoot is exposed to one-sided light, auxins are produced by the tip; auxins move towards the shaded side of the shoot/auxins are destroyed on the light side; causing an unequal distribution; cells on the shaded side are stimulated to absorb more water than those on the light side; making the cells bigger; the unequal growth causes the stem to bend towards the light;

Exam-style questions

Core

1 **a** **C** [1]

b **i)** and **ii)** [3]



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Supplement

2 Any eight points from: homeostasis means maintaining a constant internal environment; pancreas acts as a sensor in negative feedback and acts as an effector by secreting hormones; if glucose levels rise above normal, change is sensed by the pancreas; insulin is secreted by the pancreas and passed into bloodstream; insulin instructs the liver to remove excess glucose from the blood; glucose is converted to glycogen and stored; rate of respiration in the liver is increased to use up glucose; glucose levels return to normal; if glucose levels fall below normal, the pancreas stops secreting insulin and starts to secrete glucagon; glucagon instructs the liver to convert glycogen to glucose; glucose is passed into the bloodstream, glucose levels return to normal; [8]

3 **a** Any six points from:

blood vessels – muscles in arteriole walls relax; arterioles dilate; allowing more blood near to the surface of the skin; heat radiated from skin surface so body cools;

sweat – sweat glands in skin secrete more sweat; passes through pores onto surface of the skin; water evaporates; removing heat from skin so body cools; [6]

b Glucagon secreted by pancreas; causes liver to convert glycogen to glucose; heart rate increases; so more blood with glucose passes to muscles. [4]

4 **a** Insulin stimulates the liver to take up glucose from the blood and store it as glycogen; so reducing blood glucose/sugar levels. [2]

b After a meal [1]

c Any two from: take regular exercise; have regular blood tests; have a carefully controlled diet, low in sugars/carbohydrates; [2]

15 Drugs

Core

1 **a** Any substance taken into the body that modifies or affects chemical reactions in the body

b

	Yes/no
A chemical used to fight an illness	Yes
Aspirin – used to reduce the risk of a heart attack	Yes

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Paracetamol – used to reduce the pain of a headache	Yes
Water – taken to reduce thirst	No
Insulin – taken to reduce blood sugar levels	Yes
Antibiotics – taken to stop a bacterial infection	Yes
Blood transfusion – given to boost blood volume	No

Supplement

2 a Any three from: bacteria exposed to sub-lethal levels of antibiotic, e.g. by patient not taking full course of treatment; some bacteria survive; with resistance to antibiotic; reproduce; whole population is now resistant; some bacteria have resistant gene, so have an advantage;

b Any two from: only taking antibiotics when essential; ensuring course of treatment is completed; good hygiene practices in hospitals;

Exam-style questions

Core

1 Any three from: disrupt the production of the cell wall; prevent bacteria from reproducing; cause the bacteria to burst open; interfere with protein synthesis; stop the growth of the bacteria; [3]

Supplement

2 a i) bacterium [1]

ii) Any three from: presence of cell wall; presence of single strand of DNA; presence of flagella; ref. to small size; [3]

b i) asexual reproduction [1]

ii) Any two from: ref. to mutation; during cell division; variation has provided resistance to the antibiotic; [2]

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16 Reproduction

Core

1 **a** A process resulting in the production of genetically identical offspring from one parent;

b pollination – the transfer of pollen grains; from an anther to a stigma; fertilisation – the fusion; of the nuclei of gametes;

2 anther – produces pollen grains containing male sex cells; ovary – contains ovules, with the female sex cells; petal – often large and coloured to attract insects; sepal – protects the flower while in bud; stigma – sticky, to receive pollen grains during pollination

3 **a** **A**– stigma; **B** – style; **C** – ovary; **D** – ovule/seed; **E** – filament; **F** – anther;

b **i)** carpel

ii) stamen

c **i)** ref. to feathery/with a larger surface area/hanging outside the flower; to increase the chance of trapping pollen grains;

ii) ref. to larger numbers of pollen grains/pollen grains lighter; to increase chances of pollination/to be more easily carried by the wind;

4 Across: 5 prostate gland, 7 ovary

Down: 1 urethra, 2 vagina, 3 testis, 4 bladder, 6 duct

5 **a** Sperm released from the testes pass through the sperm duct; into the urethra; through the penis; they are ejaculated into the vagina; swim through the cervix and uterus; and into the oviduct.

b An ovum passes down the oviduct. A single sperm penetrates the membrane of the ovum by secreting a protease enzyme. The sperm nucleus fuses with the ovum nucleus to form a zygote.

6 **a** placenta

b 1 cervix, 2 vagina

c zygote

d amniotic fluid

e menstruation

f oviduct (fallopian tube)

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Supplement

7 **A**: The lining of the uterus is starting to build up; under the influence of oestrogen. **B**: Ovulation occurs – the wall of an ovary ruptures, releasing an egg; this is due to secretion of LH (luteinising hormone). **C**: The lining of the uterus is maintained, due to high levels of progesterone; produced by the corpus luteum. **D**: Menstruation occurs – the lining of the uterus breaks down; due to a drop in progesterone.

8 **a** Place boiling tube in a beaker of water; use a thermometer to measure the water temperature; allow the seeds time to adjust to the temperature of the water; note position of dye; time for, e.g. 5 minutes; note new position of dye; measure distance moved; repeat process for a range of different temperatures.

b **C**alculate rate of movement of dye; using formula speed = distance/time; plot graph of temperature (***x***-axis) against rate of movement of dye (***y***-axis);

Exam-style questions

Core

1 **a** Wind pollination. Explanation – Any six points from: **A** = stigma; which is feathery; hangs outside the flower; has large surface area; **B** = filament; which is long to expose the anther to the wind; **C** = anther; which hangs outside the flower; exposed to the wind [7]

b Any four points from: mature anthers burst, releasing pollen grains into air; wind carries pollen grains; some are trapped by feathery stigmas; hanging outside flowers; of other flowers of the same species [4]

2

Structure	Name of structure	Function
A	sperm duct	carries semen from the testes to the urethra
B	prostate gland	adds fluids and nutrients to the sperm to form semen
C	penis	transfers sperm to the vagina during sexual intercourse
D	urethra	1 passes sperm/semen to the penis 2 carries urine from the bladder
E	scrotum/scrotal sac	holds the testes outside the body to keep them cooler than the body
F	testis	produces sperm/produces testosterone

[13]

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Supplement

3 **C** [1]

4 **a** **i)** arrows/line from pollen grain down through the stigma (**A**), style (**B**), around either side of the ovary wall (**C**), into micropyle (**D**) to the ovule [3]

ii) Any six points from: pollen grain germinates; pollen tube grows; pollen tube contains the male nucleus; grows down through the stigma (A); through the style (B); through the ovary wall (C); into the micropyle (D) to the ovule; male nucleus fuses with nucleus of ovule; [6]

b **i)** Any one from: pollen grain would be lighter/have a larger surface area/no spikes on surface/smooth surface [1]

ii) stigma would be feathery; hangs outside the flower; [2]

5 **a** **A** – ovary; **B** – oviduct; **C** – uterus (wall); **D** – cervix; **E** – vagina; [5]

b ref. to both oviducts are closed/blocked; so eggs cannot pass down/sperm cannot reach egg; [2]

c Any three from: placenta; umbilical cord; amniotic sac; amniotic fluid; [3]

6 **a** Cross-pollination involves the transfer of pollen from the anther of a flower to the stigma of a flower; on a different plant of the same species; so there is mixing of genetic material leading to variation. [3]

b The runner/stolon is a shoot of the parent plant; so the new strawberry plant cells will have the same DNA as the parent. [2]

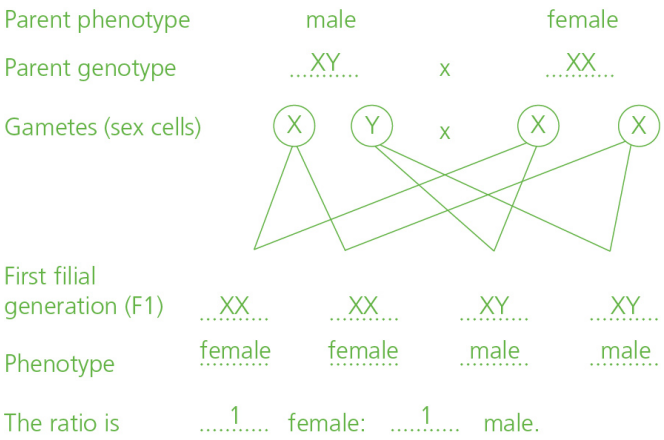
17 Inheritance

Core

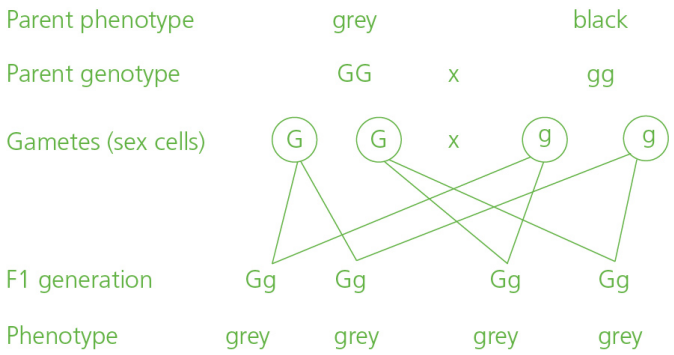
1 allele – an alternative form of a gene; chromosome – a thread of DNA, made up of genes; dominant – an allele that is always expressed if present; gene – a length of DNA, coding for a protein; genotype – the genetic make-up of an organism; homozygous – having two identical alleles of a particular gene; phenotype – the observable features of an organism

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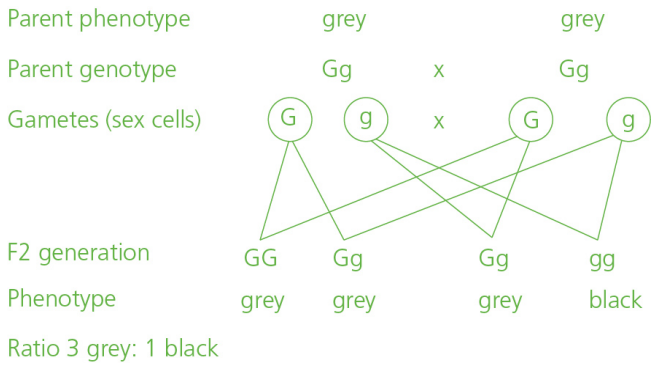
2



3 **a** (a Punnett square is acceptable)



b (a Punnett square is acceptable)



Supplement

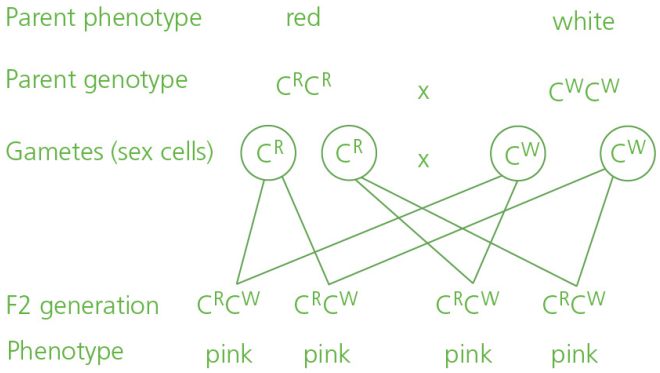
4 **a** Any two from: mitosis produces cells with the same number of chromosomes as the parent cell/the diploid number of chromosomes is maintained, meiosis produces cells with half the number of chromosomes/haploid cells produced; mitosis produces identical cells, meiosis results in variation; mitosis involves body cells/somatic cells, meiosis happens in the gonads/ovaries and testes; mitosis results in growth or replacement of old or damaged cells, meiosis makes sex cells;

b leg muscle cell – 8; sperm cell – 4; zygote – 8; skin cell – 8;

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5 a A situation in which both alleles in heterozygous organisms; contribute to the phenotype; as a result there can be three different phenotypes.

b i)



ii) 1 red : 2 pink : 1 white

Exam-style questions

Core

1 a i)

Rat B		Rat C	
X	X	X	Y

[1]

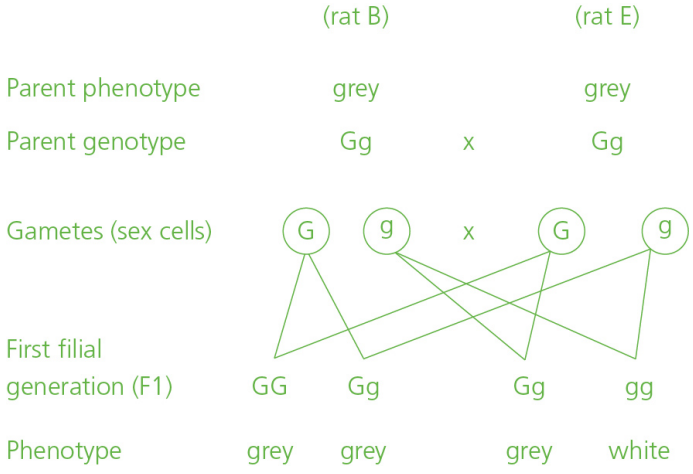
ii) 50% [1]

iii) sperm cell; the Y chromosome determines male, absence of Y in the zygote results in female; [2]

b i) an alternative form of a gene; pairs of alleles occupy the same relative positions on chromosome pairs; [2]

ii) 1 **C**; 2 **B** [2]

c Rat **E** has genotype Gg, where G = grey fur, g = white fur.



[5]

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2 **a** F – healthy allele, f – cystic fibrosis allele [1]

b 1 mark for identifying suitable letters; 1 mark for completing Punnett square or genetic diagram; [2]

Mother Ff	Father Ff	
	F	f
F	FF	Ff
f	Ff	ff

c 1 mark for identifying genotypes of children; 1 mark for identifying phenotypes of children; [2]

genotypes: CC; Cc; cc

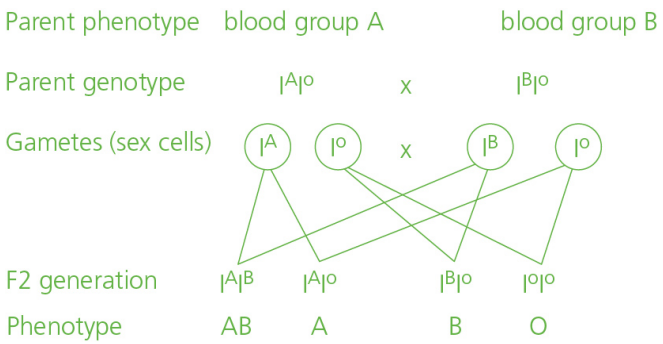
phenotypes: unaffected; unaffected; cystic fibrosis

Supplement

3 **a** A feature in which the gene responsible is located on a sex chromosome; and this makes it more common in one sex than in the other; [2]

b Any four points from: gene is present on the X chromosome; and is recessive; females need to be homozygous for the gene to suffer; men only need the gene on the X chromosome; no gene on Y chromosome to dominate it; [4]

4



[5]

5 **a** Any four points from: cell starts with chromosomes duplicated; copies of the chromosomes separate; cell splits to form two cells; which are identical to parent cell; chromosome number is maintained/ref. to diploid; [4]

b Stem cells are unspecialised cells; that divide by mitosis; to produce daughter cells; that can become specialised for specific functions. [4]

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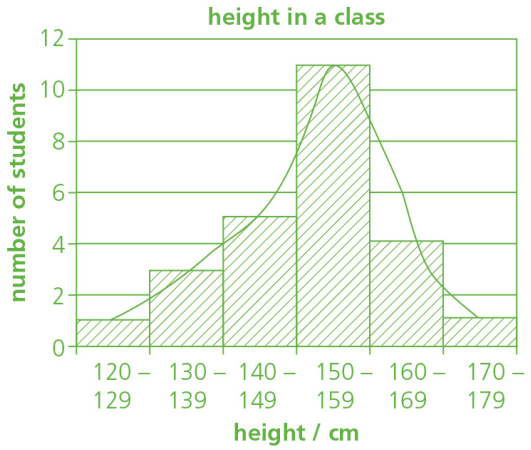
18 Variation and selection

Core

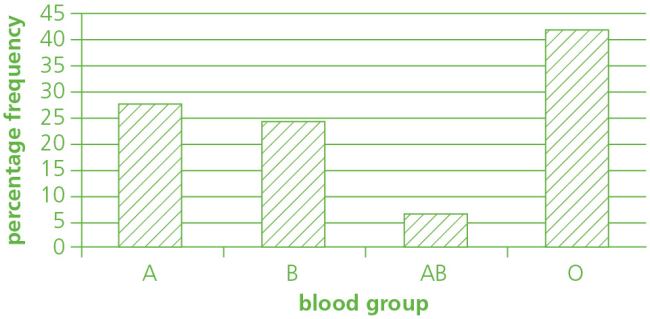
1 **a** Continuous variation – Any three points from: shows a complete range of a characteristic within a population; caused by both genes (often a number of different genes) and the environment; when the frequency is plotted on a graph, a smooth curve is produced; with the majority of the population sample grouped together and only small numbers at the extremes of the graph; e.g. height/body mass/intelligence/hand span;

Discontinuous variation – Any three points from: there are obvious, distinct categories for a feature; there are no intermediates between categories; caused by a single gene or a small number of genes; with no environmental influence; when the frequencies are plotted on a graph, bars are produced that cannot be linked with a smooth curve; e.g. blood group/ability to tongue-roll/ear lobe shape;

b Continuous variation graph, e.g.



Discontinuous variation graph, e.g.



2 **a** An inherited feature; that helps an organism to survive and reproduce in its environment.

b Any five points from: named example, e.g. lion; variation within a lion population, e.g. bigger muscles in the legs of some lions enable them to run faster/get food more

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successfully; ref. to many offspring produced; competition for resources, e.g. if there is a food shortage, the lions with the biggest leg muscles are most likely to survive to adulthood and pass on the advantageous genes to their offspring; struggle for survival, e.g. the weaker individuals die before having the chance to breed; reproduction by individuals that are better adapted to the environment than others; passing on their alleles to the next generation;

3 One named example of an animal, e.g. goat; select one variety of goat with a higher than average milk yield; select another variety that has a very high meat yield; cross-breed the two varieties to form a new breed with the benefits of both parental varieties, e.g. high milk production in females, high meat yield in males.

Supplement

4 **a** **i)** a change in the base sequence of DNA

ii) Any two from: faulty copying of DNA; faulty separation of chromosomes during cell division; exposure to radiation; exposure to some chemicals;

b Any two from: meiosis; random mating; random fertilisation;

5 **a** axerophyte

b Any three visible features and two features not visible from:

Visible **adaptive feature**	**How the feature helps the plant to survive**
no leaves/leaves reduced to spines	protects the plant from herbivores
leaves with a small surface area	reduces transpiration
long roots	to access water
succulent stem	to store water
Adaptive feature *not* visible	**How the feature helps the plant to survive**
sunken stomata	creates high humidity to reduce transpiration
stomata closed during the day	reduces water loss by transpiration
thick, waxy cuticle	to reduce water loss
stem contains chloroplasts	stem carries out photosynthesis

Exam-style questions

Core

1 **a** **C** [1]

b Any three from: thick fur; white/camouflaged fur; small ears; small tail; large claws; [3]

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Supplement

2 **a** discontinuous variation [1]

b Any example of continuous variation, e.g. height, body weight, hand span, intelligence; explanation – ref. to influence of genes; and environment; [3]

3 **a** hydrophyte [1]

b e.g. water lily; Any two modifications from: leaves contain large air spaces – this makes them buoyant for floating on the surface; no stomata on lower surface of the leaf/lower epidermis – so leaf does not become waterlogged; poorly developed roots –surrounded by water/mineral ions; roots contain air spaces – substrate is poorly oxygenated; stems lack support – plant is supported by water; [3]

19 Organisms and their environment

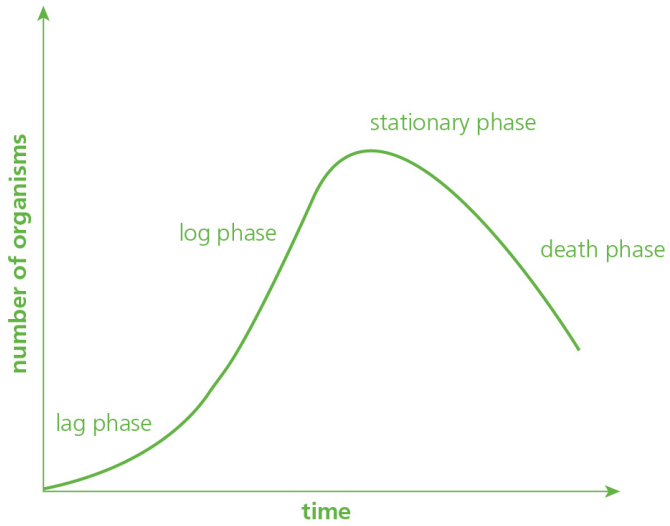
Core

1 carnivore – an animal that gets its energy by eating other animals; consumer – an organism that gets its energy by feeding on other organisms; decomposer – an organism that gets its energy from dead or waste organic material; food web – a network of interconnected food chains; herbivore – an animal that gets its energy by eating plants; producer – an organism that makes its own organic nutrients, usually through photosynthesis;

2 photosynthesis; respiration; combustion; decomposition;

3 **a** A population is a group of organisms; of one species; living in the same area at the same time.

b **i)** and **ii)**



c food supply; predation; disease

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d ref. to no stationary or death phase; the log phase will continue upwards instead of the line levelling off

4 **a** baboon – tertiary consumer; scorpion – secondary consumer; locust – primary consumer; impala – primary consumer; grass – producer

b When feeding on impala, it is a secondary consumer, but when feeding on baboons, it is a quaternary/fourth consumer.

c Any three from: over-predation or hunting; disease; pollution; use of pesticides; lack of food (or other resources)

d They represent the direction of flow of energy/point towards the consumer of the previous organism.

Supplement

5 **a** A chart showing the transfer of energy; from one organism to the next beginning with a producer.

b **i)** and **ii)**

clover	→	snail	→	thrush	→	sparrow hawk
producer		primary consumer		secondary consumer		tertiary consumer

c **i)** The thrush population would decrease/thrushes die; because they have fewer snails to eat.

ii) The sparrow hawk population would decrease/sparrow hawks die; because they have fewer thrushes to eat.

d Snails use less energy because they move less/more/slowly/don't hunt; snails are cold blooded, so less energy used maintaining a constant body temperature.

6 **a** **i)** photosynthesis

ii) sunlight

iii) Any three points from: light is reflected off shiny leaves; some of the light is the wrong wavelength for chlorophyll to trap; light passes through the leaves without passing through any chloroplasts; light does not fall on the leaves;

b **i)** Energy is lost at each level in a food chain; so very little of the energy entering the chain through the producer is available to the top carnivores.

ii) There are fewer levels to lose energy from; 90% of the energy is lost at each level/a smaller percentage of the energy trapped by the producers is lost in a short food chain.

7 **a** The producer may be a single large plant, e.g. a tree; the top consumers may be parasites which are small but many feed on the previous level.

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b There is a reduced amount of biomass at each successive level.

c Any two points from: the organisms have to be killed and burned; to remove water; to measure their biomass content;

8 **a** **i)** Present in soil/(leguminous plant) root nodules; convert nitrogen into compounds of ammonia;

ii) Convert compounds of ammonia; into nitrates;

iii) Present in waterlogged soil; break down nitrates into nitrogen;

b Adding artificial fertilisers; adding manure/compost; growing leguminous plants, then ploughing the roots (with their nodules) into the soil;

9 **a** photosynthesis; respiration;

b Any two from: cutting down forests/deforestation; combustion of fossil fuels; increasing numbers of animals/increasing the human population;

Exam-style questions

Core

1 **a** **i)** and **ii)**

microscopic algae → water fleas → minnows → perch

producer primary consumer secondary consumer tertiary consumer

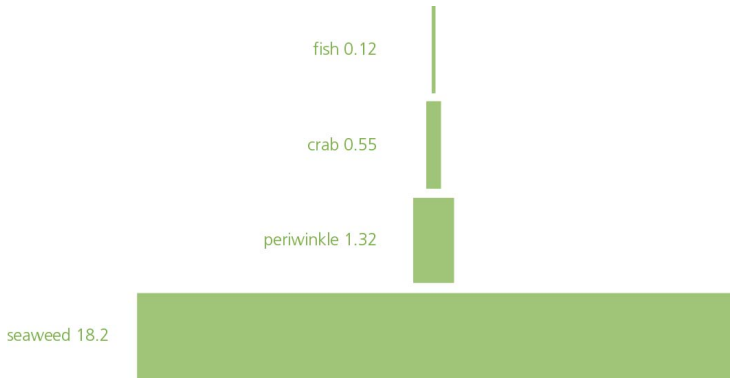
1 mark for all the organisms being in the correct order; 1 mark for correct arrows; 2 marks if all organisms are labelled correctly, but only 1 mark if one or more is incorrect [4]

b decomposers [1]

2 **a** atrophic level [1]

b an animal which eats other animals; the crabs eat periwinkles; [2]

c 1 mark for all bars correct; 1 mark for correct ascending order; 1 mark for labels;



[3]

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d The biomass decreases up a food chain. [1]

e The arrows represent the transfer of energy from one organism to the next; arrows point to the consumer of the organism at the previous feeding level. [2]

Supplement

3 a i) the position of an organism in a food chain, food web, pyramid of numbers or pyramid of biomass [1]

ii) e.g. maize → locust → lizard → snake [2]

iii) pyramid drawn with four correctly labelled trophic levels; with normal pyramid shape (broadest at the base); [2]

b i) 35% [1]

ii) (waxy) cuticle [1]

iii) Any two points from: ref. to presence of large numbers of chloroplasts; ref. to closely packed nature of palisade cells; ref. to position near upper surface of leaf; ref. to ability of chloroplasts to migrate to top of cells; [2]

c i) 90% [1]

ii) Any two from: movement, e.g. to find food or a mate; maintaining constant body temperature; some heat lost in urine or faeces; [2]

4 a i) grass – producer; sheep – primary consumer; humans – secondary consumer; [3]

ii) ref. to grass; capturing light energy from the Sun; and converting it into carbohydrates/stored food; [3]

iii) Any three from: movement, e.g. to find food or a mate; maintaining constant body temperature; building up proteins/muscles; some heat lost in urine or faeces; [3]

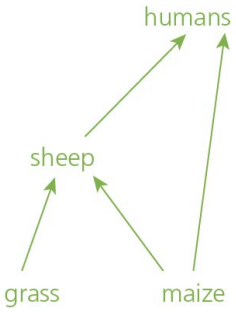
b i) $\frac{200}{100\,000} \times 100 = 0.2\%$ [2]

ii) ref. to fewer trophic levels; so less energy lost/more energy conserved for top consumer; [2]

c i) ref. to greater range of vitamins and minerals available in a mixed diet; meat contains a greater range of amino acids; [2]

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ii)



[3]

5 a i) (root) nodule [1]

ii) bacteria [1]

iii) Any four points from: ref. to nitrogen-fixing bacteria; in the root nodules; take in gaseous nitrogen from air spaces in the soil; convert it to compounds of ammonia; which are changed to nitrates; then used to make protein; for plant growth; [4]

b

	Description of feature for	
Feature	**Maize**	**Bean**
Any two from:		
leaf shape	long and narrow	broad
leaf veins	parallel	branching
cotyledons	one	two
groupings of flower parts	in threes	in fives

[3]

20 Human influences on ecosystems

Core

1 Any four from: the development/use of chemical fertilisers on farm land – boosting levels of nutrients in the soil, increasing crop yields; the development/use of pesticides – these kill pests that feed on or damage crops, so crop yields are increased; the development/use of herbicides – these kill weeds that compete with crops for nutrients/light/water/space, so crop yields are increased; the development of biological control methods for pest control as an alternative to

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pesticides – some pesticides are non-selective; the use of tractors/combine harvesters to enable land and crops to be managed more efficiently; artificial selection to produce plant varieties that are suited to particular climates/soil types, or breeds of animals for specific purposes, e.g. optimum meat/milk/wool production; (this list is not exhaustive)

2 Any five points from: diseases e.g. typhoid and cholera can make the water unsafe to drink; sewage may contain large amounts of phosphates/nitrates; microscopic plants grow rapidly; plants die; bacteria feed on plants; bacteria use up oxygen in respiration; oxygen in the water becomes depleted; animals die from lack of oxygen;

3 **a** deforestation

b Any three from: to provide land for farming; to provide land for roads; to provide timber for building/furniture; ref. to fuel source;

c Any four from: reduction of habitats/food sources for animals, which can result in their extinction; animal and plant diversity is reduced, so food chains are disrupted; the loss of plant species and their genes – may be important for medical use/genetic engineering in the future; the removal of trees, so no roots to hold soil, resulting in soil erosion and leaching of minerals, leading to possible desertification; lack of roots, leading to flooding/mudslides/lakes can become silted up; leaching of nutrients into lakes and rivers – leading to eutrophication; less carbon dioxide is absorbed from the atmosphere, increasing the greenhouse effect; less oxygen produced, so atmospheric oxygen levels can drop; less transpiration – can lead to reduced rainfall;

Supplement

4 (C), G, A, E, B, F, (D)

5 Any four points from: education; using closed seasons; setting up protected areas; controlling net types; controlling fishing net mesh sizes; using fish quotas; monitoring fishing activities;

6 Any three points from: ref. to melting of polar ice caps, causing flooding of low-lying land; ref. to a change in weather conditions in some countries, increasing flooding; ref. to reducing rainfall – changing arable (farm) land to desert; ref. to causing the extinction of some species that cannot survive in increased temperatures;

Exam-style questions

Core

1 [maximum 3 marks for each application]

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Application	How it helps to increase food production	Possible disadvantage of its use
(chemical fertiliser)	boosts levels of nutrients in the soil, so improves yield	can be leached out of the soil, leading to eutrophication of water systems
(insecticide)	kills insect pests that feed on or damage crops, so improves quality and yield	can be non-selective, so kills useful insects, e.g. crop pollinators; may persist in soil and enter food chains
(herbicide)	kills weeds that compete with crops for nutrients/light/space, so improves yield	may kill rare plant species near fields being treated

[9]

2 **a** Any four points from: named species, e.g. tiger; extinction would result in genes being lost; which may be important for genetic engineering; to produce chemicals such as medicines; species may be important in food chain; so its loss could endanger other species; [4]

b **i)** description of habitat of organism named in **a**, e.g. forest, in mountains [2]

ii) Any three points from: use laws to protect habitat; use wardens to protect habitat; control public access; maintain species features of habitat, e.g. by controlling water drainage or number of prey animals or top carnivores; [3]

Supplement

3 leaching, rapid algal growth, death of algae, decay by bacteria, death of aquatic animals [2]

4 **a** (*sustainable resource*) one which is produced as rapidly as it is removed from the environment; so that it does not run out; [2]

b Any three ways for 2 marks each from: use of education to inform local people about the importance of conserving forests; training loggers to remove trees with minimum damage to surrounding trees; introduce legal quotas for logging; introduce programmes of re-stocking when trees are felled; protect young trees from grazers; introduce coppicing or pollarding to provide wood for fuel; (this list is not exhaustive) [6]

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21 Biotechnology and genetic modification

Core

1 **a** Any two from: rapid reproduction rate; ability to make complex molecules; no ethical issues with their use; relatively easy to insert genes; have a genetic code shared with all other organisms; presence of plasmids;

b Any three points from: use of fermenter; to grow yeast; in anaerobic conditions; feed with suitable substrate, e.g. glucose/sugar cane/by-products from other processes; maintain suitable temperature;

c **i)** enzymes

ii) Enzymes speed up chemical reactions at low temperatures; they remain unchanged a the end of the reaction so can be used again.

iii) Any four points from: fruit is washed, pulped/liquidised; pectinase added; temperature maintained, e.g. 20–30 °C; mash/mixture is squeezed/pressed to remove juice;

Supplement

2 Any two from: baking, e.g. bread – enzymes in yeast convert sugar to ethanol and carbon dioxide; the carbon dioxide makes the bread dough rise; the ethanol evaporates as the bread is baked. Manufacture of lactose-free milk, using lactase to break down the lactose in the milk. Manufacture of fruit juice, using pectinase to extract juice.

3 **a** **i)** to stir the mixture of feedstock and microorganisms/distribute the heat through the liquid

ii) extracts the microorganisms from the filtrate

iii) provides nutrients for the microorganisms to grow, respire and produce enzymes

b fungi, bacteria

c Microorganisms are filtered from the feedstock; then crushed and washed with water.

4 Any two advantages from: ref. to pest resistance; herbicide resistance; yield is increased; can insert genes for vitamins, e.g. vitamin A; can insert genes for salt tolerance; protection against aluminium; can insert genes for nitrogen fixation; (this list is not exhaustive)

Any two disadvantages from: crops may contain pesticide residues; crops may contain genes for antibiotic resistance; crops may contain substances that cause allergies; inserted genes may 'escape' to other plants; public resistance to eating GM food, so limited market; GM food banned in some countries; (this list is not exhaustive)

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Exam-style questions

Core

1 **a** changing the genetic material of an organism; by removing, changing or inserting individual genes; [3]

b Any three from: insertion of human genes into bacteria to produce human insulin; insertion of genes into crop plants to confer resistance to herbicides; insertion of genes into crop plants to confer resistance to insect pests; insertion of genes into crop plants to provide additional vitamins; (this list is not exhaustive) [3]

Supplement

2 Any eight points from: isolation of the DNA making up insulin gene; using restriction enzymes; sticky ends formed; bacterial plasmid DNA cut with the same restriction enzymes; forming complementary sticky ends; human insulin gene inserted into bacterial plasmid DNA; using DNA ligase; to form a recombinant plasmid; plasmid inserted into bacteria; bacteria containing recombinant plasmids replicated; which make human insulin as they express the gene; [8]

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