<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1(a)</td><td>A substrate ;
B active site ;
C enzyme-substrate complex ;
D product(s) ;</td><td>4</td><td></td></tr>
<tr><td>1(b)</td><td>production of, small(er) / soluble / simple(r), molecules ;

(small molecules can be) absorbed / ref. to absorption ; ora

(moves through) cell membranes / wall of intestine / into blood / into cells ;</td><td>2</td><td></td></tr>
<tr><td>1(c)</td><td><table>
<tr><th>function</th><th>letter from Fig. 2.1</th><th>name of structure</th></tr>
<tr><td>site of starch digestion</td><td>A
J / E</td><td>mouth / buccal cavity
small intestine</td></tr>
<tr><td>reabsorption of water</td><td>J / E
H
F</td><td>small intestine
colon / large intestine
rectum</td></tr>
<tr><td>secretion of pepsin</td><td>C</td><td>stomach</td></tr>
<tr><td>site of maltose digestion</td><td>J / E</td><td>small intestine</td></tr>
<tr><td>secretion of bile</td><td>K
L</td><td>liver
gall bladder</td></tr>
<tr><td>storage of faeces</td><td>F</td><td>rectum</td></tr>
<tr><td>secretion of lipase and trypsin</td><td>D</td><td>pancreas</td></tr>
</table>;;;;;;</td><td>6</td><td>one mark per row
the letter must agree with the name
if more than one letter or name mark first one only

A J/E small intestine</td></tr>
</table>

Question	Answer	Marks	Guidance
3(a)(i)	label line and **X** pointing to any part of the 'star' in the centre of the root section ;	**1**	
3(a)(ii)	composed of (group of) cells with similar structures ; working together to perform shared functions ;	**2**	
3(b)	xylem supplies water ; air spaces ; large (internal) surface area ; water evaporates from surface of mesophyll cells ; guard cells, open / close, stomata ; water vapour, diffuses / moves, out through stomata ;	**3**	

Question	Answer	Marks	Guidance
5(a)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ energy released) ;;	2	one mark for correct symbols one mark for correct balancing
5(b)	150(%) ;;	2	one mark for correct working if answer wrong
5(c)	demand for, energy / oxygen, increases ; (rate of) respiration increases ; limited supply of oxygen to muscle (tissue) ; *idea that* heart / pulse / breathing, rate not increased enough ; muscles respire anaerobically ; lactic acid is produced ;	3	
5(d)	horses continue to breathe, at high rate / deeper ; continue with a high, heart / pulse, rate ; to provide, enough / AW, oxygen (to 'pay-off' the debt) ; lactic acid, moves / diffuses / AW, (from muscle) into blood ; lactic acid transported to the liver ; (in the liver) lactic acid is, broken down / oxidised / respired (aerobically) ;	4	

Question	Answer	Marks	Guidance
1(a)(i)	**A** dentine **B** cement **C** incisors **D** canine(s) **E** premolars **F** molars ;;;	**3**	6 / 5 correct = 3 marks 3 / 4 = 2 marks 1 / 2 = 1 mark
1(a)(ii)	mechanical ;	**1**	
1(b)(i)	acid ;	**1**	**A** carbon dioxide
1(b)(ii)	enamel ; dentine ;	**2**	
1(c)	(named) sugar ;	**1**	

Question	Answer	Marks	Guidance
3(a)(i)	sucrose / sugar ; amino acids ;	2	
3(a)(ii)	translocation ; (phloem) allows bidirectional movement / AW ; movement (of food / sap) from source to sink ; sucrose / amino acids / food, are produced / taken from storage, at a source ; region of respiration / storage / growth, is a sink ; named example of a, source / sink (in the correct context) ; some organs can be both a source or a sink at different times ;	4	

Question	Answer	Marks	Guidance
3(b)	*functions* conduct / transport, water (and mineral ions) ; *ref to* transpiration ; reduced resistance to water flow / AW ; structural) support (for plant) ; prevents (inward) collapse (of xylem vessels) ; (spirals) allows (some) flexibility / bending, of stems (to prevent breaking) ; *adaptations* long / elongated (cells / vessels / tubes) ; *ref to* lignin (in walls) ; (cell walls) are water impermeable / waterproof / AW ; (secondary) thickening of cell walls ; hollow / no cytoplasm / no (named) organelles ; no, end / cross, walls (between cells) ; end plates to connect vessels (end to end) ; pits in walls (for water movement between vessels) ;	**6**	max 5 from one section **A** rings / spirals / AW
3(c)	reduced / no, damage to crops ; **ora** increased, yield / quality (of the crop) ; **ora** more, income / profit ; **ora** because more, sugar / amino acids, available for growth ; **ora** reduced disease transmission / AW ; **ora**	**2**	**A** not / less, eaten by pests

Question	Answer	Marks	Guidance
5(a)	three pairs of legs ; three (named) body segments ; wings ; (pair of) antennae ; compound eyes ;	3	
5(b)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ energy released) ;;	2	one mark for correct symbols one mark for correct balancing
5(c)(i)	volume ; distance / length ; control / maintain / regulate / stabilise / keep / constant / sustain ;	3	
5(c)(ii)	carbon dioxide will affect, results / volume of gas (in respirometer) / carbon dioxide could kill the larvae ;	1	**A** to measure (changes in) oxygen only
5(c)(iii)	growth / development ; active transport ; protein synthesis ; cell division / mitosis ; passage of nerve impulses ; muscle contraction ; AVP ; e.g. metabolism / (description of) metamorphosis	2	**A** movement / breathe / egestion /digestion / excretion

Question	Answer	Marks	Guidance
5(d)	*prediction* as temperature increases the respiration rate will increase **;** **ora** and then decrease **;** *explanation:* there will be an optimum temperature (at a particular temperature) for seed germination **;** *ref to* (respiratory / germination) enzymes **;** at high temperatures enzymes denature / described **;** at low temperatures not enough (kinetic) energy for, effective collisions / biochemical reactions / respiration / digestion **;** **ora** AVP **;**	**4**	max 3 for explanation e.g. temperature will also affect the gas pressure in the respirometer

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1(a)</td><td>(food) is broken down into smaller pieces (without chemical change) ;

sites of mechanical digestion:
mouth / buccal cavity (in context mechanical) ;
stomach (in context of mechanical) ;

chewing / mastication ;
role of a named teeth ;;
ref to involvement of tongue ;
ref to movement of the jaw ;
churning / muscular, action of the stomach ;</td><td>4</td><td></td></tr>
<tr><td>1(b)</td><td><table>
<tr><th>part of the alimentary canal</th><th>enzyme</th><th>substrate</th><th>product(s)</th></tr>
<tr><td>mouth</td><td>amylase</td><td>starch</td><td>maltose</td></tr>
<tr><td>stomach</td><td>pepsin</td><td>protein</td><td>peptides</td></tr>
<tr><td>small intestine / duodenum / ileum</td><td>lipase</td><td>fat</td><td>fatty acids and glycerol</td></tr>
</table>;;;</td><td>3</td><td>one mark per row

A protease (for enzyme)

R pancreas (for part of the alimentary canal)</td></tr>
<tr><td>1(c)(i)</td><td>glycogen ;</td><td>1</td><td></td></tr>
<tr><td>1(c)(ii)</td><td>antibody ;</td><td>1</td><td></td></tr>
<tr><td>1(c)(iii)</td><td>(thermal) insulation ;</td><td>1</td><td>A storage / protection</td></tr>
</table>

Question	Answer	Marks	Guidance
3(a)(i)	**A** (upper) epidermis ; **B** palisade (mesophyll) ;	**2**	
3(a)(ii)	(cell surfaces are sites of) gas exchange ; movement of gases by diffusion ; *ref. to* efficient / faster / AW, gas exchange / diffusion / photosynthesis ; carbon dioxide is, raw material / needed, for photosynthesis ; absorption of carbon dioxide (when light available) ; loss of oxygen (when light available) / absorption of oxygen ; oxygen is required for (aerobic) respiration ; more evaporation ; *idea of* maximising light absorption ;	**3**	
3(a)(iii)	allows for, movement of (named) gases / diffusion / gas exchange, throughout the whole of the leaf ; *ref. to* faster / efficient / AW, diffusion / gas exchange ; allows / AW, photosynthesis / respiration / transpiration / evaporation ; *ref. to* storage of carbon dioxide ; (air spaces) connect (to outside air) via stomata ;	**2**	
3(b)(i)	no / little, water ; high temperature ; low humidity / dry air ; high wind speed ; long day length / high light intensity ; high salinity / salt ; freezing ; disease ; (soil) waterlogging / low oxygen concentration / pH ; mineral / magnesium, deficiency ;	**2**	**A** drought / no, rainfall / precipitation / irrigation

Question	Answer	Marks	Guidance
5(a)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ energy released) ;;	2	one mark for correct symbols one mark for correct balancing
5(b)	0.42 (ppm s^{-1}) ;	1	
5(c)	to allow oxygen to enter the chamber ; keep the crickets respiring aerobically ; to remove carbon dioxide ; to prevent death of crickets ; *ref. to* ethical treatment of animals ; maintaining similar conditions / resetting, for repeat readings / AW ;	2	
5(d)	heat (energy) is released by crickets ; movement / *ref. to* kinetic energy ; pressure increase ; increased carbon dioxide leading to greenhouse effect ; small closed space ;	2	
5(e)	rate of oxygen consumption increases with body mass of crickets (for each temperature) ; any suitable data quote comparing rate at different masses (at same temperature) ; rate of oxygen consumption increases with temperature ; any suitable data quote comparing rate at two temperatures (for the same body mass) ;	4	**A** respiration for oxygen consumption

Question	Answer	Marks	Guidance Notes
3(a)	no, cytoplasm / (named organelle) / hollow ; *ref.* to lignin (in walls) (cell walls) are waterproof / water impermeable / AW (secondary) thickening of cell wall ; long / elongated (cells / vessels / tubes) ; (bordered) pits (for water movement between vessels) ; no, (perforated) end / cross walls (between cells) / end plates to connect vessels (end to end) ;	**3**	
3(b)	(water enters) root hair (cells) / **M** ; by <u>osmosis</u> ; the soil has a higher <u>water potential</u> than the root (cells) ; ora water moves from an area of high(er) water potential to low(er) water potential ; active transport of ions to create a water potential gradient ; (across / through partially permeable), membrane(s) ; *ref to* root cortex / **L** – cortex / **M** to **L** to **(K)** to **J** ; AVP ;	**5**	
3(c)(i)	87 ;;	**2**	

Question	Answer	Marks	Guidance
3(c)(ii)	the nearer the tip / zone 1, the lower flow rate ; ora flow rate increases (from tip to bulb) in both treated and healthy roots ; flow rate is greater in zone 1 in the treated roots ; flow rate is lower in zones 2 and 3 in the treated roots ; ora comparative data quote with units ;	3	
3(c)(iii)	xylem vessels are dead, so toxins / treatment have no effect ; osmosis / water flow into root, does not rely on living cells / energy / is passive / AW ; AVP ;	2	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6(b)(i)</td><td>
<table>
<tr><td>enzyme</td><td>substrate</td><td>product(s)</td></tr>
<tr><td>amylase</td><td>starch</td><td>glucose / maltose ;</td></tr>
<tr><td>maltase</td><td>maltose</td><td>glucose ;</td></tr>
<tr><td>protease</td><td>protein</td><td>amino acids ;</td></tr>
</table>
</td><td>3</td><td></td></tr>
<tr><td>6(b)(ii)</td><td>high temperatures denature enzymes / AW ;
low temperatures result in low energy / fewer collisions / slower reactions / AW ;
enzymes work best / most efficient at optimum temperature ;</td><td>2</td><td></td></tr>
<tr><td>6(b)(iii)</td><td>pH ;
enzyme concentration ;
substrate concentration ;</td><td>1</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
3(a)(ii)	evaporation from (cell walls) in mesophyll ; diffusion of water vapour through stomata ; reduction of, pressure / water potential, at top (of plant) resulting in water moving upwards ; continuous column of water (in the xylem) ; cohesion of water (molecules) ; **A** if described incorrectly cohesion described as, forces / attraction, between water molecules ; transpiration pull ; water enters *or* leaves xylem, by osmosis / down water potential gradient ; AVP ;	**4**	
3(a)(iii)	support / described ;	**1**	
3(b)	increase / decrease (in rate of transpiration) ; more / less, evaporation ; increase / decrease, rate of diffusion (of water vapour) ; *ref. to* (kinetic) energy of (molecules of) water ; stomatal pores become, wider / narrower ; guard cells become, turgid / flaccid ;	**3**	**A** stomata close

Question	Answer	Marks	Guidance
5(a)	***red blood cell:*** *feature:* red blood cells smaller than (named) white blood cell(s) / ora ; biconcave (disc / shape) / no nucleus ; *role:* contains haemoglobin / transports oxygen / transports carbon dioxide ; ***lymphocyte:*** *feature:* little cytoplasm / large(r) nucleus / nucleus fills most of the cell ; *role:* *ref. to* active immunity / responds to, antigen(s) or vaccine(s) / produce, antibodies or antitoxins / *ref. to* memory cells ; ***phagocyte:*** *feature:* lobed / irregular-shaped / C-shaped / AW, nucleus ; *role:* engulf pathogens / phagocytosis / AW ;	**6**	
5(b)(i)	fibrinogen ⟶ fibrin ;	**1**	
5(b)(ii)	prevent blood loss ; prevent entry of (named), pathogens / microbes ; *ref. to* wound healing / tissue repair ;	**2**	

Question	Answer	Marks	Guidance
6(a)(i)	dry scaly skin ; leathery / soft-shelled, eggs ;	2	
6(a)(ii)	cellulose / cell wall ; chloroplast / chlorophyll ; starch grains ; (large / permanent / central) vacuole ;	2	
6(b)(i)	amylase ;	1	
6(b)(ii)	mouth ; small intestine ;	2	

Question	Answer	Marks	Guidance
3(a)(i)	cell membrane / cell wall / cytoplasm / vacuole / nucleus ;;	2	
3(a)(ii)	epidermis ;	1	
3(a)(iii)	allows light through ; (light) reaches chloroplasts / chlorophyll ; in mesophyll / palisade cells ; (palisade / mesophyll / chloroplasts / chlorophyll) need light for photosynthesis / trap energy from light ;	3	
3(b)	for gas exchange **/** diffusion of gases ; for, photosynthesis / respiration / transpiration ;; correct gas with direction for named process ;; controls the rate of, diffusion / transpiration / photosynthesis ; ref. to transpiration pull ;	3	**A** *ref. to* prevent, wilting / water loss
3(c)(i)	move against the concentration gradient ; proteins (in membrane) ; using energy ; from respiration ;	2	

Question	Answer	Marks	Guidance
3(c)(ii)	high(er) ion concentration results in large(r) (guard cell) volume ; ora comparative data quote with units to support any description ; high(er) ion concentration causes low(er) water potential ; ora (high ion concentration causes) water to move into (guard) cells ; across partially / AW, permeable membrane ; by osmosis ; large cell volume correlates with high turgor pressure ; ora because cell water / membrane / cytoplasm / vacuole, pushes more on cell wall ;	5	
3(c)(iii)	lack of water ; high temperature ; low humidity / dry air ; wind ; AVP ;;	2	

Question	Answer	Marks	Guidance
6(a)(i)	diffusion ;	1	
6(a)(ii)	blood (in capillaries / **A**) is under (high) pressure ; (liquid) forced out (of capillaries / **A**) ; *ref. to* thin walls / pores / holes, in capillary (walls / bed) ; *ref. to* osmosis (through capillary walls / membranes) ; to form tissue fluid (in **B** / outside of cells) ;	2	
6(a)(iii)	red blood cells ; (large / named) proteins ; platelets ; AVP ;	1	
6(b)(i)	(semi-lunar) valves ; large, lumen / AW ; thin(ner) walls (than arteries) ; (thin) elastic, tissue / layer / wall ; (thin) muscle, tissue / layer / wall ; AVP ;	2	
6(b)(ii)	transports lymph ; transports, named component of lymph ; (lymphatic vessel) absorbs excess (tissue) fluid (from **B**) ; returns fluid to, blood / circulatory system ; AVP ;	2	
6(c)	*location*: in villi / small intestine ; *function:* absorbs / transports, fats / fatty acids ;	2	
6(d)(i)	lymph node ;	1	

Question	Answer	Marks	Guidance
6(d)(ii)	(lymphocytes) provide (active) immunity ; produce antibodies ; (antibodies) lock-on to antigens ; (antibodies mark) pathogen / antigen, for destruction / AW ; (lymphocytes) produce memory cells ;	2	**A** protect against, infection / pathogen **A** *ref. to* specificity **A** kill pathogen **A** ref. to long-term immunity

Question	Answer	Marks	Guidance
4(a)	one loop to lungs / pulmonary circulation, and one loop to rest of the body / systemic circulation ; blood flows through heart twice, for one (complete) circuit / to get back to the same point ;	1	
4(b)	lymphocyte / AW ; engulf/ digest / kill / destroy, bacteria / pathogens ; platelet ; red blood cell ;	4	
4(c)	wall of artery thicker than wall of vein ; lumen labelled in both drawings ;	2	
4(d)(i)	arrow(s) start in right-hand side of heart in correct direction ; arrow(s) point upwards inside pulmonary artery ;	2	

Question	Answer	Marks	Guidance
4(d)(ii)		5	one mark per row

statement	name of structure	letter from Fig. 4.1
chamber that creates the highest blood pressure	left ventricle	**F ;**
blood vessel containing blood with the highest concentration of oxygen	pulmonary vein / aorta	**C / A ;**
structure that prevents blood going from ventricle to atrium	atrioventricular valve	**E ;**
structure that prevents backflow of blood from artery to ventricle	semilunar valve	**K ;**
chamber that receives blood from vena cava	right atrium	**J ;**

Question	Answer	Marks	Guidance
6(a)(i)	stores / contains, DNA / chromosomes / genes ; controls the cell ; AVP ;	1	
6(a)(ii)	**P** – endoplasmic reticulum / (rough) ER / ribosome ; **R** – mitochondrion / mitochondria ;	2	
6(b)	catalysts ; starch ; maltose / glucose ; pepsin ; liver ; neutralises ; emulsification ;	7	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance Notes</th></tr>
<tr><td>1(a)</td><td>many (body) segments ;
head and, body (segments) / AW ;
many legs / many pairs of legs;
elongated bodies ;</td><td>2</td><td></td></tr>
<tr><td>1(b)</td><td>crustaceans ;
arachnids ;
insects ;</td><td>2</td><td></td></tr>
<tr><td>1(c)</td><td><table><tr><th>class</th><th>letter(s) of species from Fig. 1.3 in each class</th></tr><tr><td>1</td><td>J</td></tr><tr><td>2</td><td>L</td></tr><tr><td>3</td><td>M,</td></tr><tr><td>4</td><td>K,N,O</td></tr></table>;;;</td><td>3</td><td>4 rows correct = 3
2 or 3 rows correct = 2
1 row correct = 1</td></tr>
<tr><td>1(d)(i)</td><td>(genus) Apheloria ;
(kingdom) animal ;</td><td>2</td><td></td></tr>
<tr><td>1(d)(ii)</td><td>no (aerobic) respiration ; ora
cannot release energy ; ora</td><td>1</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance Notes
2(a)	*carbohydrates* cellulose ; for cell walls ; starch ; for energy/respiration ; to attract insects to flowers / nectar / fruits ; *amino acids* to make (named) proteins ; for enzymes ; for growth ; AVP ;	**4**	
2(b)	correct position labelled on the leaf ; correct position labelled on the stem ; correct position labelled on the root ;	**3**	
2(c)(i)	higher concentration in the stem / aphid **D** is nearer the root / is before the branching of the plant ; (sucrose moves by) translocation ; sucrose moves up the plant ; root / tuber, is a source ; (leaves / stems / AW) are a sink ; no photosynthesis (in the dark) ; no / less, glucose/sucrose (made in the leaves) ; plant uses stored starch (from root) / AW ;	**3**	
2(c)(ii)	insert gene / ref. to genetic engineering / ref. to genetic modification ; gene, for insect / aphid resistance ; ref. to insecticide / described ; AVP ; description of how insecticide applied / biological control / grow in glasshouses / netting	**3**	

Question	Answer	Marks	Guidance Notes
5(a)(i)	coronary artery ;	1	
5(a)(ii)	ref. to platelets ; fibrinogen converted to fibrin ; soluble to insoluble ; forms a mesh ; traps, (red blood) cells ;	3	
5(a)(iii)	aspirin / AVP ;	1	
5(b)(i)	98 (%) ;;;	3	one mark for correct readings from graph one mark for correct calculation one mark for correctly rounding to a whole number

Question	Answer	Marks	Guidance Notes
5(b)(ii)	*argument for:* as exercise increased CHD deaths decreased ; **ora** comparative data quote with units ; the same group of people were studied ; regular measurements were taken ; large benefit for doing only a small amount of exercise (therefore easy to do) ; even if there are some doubts about the benefits no harm will be done / AW ; *argument against:* only women in the study ; **ora** none younger than 35 (at the start of the study) ; **ora** actual number of deaths per 10 000 is very small even for those that do not exercise ; other risk factors not considered ; named examples of other risk factors ;; e.g. diet / smoking / alcohol / genetics some women may have forgotten / not answered correctly about how much exercise they did / AW ; some women may have been successfully treated for CHD / not died from the condition / AW ; other variables not considered ; e.g. pre-existing conditions / medication / type of exercise / length of exercise	**5**	
5(c)	more <u>blood</u>, to muscles ; to deliver more, oxygen / glucose ; for muscle <u>contraction</u> ; for (aerobic) respiration ; more <u>energy</u> required ; ref. to adrenaline ;	**3**	

Question	Answer	Marks	Guidance
1(a)(i)	exoskeleton / AW ; jointed / segmented, limbs / legs / appendages / AW ; pairs of, limbs / legs / appendages / AW ; segmented (body) / AW ; bilateral body symmetry ;	2	
1(a)(ii)	**Box 2**: *any one from:* animal has, 3 pairs of legs / 6 legs / less 4 pairs of legs / less than 8 legs ; wings ; head, thorax, abdomen / body in three sections ; no, pincers / claws / carapace ; **Box 3**: *any one from:* (animal has) claws / pincers, of different sizes / AW ; eyes on stalks ; smooth, carapace / body / 'shell' ; body, has five sides / is angular ; hairs / bristles / AW, on, legs / claws ;	2	

2(a)	any shape drawn that includes one whole vascular bundle including all of the xylem and phloem with or without sclerenchyma ; label line from **X** to xylem in any of the vascular bundles ;	**2**	
2(b)	cell vacuoles / cells, contain (much) water / have high water potential ; water absorbed, by osmosis / down water potential gradient ; cells, are turgid / have a turgor pressure ; cell contents / vacuole / cell membrane, pushes out (against cell wall) ; cell wall, does not stretch / is inelastic / is rigid ; AVP ; e.g. cells are tightly packed / AW	**3**	