

Markscheme

May 2019

Biology

Higher level

Paper 3

26 pages

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Section A

Question			Answers	Notes	Total
1.	a		<i>Angiospermophyta</i> /Angiosperms AND flowers «as reproductive organs» ✓	<i>Both required.</i>	1 max
1.	b	i	ovule ✓		1
1.	b	ii	a. <u>mutualistic</u> relationship OR bee gets nectar/pollen «as food» AND flower is pollinated/fertilized ✓ b. when bee enters, pollen from <u>anther</u> sticks to it ✓ c. pollen is picked up by <u>stigma</u> «of same or other flower» ✓	<i>Both needed.</i>	2 max
1.	c		a. different values for the named independent variable ✓ b. large / equal number of seeds in each Petri dish ✓ c. control of other variables «than seeds» ✓ d. mentions how germination will be determined OR how germination rate/percentage will be measured ✓ e. includes a control giving seeds all factors needed ✓	<i>Possible factors include water, oxygen, temperature, pH, light, salt concentration.</i> <i>Name of the independent variable must be included, eg temperature.</i> <i>eg appearance of radicle.</i> <i>eg number germinated over time/in a set time.</i> <i>Do not accept measurement of growth of stem/number of leaves.</i>	3 max

Question		Answers	Notes	Total
2.	a	age/height/fitness level/weight/room temperature/rest in between tests/model or type of bike ✓	<i>Other valid factor. Only mark first factor listed.</i> <i>Do not accept sex, health, smoking, oxygen level or altitude as this already listed.</i>	1
2.	b	a. in both sea level and 4000 m ventilation rate while exercising «at all intensities» is «significantly» more than at rest OR both sea level and 4000 m show an increase in ventilation rate «dm ³ min ⁻¹ » as exercise intensity increased ✓ b. ventilation rate at 4000 m «slightly» higher than at sea level for all conditions OR higher ventilation rate at 4000 m not «significantly» different as error bars overlap ✓	<i>Accept positive correlation.</i>	2 max
2.	c	a. «data logging» with spirometer OR chest belt ✓ b. «tidal» volume recorded for a given period of time OR average «tidal» volume found and multiplied by number breaths per minute ✓	<i>Must include a reference to time.</i>	2

Question		Answers			Notes	Total	
3.	a	$\left\langle \frac{(2250 - 300) \times 100}{300} \Rightarrow 650 \text{ « \% » } \checkmark \right\rangle$				1	
3.	b		Gas	Liquid	Solid	<p>[Source: Boden T ; Marland G ; Andres R J (1999): Global, Regional, and National Fossil-Fuel CO2 Emissions (1751 - 2014) (V. 2017). Carbon Dioxide Information Analysis Center (CDIAC), Oak Ridge National Laboratory (ORNL), Oak Ridge, TN (United States). doi:10.3334/CDIAC/00001_V2017]</p>	2
	a.	similarity/ comparison	all 3 increase use «over this period» OR gas and solid use increases in a similar/gradual way ✓ liquid use increases exponentially/faster «than solids or gas»				
	b.	difference/ contrast	OR greater liquid use than solids or gas in 1975 OR greater solid use than liquids or gas in 1950 OR least gas use throughout ✓				

Section B

Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	a	i	X: semicircular canals ✓ Y: eardrum/tympanic membrane ✓		2
4.	a	ii	a. sound picked up by microphone relayed electronically to speech processor ✓ b. speech processor filters background noise/selects only speech frequencies ✓ c. «radio» signal from transmitter to receiver/stimulator which converts it to electric signal ✓ d. «electrical impulses» sent to electrode «array» in cochlea OR cochlear implant bypasses the hair cells in the cochlea ✓ e. electrode/electrical signal stimulates auditory nerve «fibers in cochlea» ✓ f. signals «generated by implant» sent to brain «which recognizes signals as sound» ✓	OWTTE	3 max

(continued...)

(Question 4 continued)

Question			Answers	Notes	Total
4.	b	i	cerebrum/cerebral hemisphere ✓		1
4.	b	ii	a. all «deaf and hearing» people show common pattern of brain activation/engage similar tissues ✓ b. all show two distinct areas, one in frontal/anterior region and another in back/posterior region ✓		1 max
4.	b	iii	a. to see whether results are valid/held across different cultural/linguistic groups ✓ b. to see whether results are specific to only one language ✓		1 max
4.	b	iv	a. active parts of brain receive increased blood flow ✓ b. harmless dye injected to make blood flow visible ✓ c. brain activity for specific tasks can be observed «in real time» ✓		2 max
4.	b	v	they might make mistakes in signing/naming/repetition «which is what they use to “speak”» ✓		1

Question		Answers		Notes	Total																			
5.	a		Innate behaviour	Learned behaviour	<p><i>Not necessary to answer within a table.</i></p> <p style="text-align: right;">2 max</p>																			
		a.	genetically determined/inherited	acquired «skills/knowledge/experience» during lifetime ✓																				
		b.	independent of environment	dependent of environment/experience ✓																				
		c.	similar within the species OR spreads slowly through population	variable within the species OR spreads quickly through population ✓																				
5.	b	i	a. trained bees made few mistakes/were successful ✓	<table border="1"> <caption>Approximate data from the bar chart</caption> <thead> <tr> <th>Group</th> <th>no mistakes (%)</th> <th>some mistakes (%)</th> <th>unsuccessful (%)</th> </tr> </thead> <tbody> <tr> <td>Control bees</td> <td>~2</td> <td>~33</td> <td>~65</td> </tr> <tr> <td>Training</td> <td>~75</td> <td>~25</td> <td>~0</td> </tr> <tr> <td>Maze 1</td> <td>~78</td> <td>~22</td> <td>~0</td> </tr> <tr> <td>Maze 2</td> <td>~65</td> <td>~35</td> <td>~0</td> </tr> </tbody> </table> <p style="text-align: right;">3 max</p> <p>[Source: reprinted from <i>Neurobiology of Learning and Memory</i>, 72, S.W. Zhang et al, Honeybee Memory: Navigation by Associative Grouping and Recall of Visual Stimuli, 180–201, Copyright 1999, with permission from Elsevier]</p> <p><i>Accept converse statements.</i></p>	Group	no mistakes (%)	some mistakes (%)	unsuccessful (%)	Control bees	~2	~33	~65	Training	~75	~25	~0	Maze 1	~78	~22	~0	Maze 2	~65	~35	~0
			Group		no mistakes (%)	some mistakes (%)	unsuccessful (%)																	
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			Training		~75	~25	~0																	
Maze 1	~78	~22	~0																					
Maze 2	~65	~35	~0																					
b. trained bees could use cues on two different mazes so able to remember «over time» OR bees who did well on training maze continued to do well on other mazes ✓																								
c. «approximately» same percentage/frequency of successful bees on training and other two mazes ✓																								
d. most control/untrained bees unable to find path through maze without mistakes OR most control/untrained bees always made mistakes ✓																								

(continued...)

(Question 5 continued)

Question			Answers	Notes	Total
5.	b	ii	a. return to flowers with nectar OR «more chance» to obtain food ✓ b. increases chances of survival «if they can learn directions to and from food» ✓		1 max
6.	a	i	a. has eaten its full ✓ b. feeding depends on ratio of predator to prey OR when «certain» ratio of predator to prey is reached feeding/graph levels off ✓ c. prefers certain size mussel so only preys on these ✓	<p>Key: Numbers per cage ○ 1 crab ■ 2 crabs ▲ 4 crabs</p> <p>[Source: reprinted from B D Griffen and D G Delaney, <i>Ecology</i>, 88 (12), pages 3012–3021, copyright 2007, with permission, the Ecological Society of America]</p>	1 max
6.	a	ii	a. «foraging» depends on number of predators/crabs ✓ b. mean number of mussels/prey consumed per crab decreases as number of crabs increases ✓ c. crabs compete for prey/mussels ✓ d. both «prey and predator» affect foraging success ✓	Accept vice versa.	2 max
6.	b		a. genetically based/innate behavior can be passed on to offspring ✓ b. behavior increases chances of survival and reproduction ✓ c. will increase in frequency/become more prevalent in a population ✓		2 max

Question	Answers	Notes	Total
7.	a. neural tube formed by infolding of ectoderm/outer tissue layer ✓ b. «spina bifida» caused by «embryonic» neural tube not closing off completely ✓ c. « spina bifida» results in backbone vertebrae/spinal cord not closing/fusing properly ✓	Award marks for marking points in an annotated diagram.	2 max
8.	a. pain receptors/ends of sensory neurons send impulses to cerebral cortex creating sensation of pain ✓ b. endorphins interfere with neural transmission between areas of pain perception and CNS ✓ c. endorphins produced/secreted «primarily» by pituitary gland ✓ d. endorphins secreted during times of physical exercise/emotional stress ✓ e. endorphins bind to «opiate» receptors at «pre/post»synaptic membrane ✓ f. prevent neurotransmitters binding to postsynaptic membrane/cell ✓ g. decrease transmission at postsynaptic membrane OR are inhibitory neurotransmitters ✓ h. effects have slow onset but last long time «minutes/hours» ✓ i. act as natural painkiller OR produce feeling of euphoria ✓		6 max

Option B — Biotechnology and bioinformatics

Question			Answers	Notes	Total
9.	a	i	flavour enhancer/«food» preservative ✓		1
9.	a	ii	<i>Aspergillus niger</i> ✓	<i>Both names in full required.</i>	1
9.	b	i	glucose/fructose ✓		1
9.	b	ii	a. both show lag phase/no/little change in concentration at the beginning ✓ b. «after lag phase» citric acid concentration increases while sucrose concentration decreases OR «after lag phase» citric acid shows continued increase while sucrose falls to 0 ✓		2 max
9.	c		a. fermentation carried out by batch/continuous culture ✓ b. microorganisms use sugar for their own metabolism/fermentation ✓ c. microorganisms may become limited by their own waste products ✓ d. «probes used to» monitor conditions within fermenters ✓ e. best conditions maintained «for growth of microorganisms being cultured» ✓		3 max

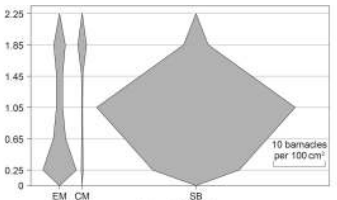
Question			Answers	Notes	Total
10.	a	i	a. cells/bacteria in a biofilm are close together ✓ b. cells secrete signaling molecules ✓ c. «signaling molecules» bind to receptors of other cells OR «signaling molecules» allow communication between cells ✓ d. a threshold is reached which enables emergent properties ✓		2 max
10.	a	ii	a. polysaccharide matrix/EPS does not let antibiotic pass/limits transport of antibiotic ✓ b. reduced metabolic activity/growth rate of bacteria in biofilm contributes to resistance ✓ c. increased cell density limits transport of antibiotic «to the interior of biofilm» ✓ d. «horizontal» transfer of antibiotic resistance via plasmids ✓	OWTTE	1 max
10.	b		a. area where biofilm problem exists ✓ b. environmental concern ✓	eg emptying introduces invasive bacterial species into coastal waters. Allow other verified examples.	2

Question			Answers	Notes	Total																																																																																																																																																																																																											
11.	a		<p>a. correct starting point ✓ eg</p> <p>DNA 5' <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>A</td><td>G</td><td>A</td><td>T</td><td>G</td><td>T</td><td>C</td><td>A</td><td>C</td><td>T</td><td>A</td><td>C</td><td>A</td><td>G</td><td>T</td><td>C</td><td>T</td><td>T</td><td>C</td><td>A</td><td>C</td><td>T</td><td>G</td><td>A</td><td>A</td><td>A</td><td>C</td><td>C</td><td>T</td></tr><tr><td>T</td><td>C</td><td>T</td><td>A</td><td>C</td><td>A</td><td>G</td><td>T</td><td>G</td><td>A</td><td>T</td><td>G</td><td>T</td><td>C</td><td>A</td><td>G</td><td>A</td><td>A</td><td>G</td><td>T</td><td>G</td><td>A</td><td>C</td><td>T</td><td>T</td><td>T</td><td>G</td><td>G</td><td>A</td></tr></table></p> <p>DNA 3' <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>T</td><td>C</td><td>T</td><td>A</td><td>C</td><td>A</td><td>G</td><td>T</td><td>G</td><td>A</td><td>T</td><td>G</td><td>T</td><td>C</td><td>A</td><td>G</td><td>A</td><td>A</td><td>G</td><td>T</td><td>G</td><td>A</td><td>C</td><td>T</td><td>T</td><td>T</td><td>G</td><td>G</td><td>A</td></tr></table></p> <p>ORF <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td></td><td>A</td><td>U</td><td>G</td><td>U</td><td>C</td><td>A</td><td>C</td><td>U</td><td>A</td><td>C</td><td>A</td><td>G</td><td>U</td><td>C</td><td>U</td><td>U</td><td>C</td><td>A</td><td>C</td><td>U</td><td>G</td><td>A</td><td>A</td><td>A</td><td>C</td><td>C</td><td>U</td></tr></table></p> <p>OR</p> <p>DNA 5' <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>A</td><td>G</td><td>A</td><td>T</td><td>G</td><td>T</td><td>C</td><td>A</td><td>C</td><td>T</td><td>A</td><td>C</td><td>A</td><td>G</td><td>T</td><td>C</td><td>T</td><td>T</td><td>C</td><td>A</td><td>C</td><td>T</td><td>G</td><td>A</td><td>A</td><td>A</td><td>C</td><td>C</td><td>T</td></tr><tr><td>T</td><td>C</td><td>T</td><td>A</td><td>C</td><td>A</td><td>G</td><td>T</td><td>G</td><td>A</td><td>T</td><td>G</td><td>T</td><td>C</td><td>A</td><td>G</td><td>A</td><td>A</td><td>G</td><td>T</td><td>G</td><td>A</td><td>C</td><td>T</td><td>T</td><td>T</td><td>G</td><td>G</td><td>A</td></tr></table></p> <p>DNA 3' <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>A</td><td>G</td><td>A</td><td>U</td><td>G</td><td>U</td><td>C</td><td>A</td><td>C</td><td>U</td><td>A</td><td>C</td><td>A</td><td>G</td><td>U</td><td>C</td><td>U</td><td>U</td><td>C</td><td>A</td><td>C</td><td>U</td><td>G</td><td>A</td><td></td><td></td><td></td><td></td><td></td></tr></table></p> <p>b. correct RNA nucleotides ✓</p>	A	G	A	T	G	T	C	A	C	T	A	C	A	G	T	C	T	T	C	A	C	T	G	A	A	A	C	C	T	T	C	T	A	C	A	G	T	G	A	T	G	T	C	A	G	A	A	G	T	G	A	C	T	T	T	G	G	A	T	C	T	A	C	A	G	T	G	A	T	G	T	C	A	G	A	A	G	T	G	A	C	T	T	T	G	G	A			A	U	G	U	C	A	C	U	A	C	A	G	U	C	U	U	C	A	C	U	G	A	A	A	C	C	U	A	G	A	T	G	T	C	A	C	T	A	C	A	G	T	C	T	T	C	A	C	T	G	A	A	A	C	C	T	T	C	T	A	C	A	G	T	G	A	T	G	T	C	A	G	A	A	G	T	G	A	C	T	T	T	G	G	A	A	G	A	U	G	U	C	A	C	U	A	C	A	G	U	C	U	U	C	A	C	U	G	A							2
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11.	b	i	identify a sequence/gene «that has the potential to be transcribed» ✓		1																																																																																																																																																																																																											
11.	b	ii	silence gene to observe the effect when the gene is not expressed OR change in phenotype to deduce function of gene ✓		1																																																																																																																																																																																																											
11.	b	iii	to compare nucleotide/DNA sequence with other «nucleotide» sequences ✓		1																																																																																																																																																																																																											

Question		Answers	Notes	Total
12.	a	<p>ALTERNATIVE 1</p> <p>a. <i>Agrobacterium tumefaciens</i> contains a <u>tumour-inducing/Ti plasmid</u> ✓</p> <p>b. required/target gene inserted into plasmid ✓</p> <p>c. bacterium injects modified plasmid into plant cell and DNA becomes incorporated into plant cell nucleus ✓</p> <p>ALTERNATIVE 2</p> <p>d. tobacco mosaic virus/TMV is the vector ✓</p> <p>e. required/target gene inserted into TMV ✓</p> <p>f. TMV injects modified DNA into plant cell «and DNA becomes incorporated into plant cell nucleus» ✓</p>		2 max
12.	b	to verify that the target gene has been incorporated in the target cell/organism ✓	OWTTE	1
12.	c	<p>a. gene for human antithrombin «fused with goat DNA and» inserted into «goat» embryos by microinjection ✓</p> <p>b. embryos inserted into recipient female ✓</p> <p>c. test offspring for antithrombin «in milk during induced lactation» ✓</p> <p>d. breed selected offspring/clones that produce antithrombin «in milk» ✓</p> <p>e. purify antithrombin from milk ✓</p>	Accept other verified animals eg: sheep, cows.	3 max

Question	Answers	Notes	Total
13.	a. DNA spots/probes/sequences attached to solid surface/microarray ✓ b. mRNA from healthy tissue/cell isolated and converted to cDNA OR mRNA from cancer tissue/cell isolated and converted to cDNA ✓ c. conversion to cDNA by reverse transcriptase ✓ d. fluorescent dye linked to copy DNA/cDNA ✓ e. cancer cDNA colored with a different dye from the healthy cDNA ✓ f. cDNA binds to/hybridizes with probes that have complementary base sequences ✓ g. microarray rinsed to remove cDNA that has not hybridized ✓ h. microarray exposed to laser light which causes fluorescent dye to give off light ✓ i. fluorescence shows which probes have hybridized OR fluorescence shows which sequences were in the tissue/sample ✓ j. hybridized probe shows gene expression OR hybridized probe helps in diagnosis of disease ✓ k. infection by pathogen can be detected by presence of its genetic material ✓	Accept named colour.	6 max

Option C — Ecology and conservation

Question		Answers	Notes	Total
14.	a	<p>a. <u>transect</u> across area to be studied ✓</p> <p>b. count/record barnacles «per species» in <u>quadrats</u> at regular intervals ✓</p>		2
14.	b	<p>a. both species present throughout the range ✓</p> <p>b. <i>C. montagui</i> has a small number of individuals «throughout» OR <i>C. montagui</i> occupies «mostly» upper shore/intertidal zone ✓</p> <p>c. <i>S. balanoides</i> has large number of individuals «throughout» OR <i>S. balanoides</i> «mostly» occupies low tide area ✓</p>		2
14.	c	<p>a. native species/<i>C. montagui</i> and <i>S. balanoides</i> have niches that don't overlap much/are distinct OR range of <i>E. modestus</i> overlaps with both native species ✓</p> <p>b. niches of native species don't overlap much which shows competition between native species OR <i>E. modestus</i> invades habitats of <i>C. montagui</i>/<i>S. balanoides</i> resulting in competition with both native species ✓</p> <p>c. <i>E. modestus</i>/EM has a wide niche/higher tolerance/covers entire «intertidal» range making it easier to invade the habitat ✓</p>	 <p>[Source: reprinted from <i>Estuarine Coastal and Shelf Science</i>, 152, M C Gallagher, <i>et al.</i>, The invasive barnacle species, <i>Austrominius modestus</i>: Its status and competition with indigenous barnacles on the Isle of Cumbrae, Scotland, pages 134–141, 2014 with permission from Elsevier]</p>	2 max

(continued...)

(Question 14 continued)

14.	d	a. indicator species need particular environmental conditions OR indicator species tolerate only certain environmental conditions ✓ b. increase/decrease in population size «over time» shows effect of environmental conditions ✓ c. used to calculate biotic index/index of cleanliness ✓ d. index of 10/high index number indicates totally unpolluted OR index of 2 or 1/low index number indicates severe pollution ✓		2 max
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Question			Answers	Notes	Total
15.	a	i	« 30 – 26 = » 4 « °C » ✓	Accept answers between 3 to 5 « °C » .	1
15.	a	ii	maximum temperature occurs just when rainfall begins/at the onset of the rainy season/monsoon OR negative relationship «as maximum temperature drops, rainfall increases» ✓	OWTTE	1
15.	a	iii	rainfall concentrated between April to December/peaks in June-August «followed by months with little/no rainfall» ✓	OWTTE	1
15.	b		a. dry season/Jan/Feb ✓ b. «drop leaves» to prevent water loss/transpiration «since no rainfall for almost four months» ✓		2
15.	c		a. statement correctly explaining the quantity of nutrients in identified circle/circles ✓ b. statement correctly explaining high nutrient flow/transfer of any thick/large arrow ✓ c. statement correctly explaining low nutrient flow/transfer of any thin arrow ✓ d. any statement correctly comparing nutrient storage/flow rates ✓ e. a Gersmehl diagram models «interrelationships between» nutrient stores and flows in an ecosystem ✓	eg most nutrients are stored in biomass/equal quantities of nutrients stored in soil and litter. eg high transfer rate of nutrients from soil to biomass. eg low transfer rate of nutrients from litter to the outside/another ecosystem. eg higher nutrient transfer between soil and biomass than between biomass and litter OWTTE.	3 max

Question		Answers	Notes	Total
16.	a	a. ideal environment/unlimited resources/below carrying capacity ✓ b. little disease/few predators ✓ c. high natality/birth rate AND immigration ✓ d. natality and immigration <u>greater</u> than mortality and emigration ✓	<i>Both needed.</i>	3 max
16.	b	a. carrying capacity is maximum population size/number of individuals that environment can support OR carrying capacity varies with abundance of limiting resources ✓ b. population growth slows/fluctuates as the carrying capacity of environment reached ✓		2 max
17.		a. name of organism ✓ b. why endangered ✓ c. where bred ✓ d. how programme carried out ✓ e. success rate ✓	<i>To award [3] name of organism, either scientific or correct common name, must be given. eg <u>Giant</u> panda eg loss of habitat/hunted for fur eg in zoos/ex situ/in situ/China eg bred/raised in captivity eg relative success re: introducing to wild/some reproduction in zoos</i>	3 max

Question	Answers	Notes	Total
18.	a. adding fertilizer increases nitrogen/phosphate in soil/nutrient cycles ✓ b. adding fertilizer increases crop yield ✓ c. commercial fertilizers may not stay in ground as long as organic fertilizers/manure ✓ d. commercial fertilizers release compounds more rapidly than organic fertilizers/manure ✓ e. nutrients run off/leached from land into water/groundwater/lakes/streams ✓ f. «high concentrations of nitrogen/phosphate in water» causes eutrophication ✓ g. «high concentrations of nitrogen/phosphate» causes algae to multiply rapidly OR leads to algal blooms ✓ h. algae die and decomposed by bacteria ✓ i. «decomposers» require oxygen from water OR increased biochemical oxygen demand/BOD ✓ j. if oxygen levels drop too low fish/aquatic organisms die ✓		6 max

Option D — Human physiology

Question		Answers	Notes	Total
19.	a	hepatic artery ✓		1
19.	b	a. both produce pyruvate «from lactate» OR both produce CO ₂ and H ₂ O «via acetyl CoA» ✓ b. hepatocytes produce glucose from lactate but mitochondria-rich cells cannot ✓	<i>OWTTE – eg: “only hepatocytes produce glucose” would be acceptable.</i>	2
19.	c	a. detoxification ✓ b. production/secretion of bile ✓ c. conversion of cholesterol to bile salts ✓ d. production of plasma proteins ✓ e. nutrient storage ✓ f. glucose regulation «in blood» ✓ g. other function «eg deamination/transamination, conversion of ammonia to urea» ✓	<i>Only two functions are required.</i>	2

Question		Answers	Notes	Total
20.	a	<i>Helicobacter pylori</i> ✓	To award [1] full scientific name is required.	1
20.	b	<p>a. vitamin E and thioctic acid both improve healing rate «compared with nizatidine alone» OR all trials with antioxidant/three trials improve healing rate «compared to N alone» ✓</p> <p>b. adding vitamin E increases healing rate more than adding thioctic acid OR adding both vitamin E and thioctic acid increases healing rate to highest level «but still less than 100 %» ✓</p>	<p>Giving values alone is not enough.</p> <p>[Source: Effect of Helicobacter Pylori Eradication Therapy and some Antioxidants on Ulcer Healing Rates in Patients with Helicobacter pylori-associated Duodenal Ulcer, Ahmed M Ali, 2013, http://www.rroj.com/open-access/effect-of-helicobacter-pylori-eradication-therapy-and-some-antioxidants-on-ulcer-healing-rates-in-patients-with-helicobacter-pylor-.php?aid=34774, licensed under a Creative Commons Attribution 4.0 International License]</p>	2

(continued...)

(Question 20 continued)

Question		Answers	Notes	Total
20.	c	a. sight/smell of food stimulates brain ✓ b. food entering stomach stimulates chemoreceptors/stretch receptors to send impulses/signals to brain ✓ c. impulse/signal from brain causes cells in stomach lining/parietal cells to secrete acid/HCl/gastric juice ✓ d. brain sends impulses/signals «via vagus nerve» to endocrine cells in wall of stomach to release gastrin ✓ e. gastrin stimulates «more» production of acid/HCl/gastric juice ✓		3 max
20.	d	a. bind to <u>plasma</u> membrane receptors of «target» cell ✓ b. results in activation/release/synthesis of a secondary messenger ✓ c. triggers a cascade of reactions ✓ d. leads to promotion/inhibition of enzymes OR causes activation of protein kinase «resulting in hormonal effect» ✓		3 max

Question			Answers	Notes	Total														
21.	a	i	Northern Territory ✓		1														
21.	a	ii	less sun in winter than in summer OR colder in winter so cover up/indoors more OR skin has more exposure to sun in summer ✓	<i>Accept other valid suggestions.</i> <i>Accept vice versa.</i>	1 max														
21.	b		a. «lack of vitamin D results in» calcium «ions» not absorbed from gut in sufficient quantities ✓ b. calcium salts not deposited or reabsorbed OR affects bone mineralization ✓ c. bones become softened/weakened ✓ d. can cause rickets «in children»/osteomalacia «in adults» ✓		2 max														
21.	c		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 35%; text-align: center;">Vitamins</th> <th style="width: 35%; text-align: center;">Minerals</th> </tr> </thead> <tbody> <tr> <td>a. similarity/comparison</td> <td colspan="2" style="text-align: center;">both required in minute/small quantities/are micronutrients OR both obtained in diet ✓</td> </tr> <tr> <td rowspan="2">b. difference/contrast</td> <td style="text-align: center;">organic molecules/compounds</td> <td style="text-align: center;">inorganic/ions/elements</td> </tr> <tr> <td colspan="2" style="text-align: center;">OR</td> </tr> <tr> <td></td> <td style="text-align: center;">example of function eg essential in metabolic processes</td> <td style="text-align: center;">example of function eg maintaining osmolarity/synaptic transmission ✓</td> </tr> </tbody> </table>		Vitamins	Minerals	a. similarity/comparison	both required in minute/small quantities/are micronutrients OR both obtained in diet ✓		b. difference/contrast	organic molecules/compounds	inorganic/ions/elements	OR			example of function eg essential in metabolic processes	example of function eg maintaining osmolarity/synaptic transmission ✓	<i>Not necessary to present answer in a table.</i> <i>Accept other valid similarities and/or differences.</i> <i>Award marks for complete lines only.</i>	2
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Question		Answers	Notes	Total																		
22.	a	a. relays signal from SAN to ventricles ✓ b. causes ventricular systole ✓ c. delays signal enabling both ventricles to contract simultaneously OR delays signal so the atria empty before ventricular systole ✓		1 max																		
22.	b	<table border="1"> <thead> <tr> <th></th> <th>structure</th> <th>function</th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>intercalated discs</td> <td>form connections between cells/join cells together/strong adhesion/prevent cells from pulling apart/resist mechanical stress ✓</td> </tr> <tr> <td>b.</td> <td>cytoplasmic connections between cells/gap junctions</td> <td>allow passage of ions/propagate rapid electrical stimuli between cells/allow coordinated contraction ✓</td> </tr> <tr> <td>c.</td> <td>striations/thick and thin muscle fibers</td> <td>form the mechanism for contraction ✓</td> </tr> <tr> <td>d.</td> <td>abundance of mitochondria</td> <td>produce supply of energy for continuous contractions ✓</td> </tr> <tr> <td>e.</td> <td>branched/Y-shaped cells</td> <td>allow for rapid propagation/faster coordinated contraction ✓</td> </tr> </tbody> </table>		structure	function	a.	intercalated discs	form connections between cells/join cells together/strong adhesion/prevent cells from pulling apart/resist mechanical stress ✓	b.	cytoplasmic connections between cells/gap junctions	allow passage of ions/propagate rapid electrical stimuli between cells/allow coordinated contraction ✓	c.	striations/thick and thin muscle fibers	form the mechanism for contraction ✓	d.	abundance of mitochondria	produce supply of energy for continuous contractions ✓	e.	branched/Y-shaped cells	allow for rapid propagation/faster coordinated contraction ✓	Not necessary to present answer in a table. Award [1] for each set of corresponding structure and function.	3 max
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Question	Answers	Notes	Total
23.	<p>a. oxyhemoglobin forms when partial pressure of oxygen is high OR oxyhemoglobin dissociates/breaks apart when partial pressure of oxygen is low ✓</p> <p>b. respiring tissues have low partial pressure of oxygen ✓</p> <p>c. sketch/statement of S-shaped «oxygen dissociation» curve ✓</p> <p>d. axes of graph labelled correctly as percentage oxygen saturation of hemoglobin on y-axis AND partial pressure of oxygen on x-axis ✓</p> <p>e. «small» decrease in oxygen partial pressure over steep part of curve results in dissociation of oxyhemoglobin/oxygen release to tissues ✓</p> <p>f. fetal hemoglobin is structurally different from adult/maternal hemoglobin ✓</p> <p>g. fetal dissociation curve to left of adult dissociation curve ✓</p> <p>h. fetal hemoglobin has greater affinity for oxygen than adult/maternal blood ✓</p> <p>i. fetus obtains its oxygen from mother's blood «at placenta» ✓</p> <p>j. at any given partial pressure of oxygen fetus will take up oxygen from mother OR fetal hemoglobin always more saturated with oxygen than maternal blood ✓</p>	<p><i>Some of these points may be present in annotated diagrams.</i></p> <p><i>Both needed. Do not accept reverse axes.</i></p>	6 max