

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	$\left\langle \frac{(2250 - 300) \times 100}{300} \Rightarrow 650 \text{ «\%»} \right\rangle \checkmark$		1															
3.	b	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th></th> <th>Gas</th> <th>Liquid</th> <th>Solid</th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>similarity/ comparison</td> <td colspan="3"> all 3 increase use «over this period» OR gas and solid use increases in a similar/gradual way \checkmark </td> </tr> <tr> <td>b.</td> <td>difference/ contrast</td> <td colspan="3"> liquid use increases exponentially/faster «than solids or gas» 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 \checkmark </td> </tr> </tbody> </table>			Gas	Liquid	Solid	a.	similarity/ comparison	all 3 increase use «over this period» OR gas and solid use increases in a similar/gradual way \checkmark			b.	difference/ contrast	liquid use increases exponentially/faster «than solids or gas» 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 \checkmark			<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
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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>~35</td> <td>~63</td> </tr> <tr> <td>Trained bees - Training</td> <td>~75</td> <td>~25</td> <td>~2</td> </tr> <tr> <td>Trained bees - Maze 1</td> <td>~78</td> <td>~22</td> <td>~2</td> </tr> <tr> <td>Trained bees - Maze 2</td> <td>~65</td> <td>~35</td> <td>~2</td> </tr> </tbody> </table> <p style="text-align: right;">3 max</p>	Group	no mistakes (%)	some mistakes (%)	unsuccessful (%)	Control bees	~2	~35	~63	Trained bees - Training	~75	~25	~2	Trained bees - Maze 1	~78	~22	~2	Trained bees - Maze 2	~65	~35	~2
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b.	<p>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 ✓</p> <p>c. «approximately» same percentage/frequency of successful bees on training and other two mazes ✓</p> <p>d. most control/untrained bees unable to find path through maze without mistakes OR most control/untrained bees always made mistakes ✓</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>																							

(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>Initial number of mussels per cage</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

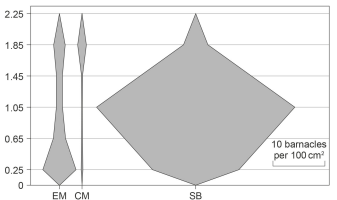
Question			Answers	Notes	Total
10.	a	i	a. cells/bacteria in a biofilm are close together ✓ b. cells secrete signaling molecules ✓ c. «signaling molecules» bind to receptors of other cells OR «signaling molecules» allow communication between cells ✓ d. a threshold is reached which enables emergent properties ✓		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> <table border="1"> <tr> <td>DNA 5'</td> <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>DNA 3'</td> <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> <tr> <td>ORF</td> <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>OR</p> <table border="1"> <tr> <td>DNA 5'</td> <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>DNA 3'</td> <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> <tr> <td>ORF</td> <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>b. correct RNA nucleotides ✓</p>	DNA 5'	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	DNA 3'	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	ORF			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	DNA 5'	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	DNA 3'	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	ORF	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.	<p>a. DNA spots/probes/sequences attached to solid surface/microarray ✓</p> <p>b. mRNA from healthy tissue/cell isolated and converted to cDNA OR mRNA from cancer tissue/cell isolated and converted to cDNA ✓</p> <p>c. conversion to cDNA by reverse transcriptase ✓</p> <p>d. fluorescent dye linked to copy DNA/cDNA ✓</p> <p>e. cancer cDNA colored with a different dye from the healthy cDNA ✓</p> <p>f. cDNA binds to/hybridizes with probes that have complementary base sequences ✓</p> <p>g. microarray rinsed to remove cDNA that has not hybridized ✓</p> <p>h. microarray exposed to laser light which causes fluorescent dye to give off light ✓</p> <p>i. fluorescence shows which probes have hybridized OR fluorescence shows which sequences were in the tissue/sample ✓</p> <p>j. hybridized probe shows gene expression OR hybridized probe helps in diagnosis of disease ✓</p> <p>k. infection by pathogen can be detected by presence of its genetic material ✓</p>	<p><i>Accept named colour.</i></p>	<p>6 max</p>

Option C — Ecology and conservation

Question		Answers	Notes	Total
14.	a	a. <u>transect</u> across area to be studied ✓ b. count/record barnacles «per species» in <u>quadrats</u> at regular intervals ✓		2
14.	b	a. both species present throughout the range ✓ b. <i>C. montagui</i> has a small number of individuals «throughout» OR <i>C. montagui</i> occupies «mostly» upper shore/intertidal zone ✓ c. <i>S. balanoides</i> has large number of individuals «throughout» OR <i>S. balanoides</i> «mostly» occupies low tide area ✓		2
14.	c	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 ✓ 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 ✓ c. <i>E. modestus</i> /EM has a wide niche/higher tolerance/covers entire «intertidal» range making it easier to invade the habitat ✓	 <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	<p>a. indicator species need particular environmental conditions OR indicator species tolerate only certain environmental conditions ✓</p> <p>b. increase/decrease in population size «over time» shows effect of environmental conditions ✓</p> <p>c. used to calculate biotic index/index of cleanliness ✓</p> <p>d. index of 10/high index number indicates totally unpolluted OR index of 2 or 1/low index number indicates severe pollution ✓</p>		2 max
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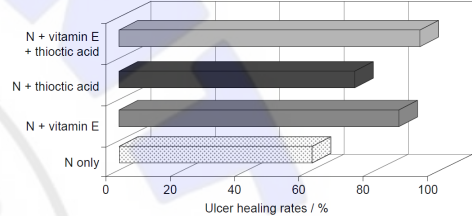
Question			Answers	Notes	Total
15.	a	i	« 30 – 26 = » 4 « °C » ✓	Accept answers between 3 to 5 « °C » .	1
15.	a	ii	maximum temperature occurs just when rainfall begins/at the onset of the rainy season/monsoon OR negative relationship «as maximum temperature drops, rainfall increases» ✓	OWTTE	1
15.	a	iii	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 ✓	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	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 ✓	Accept other valid suggestions. Accept vice versa.	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%;">Vitamins</th> <th style="width: 35%;">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 ✓	Not necessary to present answer in a table. Accept other valid similarities and/or differences. Award marks for complete lines only.	2
	Vitamins	Minerals																	
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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