

# Markscheme

**May 2018**

**Biology**

**Higher level**

**Paper 3**

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**Section A**

Question		Answers	Notes	Total
1.	a	a. in NaCl concentrations between 0.3 to 0.5 % venom increases the percentage of hemolysis/more cells lyse ✓ b. venom has no effect below 0.3% and above 0.55% NaCl <b>OR</b> Venom has no effect at very low or very high NaCl concentrations ✓		2
1.	b	a. weigh all pieces to ensure same amount of plant material/allow comparisons ✓ b. control surface area by having same shape/ size ✓ c. carry out experiment at same temperature e.g. using a water bath or constant room temperature ✓ d. all samples in solution for same length of time ✓ e. all samples from same plant (to minimize variability) ✓ f. use a range of solutions of the same solute ✓ g. constant method of removing excess fluid before weigh tissue samples ✓	<i>Do not accept just a list of controlled variables.</i>	3

Question			Answers	Notes	Total
2.	a		spirometer ✓		1
2.	b		a. tidal volume x ventilation rate <b>OR</b> litres breath <sup>-1</sup> x breath min <sup>-1</sup> ✓ b. 186 L (min <sup>-1</sup> ) ✓		2
2.	c		a. both ventilation rate and tidal volume increase with increase in treadmill speed / intensity of exercise ✓ b. at low treadmill speed/below 14.2 kmh <sup>-1</sup> , the tidal volume increases more steeply than ventilation rate <b>OR</b> at high treadmill speed, ventilation rate increases more steeply than tidal volume <b>OR</b> tidal volume plateaus while ventilation rate does not ✓		2

Question		Answers	Notes	Total
3.	a	a. the research question identifies the independent variables ✓ b. the research question identifies the dependent variable/derived value ✓ c. the research question identifies the organism tested ✓	If several variables are given, mark the first one only. Examples: a. Effect of changing/increasing wind/temperature/light/humidity/surface area /comparing different species b. accept transpiration <u>rate</u> c. accept common names.	2
3.	b	a. not all of the water taken up by the plant is used for transpiration ✓ b. some water taken up might be used for photosynthesis/ cell turgidity ✓ c. (bubble) potometer measures rate of water uptake (not transpiration directly) <b>OR</b> bubble in potometer may expand due to changes in temperature/pressure✓ d. (cut) plant/twig gets damaged/may not survive ✓ e. conditions in a lab are not equivalent to those in nature/ difficult to change only one abiotic factor ✓ f. Difficult to extrapolate values from a twig to whole plant ✓		3

## Section B

### Option A — Neurobiology and behaviour

Question		Answers	Notes	Total
4.	a	a. neural plate moves/folds/bends inwards to form a groove ✓ b. cells multiply/edges increase in height ✓ c. borders/edges of neural plate join/form neural crest ✓ d. neural tube forms/separates from rest (of ectoderm) ✓		2
4.	b	a. spine/spinal cord does not form properly <b>OR</b> incomplete closure of embryonic neural tube/ tissues around the neural tube do not fuse ✓ b. lack of folic acid/folate (B9 vitamin) in pregnancy ✓ c. genetic/family history ✓ d. exposure to certain medication/environmental conditions during pregnancy ✓		2
4.	c	a. development of vertebrate nervous system results in overabundance of neurons/connections ✓ b. unused neurons/synapses are lost ✓ c. neurons destroy themselves by programmed/natural cell death/apoptosis ✓ d. removal of dendrites from neurons ✓		2

Question			Answers	Notes	Total
5.	a	i	learning / memory /emotions / language / other correct function ✓		1
5.	a	ii	a. humans have a (much) larger ratio of cerebral cortex mass compared to body size/mass than elephants✓ b. humans have higher number of (cortex) neurons (than elephants)/vice versa ✓ c. larger number of neurons (in cortex) leads to higher intelligence (as cortex is site of functions associated with intelligence) ✓ d. other factors not shown in the table may determine to intelligence ✓		2
5.	b		a. brain cells/neurons carry out large amount of metabolic activity ✓ b. maintenance of resting potential requires energy/ATP <b>OR</b> functioning of Na-K pumps requires energy/ATP ✓		1
5.	c		a. (measures brain activity by) detecting changes associated with blood flow ✓ b. more active parts of brain receive more blood flow ✓ c. activity leads to change in magnetization between oxygen-rich and oxygen-poor blood ✓ d. scans/images are taken while the subject is exposed to a stimulus/activity ✓		2

Question			Answers	Notes	Total
6.	a	i	mechanoreceptor ✓		1
6.	a	ii	a. permanent injury/loss of <u>hair cells</u> / <u>sensory hairs</u> in cochlea ✓ b. damage to bones in the middle ear / damage the connections between the ossicles ✓ c. ruptured eardrum ✓		1
6.	b		a. (3) semicircular canals are perpendicular/at right angles/help sense movement ✓ b. movement (of head) causes fluid in canals/inner ear to move ✓ c. deflects/bends <u>hair cells</u> ✓ d. (Hair cells) send messages to brain via auditory nerve ✓		2

Question		Answers	Notes	Total
7.	a	benzodiazepines / alcohol / THC /barbiturates ✓		1
7.	b	<p><b>EITHER</b></p> <p>a. genetic predisposition ✓</p> <p>b. metabolic/enzyme differences (e.g. in processing of alcohol) ✓</p> <p><b>OR</b></p> <p>a. dopamine secretion ✓</p> <p>b. addictive drugs trigger (higher) secretion/extracellular levels of dopamine (which causes positive effect on mood) ✓</p>		2
7.	c	<p>a. innate behaviour is controlled by genes/inherited while learned is not inherited ✓</p> <p>b. the early birdsong pattern is genetically determined/innate ✓</p> <p>c. learned behaviour occurs as a result of experience while innate is independent of environment ✓</p> <p>d. (Later) birds modify their (early) song pattern based on learning from adults/other birds/the environment ✓</p>	<i>Note that mpa and mpc have two parts that are both required for the mark to be awarded. They are comparisons.</i>	3

(continued...)

(Question 7 continued)

Question		Answers	Notes	Total
7.	d	<p>a. named animal and traditional behavior ✓</p> <p>b. natural selection pressure with resulting animal response ✓</p>	<p><i>Accept common or general names of organisms.</i></p> <p><i>Examples of change in colour (peppered moth) are <u>not</u> behavioural changes.</i></p> <p><i>Example:</i></p> <p><i>a. blackcap/warbler migrates to Spain ✓</i></p> <p><i>b. warmer winters in UK / more food resulting in selection of those migrating to UK / increased numbers / greater survival ✓</i></p> <p><b>OR</b></p> <p><i>a. native green lizards traditionally occupy the lower branches and trunks of Florida’s trees ✓</i></p> <p><i>b. now live in upper branches due to pressure caused by competition of Invasive brown lizard (Over 20 generations/15 years developed sticky foot pads to hold on to smoother branches) ✓</i></p> <p><b>OR</b></p> <p><i>a. House finches in California are sedentary/do not migrate ✓</i></p> <p><i>b. Introduced into New York (about 1940) and increasing numbers migrate south during the winter months to warmer conditions/more food ✓</i></p>	2

Question	Answers	Notes	Total
8.	<p>a. (white) light is a mix of different wavelengths which correspond to different colours seen ✓</p> <p>b. light hits the back of the eye /retina ✓</p> <p>c. cones are photoreceptors in the retina/concentrated in fovea ✓</p> <p>d. cone cells are sensitive to a specific wavelength/specific colours/contain different pigments ✓</p> <p>e. three types of cone cells respond to red, blue or green light ✓</p> <p>f. different colours are perceived by the relative degree of stimulation of different cone cells ✓</p> <p>g. single cone cell passes impulses to a single nerve fibre/ganglion cell ✓</p> <p>h. (stimulation of) cones require bright light/ colour vision is less in dim light ✓</p> <p>i. genetic disorders can cause absence of red/green/some pigments / colour blindness ✓</p>		6

**Option B — Biotechnology and bioinformatics**

Question			Answers	Notes	Total
9.	a	i	methane / biogas ✓		1
9.	a	ii	a. anaerobic conditions / prevent entry of oxygen ✓ b. warm temperatures / temperature above 15°C ✓ c. different communities of microorganisms / Eubacteria and methanogens ✓ d. proper pH needs to be maintained ✓		1
9.	b		a. changes of pH (possibly caused by changes of CO <sub>2</sub> ) affect enzyme activity ✓ b. ambient pressure / build-up of gases may affect reactions involving gases ✓ c. increase of temperature could affect reaction rates /denature enzymes ✓ d. decrease in nutrients/raw materials/change in substrate could decrease rate of product formation e. increase in wastes could decrease rate of metabolism ✓ f. particle size affects rate of fermentation associated with surface area (for substrate interactions) ✓ g. mixing is necessary as sedimentation lowers surface area thus decreasing rate of reactions ✓		3
9.	c		I. peptidoglycan ✓ II. outer membrane/layer of lipopolysaccharide and protein ✓ III. peptidoglycan ✓		3

Question		Answers	Notes	Total
10.	a	<p>a. large increase in (percentage of area planted with) genetically modified corn ✓</p> <p>b. Bt and HT together hardly/not planted in the year 2000 but is majority of corn planted in 2015 ✓</p> <p>c. HT alone has slightly increased while Bt alone has decreased ✓</p> <p>d. all 3 types of corn were planted in both 2000 and 2015 ✓</p>		2
10.	b	<p>a. insect-resistant crops contain genes from the soil bacterium (<i>Bacillus thuringiensis</i>) Bt ✓</p> <p>b. herbicide (glyphosate) resistance gene has been introduced in plants ✓</p> <p>c. (resistance genes introduced) by vectors / physical methods / chemical methods ✓</p> <p>d. successfully modified plants are selected for further propagation ✓</p>		2

Question			Answers	Notes	Total
11.	a	i	<p>«a biofilm is» any group of microorganisms in which cells stick to each other on a surface  <b>OR</b>                      «a biofilm is» any group of microorganisms in which cells cooperatively produce a polysaccharide matrix ✓</p>		1
11.	a	ii	<p>a. biofilms show properties that are not shown by the individual cells / biofilms develop emergent properties ✓                      b. quorum sensing changes microbial behaviour/production of matrix ✓                      c. (matrix) hard to remove from a surface ✓                      d. biofilms are tolerant to desiccation and heat shock ✓                      e. biofilms may be very resistant to the action of (many) antibiotics/antimicrobial agents ✓                      f. because cell division in biofilms is slow, antibiotics targeting this will be ineffective ✓  <b>OR</b>                      matrix forms a barrier to antibiotics ✓</p>		3

(continued...)

(Question 11 continued)

Question		Answers	Notes	Total
11.	b	<p>a. (bioremediation is the) use of microorganisms to consume/break down pollutants ✓</p> <p>b. name of bacterium (genus required) and contaminating substance ✓</p> <p>c. outline one action of (this) bacterium to remove environmental contaminants from water or soil ✓</p> <p>d. another detail of use of (this) bacterium to remove the contaminant ✓</p> <p>e. advantage/disadvantage of using this bacterium ✓</p>	<p>b. e.g. some <i>Pseudomonas</i> to remove oil spills ✓</p> <p>c. uses crude oil for energy / breaks down crude oil ✓</p> <p>d. e.g. bacteria also need other chemicals/process may be speeded up by adding essential inorganic nutrients (phosphates/nitrates) ✓</p> <p>OR</p> <p>b. e.g. <i>Pseudomonas</i> used to remove methyl mercury ✓</p> <p>c. bacteria (<i>Pseudomonas</i>) degrade methyl mercury into elemental mercury and methane ✓</p> <p>d. methyl mercury is very toxic / can be biomagnified in food chain ✓</p>	3

Question		Answers	Notes	Total
12.	a	<p>a. organisms with similar gene sequence could be used as models for specific gene functions (in humans) ✓</p> <p>b. it is possible for researchers to learn about the gene function faster/more easily as fewer genes (in model) ✓</p> <p>c. can predict effects in other organisms ✓</p> <p>d. some research may be unethical in humans ✓</p>		2
12.	b	<p>a. results from BLASTn or BLASTp /genomic or proteomic sequences can be used ✓</p> <p>b. compared with data from available organisms ✓</p> <p>c. matches based on the number of similarities in the sequence are identified ✓</p> <p>d. similarities in sequence may be caused by evolution or by chance ✓</p> <p>e. computer programs (use sequence alignments) to suggest evolutionary relationships / cladograms can be constructed ✓</p>		3

Question	Answers	Notes	Total
13.	<ul style="list-style-type: none"> <li>a. used on genetic diseases caused by defective genes/lack of enzyme/ protein ✓</li> <li>b. viral vector (genetically) modified for (safe) use ✓</li> <li>c. virus genome is altered and missing gene/allele is introduced into virus ✓</li> <li>d. a retrovirus is used to introduce <u>RNA</u> and <u>reverse transcriptase</u> in a host cell ✓</li> <li>e. RNA is copied into DNA and introduced (permanently) into the cells genome ✓</li> <li>f. could use adenovirus/virus with DNA to introduce genetic material ✓</li> <li>g. in this technique DNA is not attached to cell genome ✓</li> <li>h. thus not replicated during host cell replication / treatment has to be repeated ✓</li> <li>i. it could be done in somatic treatment (body cells) or in sex cells (egg cells) ✓</li> <li>j. example (<i>ie</i> Gendicine, is an adenovirus used for treatment of head and neck cancer) ✓</li> </ul>		6

**Option C — Ecology and conservation**

Question		Answers	Notes	Total
14.	a	a. keystone species has a strong/disproportionate effect on a community/food web/ecosystem ✓ b. absence of keystone species would completely alter the ecosystem ✓		1
14.	b	a. example of mutualistic species ✓ b. description of mutualism ✓	Accept commonplace names for organisms in (a)  Examples: a. oxpecker (bird) and the rhinoceros/zebra ✓ b. oxpeckers/bird on rhinos/zebras eat parasites getting food while rhino/zebra get pest control  <b>OR</b> a. hummingbird hawk-moth and Dianthus ✓ b. (hummingbird hawk) moth gets nectar from flower while it pollinates the flower ✓	2
14.	c	fundamental is the potential (niche) and realized is the actual (niche) ✓	<b>OWTTE</b>	1

Question		Answers	Notes	Total
15.	a	temperature/precipitation/rainfall/minerals /pH of soils/light/humidity/wind/slope (in this specific example) ✓		1
15.	b	a. (bare ground) colonized by microorganisms/pioneer species ✓ b. thin soil forms from rock fragments / decomposing organisms ✓ c. soil retains water from melting permafrost/ice ✓ d. grasses/small plants/herbaceous plants/moss grow ✓ e. (larger plants) create habitat for animals ✓ f. weather/climate may limit plant size/biodiversity <b>OR</b> <u>climax community</u> forms ✓		3
15.	c	<i>Similarities:</i> a. in both food webs and chains organisms are arranged by trophic levels/feeding positions ✓ b. both represent the transfer of food/energy in an ecosystem ✓ c. both include producers and consumers ✓  <i>Differences:</i> d. one species could occupy different trophic levels in a food web but not in a food chain / converse ✓ e. food chain represents one possible feeding option for each organism but food web represents more possible feeding relationships/trophic levels ✓	<b>OWTTE</b> (max 1 for similarities)  (max 1 for differences)	2

Question		Answers	Notes	Total
16.	a	organisms that are introduced (accidentally or deliberately) <b>and</b> negative environmental consequences ✓	<b>OWTTE</b>	<b>1</b>
16.	b	a. inter-specific competition/alien species may out-compete native species ✓ b. lack of predators may allow alien species to thrive / reproduce more rapidly ✓ c. alien species may utilize areas/ resources that native species cannot ✓ d. predation by invasive species can cause loss of biodiversity ✓ e. can lead to species extinction ✓ f. alien species may introduce new diseases ✓ g. global shipping/air travel allows rapid transfer of alien species to new ecosystems ✓		<b>3</b>

(continued...)

(Question 16 continued)

Question		Answers	Notes	Total
16.	c	<p>a. specific name of invasive alien species to be controlled and where (in general) ✓</p> <p>b. method of biological control with specific name of predator/parasite/pathogen ✓</p>	<p><i>Examples must be verified.</i></p> <p><i>a. rabbits introduced into Australia ✓</i></p> <p><i>b. controlled by release of myxoma virus / myxomatosis (from South America) ✓</i></p>	2
16.	d	<p>a. organisms may get tangled in plastic debris ✓</p> <p>b. animals accidentally eat plastic mistaking it for food/feed plastic pieces to offspring ✓</p> <p>c. (floating) plastic debris can block sunlight preventing photosynthesis ✓</p>	<p><i>(allow any other reasonable example)</i></p>	1

(continued...)

(Question 16 continued)

Question			Answers	Notes	Total
16.	e		a. chemicals (non-degradable) accumulate along the food chain becoming more concentrated at each successive trophic level ✓ b. negative effects of organisms high in food chain ✓ c. toxic effects/death/ thin egg shells/other valid example ✓	<i>Accept specific examples of chemicals.</i>	2
17.	a	i	exponential «population growth» ✓		1
17.	a	ii	lack of food / disease / hunting / increase of predators ✓		1
17.	b		a. large area can support greater range of habitats / longer food chains / higher population numbers ✓ b. low <u>edge</u> effect with circular reserves <b>OR</b> reduced <u>edge</u> effect minimises area that is disturbed/competition ✓ c. intact / unbroken areas represent less disturbance on habitats ✓ d. fragmented areas linked by corridors ✓ e. (proximity of fragmented areas) allows for animal movement / genetic exchange ✓		3

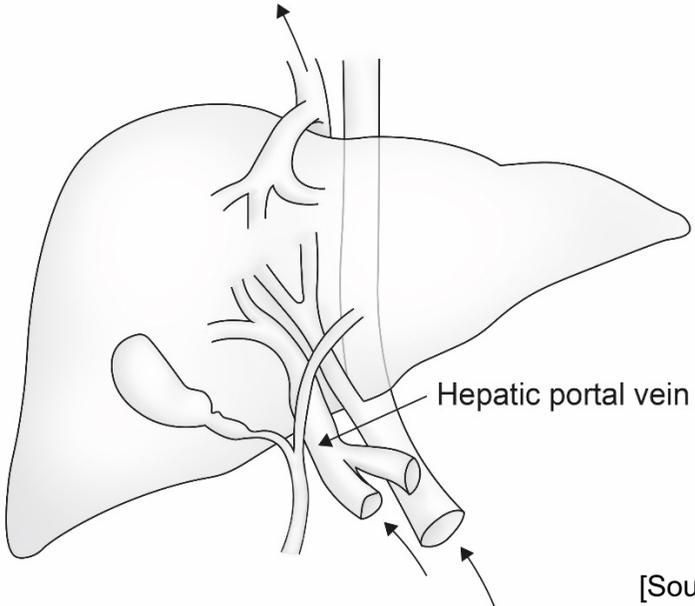
Question	Answers	Notes	Total
18.	<p>a. phosphorus in rock (reserves) enters slowly into the biosphere by weathering ✓                      b. mining of phosphorus (-bearing) rocks accelerates the natural cycle/faster than natural erosion ✓                      c. (mined) phosphorus is made into fertilizers/animal feeds/other products  <b>OR</b>                      artificial fertilizers contain phosphate ✓                      d. (phosphorous products) transported to agricultural areas (all over the world) ✓                      e. with use of fertilizers phosphorus makes its way into the soil ✓                      f. run-off/drainage from farms causes phosphorus to move into aquatic ecosystems ✓                      g. use of detergents adds phosphorus to water ✓                      h. release of sewage adds phosphorus to water ✓                      i. excess phosphorus can lead to over growth of algae and plants in water ✓                      j. decomposition of dead plant material (by bacteria) use up all the oxygen in the water/increase BOD  <b>OR</b>                      decomposition of dead plant material causes eutrophication ✓                      k. «eutrophication» can kill fish and other plants / is negative for ecosystems ✓                      l. phosphorus removed (from ecosystem) by the harvesting of agricultural crops ✓</p>		6

Option D — Human physiology

Question			Answers	Notes	Total												
19.	a	i	are essential for health / cannot be synthesized by humans ✓	<i>Vitamin D is altered from a precursor.</i>	1												
19.	a	ii	does not mention whether the information is based on adults/children/age <b>OR</b> only two vitamins are shown/no quantities given for vitamins <b>OR</b> it does not take into consideration sex / pregnancy / activity levels ✓	<i>Accept other valid correct limitation.</i>	1												
19.	b		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Gastric juice</th> <th style="width: 50%; text-align: center;">Pancreatic juice</th> </tr> </thead> <tbody> <tr> <td>a. produced by glands in stomach wall Accept as an alternative to mpa:</td> <td>produced by pancreas ✓</td> </tr> <tr> <td>b. low pH / acidic</td> <td>high pH / alkaline ✓</td> </tr> <tr> <td>c. contains hydrochloric acid</td> <td>contains HCO<sub>3</sub><sup>-</sup> ✓</td> </tr> <tr> <td>d. no enzymes for lipid/starch digestion</td> <td>lipase/amylase ✓</td> </tr> <tr> <td>e. contains mucus</td> <td>no mucus ✓</td> </tr> </tbody> </table>	Gastric juice	Pancreatic juice	a. produced by glands in stomach wall Accept as an alternative to mpa:	produced by pancreas ✓	b. low pH / acidic	high pH / alkaline ✓	c. contains hydrochloric acid	contains HCO <sub>3</sub> <sup>-</sup> ✓	d. no enzymes for lipid/starch digestion	lipase/amylase ✓	e. contains mucus	no mucus ✓	<i>Each row must be a distinction</i>	3
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a. produced by glands in stomach wall Accept as an alternative to mpa:	produced by pancreas ✓																
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d. no enzymes for lipid/starch digestion	lipase/amylase ✓																
e. contains mucus	no mucus ✓																
19.	c		<ul style="list-style-type: none"> <li>a. steroid hormones enter cell / steroid hormones can pass through cell membranes ✓</li> <li>b. steroid hormones bind to receptor in the cytoplasm ✓</li> <li>c. the receptor-hormone complex interacts directly with genes/regulates gene expression ✓</li> <li>d. example (e.g. oestrogen, testosterone, progesterone) ✓</li> </ul>		3												

(Question 19 continued)

Question			Answers	Notes	Total
19.	d		a. provides ideal pH for stomach enzyme activity ✓ b. (acidic conditions) denature proteins /start breakdown of other organic substances ✓ c. (acidic conditions) convert pepsinogen (inactive) into pepsin ✓ d. (acidic conditions) destroy pathogens in ingested food ✓		2

20.	a	i	 <p>[Source: VectorStock]</p>	Accept the vessel labeled (hepatic portal vein) as it ends in the liver and does not continue. A label anywhere on the vessel or pointing to the arrow underneath it is acceptable.	1
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(continued...)

(Question 20 continued)

Question			Answers	Notes	Total
20.	a	ii	a. hepatic artery carries oxygenated blood (from the aorta) ✓ b. hepatic portal vein carries (deoxygenated) blood from digestive tract ✓ c. blood from hepatic portal vein and hepatic artery mixes ✓ d. flows through sinusoids ✓ e. hepatic vein carries blood away from liver/to heart ✓		3
20.	b		a. hemoglobin absorbed by phagocytes/Kupffer cells ✓ b. split into heme and globin ✓ c. globin hydrolysed/broken down to amino acids ✓ d. iron removed from heme group / heme broken down to form bilirubin/bile pigment ✓		3

Question			Answers	Notes	Total
21.	a		a. initiates action potentials / electrical impulses (at start of cardiac cycle) ✓ b. acts as pacemaker/ continuous beating without external stimuli ✓ c. signal spreads over atria / causes contraction of atria (systole) ✓ d. impulses transmitted to AV (atrioventricular) node / cannot pass directly to ventricles ✓		2
21.	b	i	a. data show correlation (increased chance of CHD with age) not causation ✓	<i>OWTTE.</i>	1
21.	b	ii	sex / ethnic group / genetics / obesity / diet / life style / medical history / high cholesterol levels ✓	<i>Smoking / stress go under lifestyle.</i>	1
21.	c		a. deposition of fat in arteries thus losing elasticity/forming fibrous tissues ✓ b. deposition of fat/formation of plaque in arteries thus narrowing of lumen/causing a blockage ✓ c. high salt levels in diets thus retaining more fluids ✓ d. smoking because nicotine is a vasoconstrictor molecule ✓ e. prolonged high levels of stress thus causing vasoconstriction / exposure to stress hormones ✓ f. genetic predisposition makes it more likely that other factors will lead to hypertension ✓	<i>Do not accept a list.</i>	3

Question	Answers	Notes	Total
22.	<p>a. cell respiration consumes <math>O_2</math> / lowers <math>O_2</math> partial pressure in tissues</p> <p>b. (actively) respiring tissues release <math>CO_2</math> / partial pressure of <math>CO_2</math> increases ✓</p> <p>c. <math>CO_2</math> increases acidity / lowers pH of the blood ✓</p> <p>d. decreases hemoglobin's affinity for <math>O_2</math> ✓</p> <p>e. promotes the release of oxygen to respiring cells/tissues ✓</p> <p>f. binding of hydrogen ions/ allosteric effect / conformational change in hemoglobin releases <math>O_2</math> more readily ✓</p> <p>g. more oxygen released at the same partial pressure ✓</p> <p>h. this shifts the oxygen dissociation curve to the right/Bohr shift ✓</p> <div data-bbox="421 786 878 1203" style="text-align: center;"> </div> <p><i>diagram with correct labels:</i></p> <p>i. partial pressure <math>O_2</math> on x-axis <u>and</u> (percentage) saturation hemoglobin with <math>O_2</math> on y-axis ✓</p> <p>j. exponential shape curve at lower partial pressure/concentration of <math>O_2</math> ✓</p> <p>k. curve shifted to right (and lower) for higher partial pressure /concentration of <math>CO_2</math> /lower pH ✓</p>	<p><i>These points can be presented in a graph.</i></p>	<p>6</p>