



# Markscheme

**May 2019**

**Biology**

**Higher level**

**Paper 3**

21 pages

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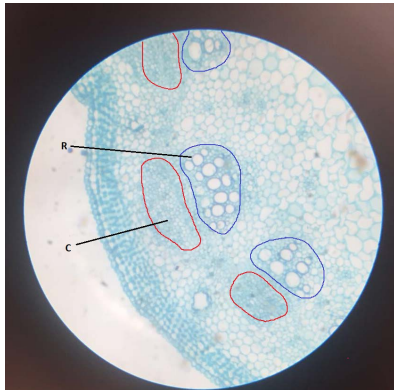
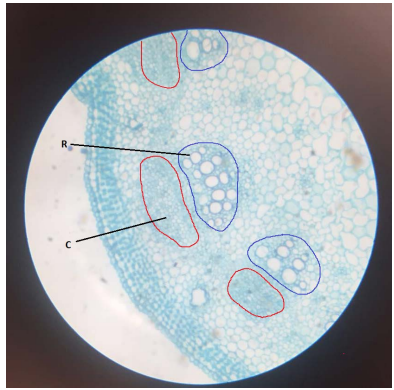
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## Section A

Question		Answers	Notes	Total
1.	a	it is increased ✓		1
1.	b	a. the experiment is repeated with smaller increments of pH ✓ b. «repeated» within the range of the optimum pH <b>OR</b> between pH 6/7 and 8 ✓ c. the pH that gives the highest enzyme activity is optimum ✓		2 max
1.	c	a. a. it increases the range of temperature/pH that give high activity ✓ b. allows for commercial use in detergents ✓		1 max



(Question 2 continued)

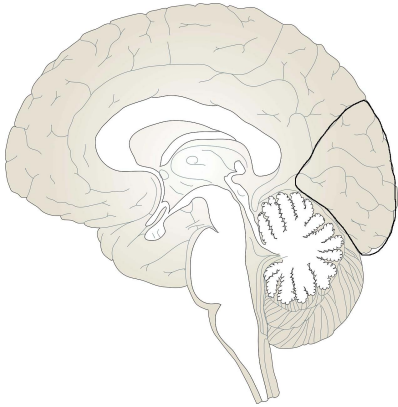
Question			Answers	Notes	Total
2.	d	i		Award [1] for correct labeling of R	1
2.	d	ii		Award [1] for correct labeling of C	1
3.	a		vein/veins ✓		1
3.	b		a. blood flows towards the heart ✓ b. valves prevent backflow ✓ c. blood flow is unidirectional ✓		2 max

## Section B

## Option A — Neurobiology and behaviour

Question		Answers	Notes	Total
4.	a	6		1
4.	b	a. MDMA «former» users made quicker responses <b>AND</b> made more errors than those who never used drugs ✓ b. quick responses with errors suggest impulsive behaviour ✓ c. possible impulsive behaviour was reason for taking drug rather than a consequence <b>OR</b> drug users could always have shown impulsive behaviour <b>OR</b> study shows correlation, not causation ✓		2 max
4.	c	a. MDMA increases the release of serotonin ✓ b. occurs in synapses of brain cells ✓ c. MDMA binds to serotonin transporters so MDMA not removed from synapse ✓ d. MDMA also causes increased dopamine/norepinephrine secretion ✓ e. these neurotransmitters influence our mood/cause euphoria <b>OR</b> may lead to memory problems ✓		3 max

Question		Answers	Notes	Total
5.	a	a. the process is neurulation ✓ b. <u>ectoderm</u> tissue differentiates to form the neural plate ✓ c. the neural plate «changes shape and» folds ✓ d. «the ends join» to form the neural tube ✓		3 max
5.	b	elongation «of the neural tube» ✓		1
5.	c	a. this leads to condition spina bifida ✓ b. some of the vertebrae may not form correctly <b>OR</b> incomplete closing of the backbone ✓ c. spinal cord may protrude ✓ d. «may» cause paralysis ✓		2 max
6.	a	a. X: pinna ✓ b. Y: auditory/cochlear/acoustic nerve ✓		2
6.	b	<u>oval</u> window ✓		1
6.	c	a. semi-circular canals are concerned with balance/head movement ✓ b. movement of the head causes fluid/liquid/endolymph in the canals to move ✓ c. <u>hair cells</u> detect this movement and transmit information to brain ✓ d. along the <u>vestibular</u> nerve ✓ e. three canals allow us to detect movement in all directions/planes ✓		3 max

Question			Answers	Notes	Total
7.	a	i		Accept any label within marked area	1
7.	a	ii	<p>a. the cerebral hemispheres are larger «relative to rest of brain» ✓</p> <p>b. the cerebral cortex forms a larger proportion of the brain ✓</p> <p>c. there is extensive folding of the cerebral cortex ✓</p>		2 max
7.	b		<p>a. lesions are areas of brain injury ✓</p> <p>b. diagnosed in living people using MRI/CAT scan/PET scan ✓</p> <p>c. autopsies reveal the position and extent of lesions <b>OR</b> animal experimentation ✓</p> <p>d. the behaviour/functioning of patient with lesion was observed ✓</p>	Other possible techniques: cerebral arteriogram/angiogram, diffusion weighted MRI	3 max



Question	Answers	Notes	Total
8.	<p>a. operant conditioning consists of trial and error ✓</p> <p>b. operant conditioning uses the consequences of the behaviour to modify the behaviour ✓</p> <p>c. this can be carried out by positive reinforcement <b>OR</b> reward the desired behaviour ✓</p> <p>d. showing the dog affection/food when it does not jump up ✓</p> <p>e. can be negative reinforcement <b>OR</b> stopping a negative consequence when the appropriate behaviour is observed ✓</p> <p>f. hold the dog until it no longer wants to jump up ✓</p> <p>g. can be positive punishment <b>OR</b> a negative consequence to undesired behaviour ✓</p> <p>h. hitting the dog when it jumps up/pushing the dog down/show anger at the dog ✓</p> <p>i. negative punishment <b>OR</b> taking away a desired item ✓</p> <p>j. tying the dog up/isolating the dog to another place when it jumps up/remove attention/ ignore dog ✓</p>		6 max

## Option B — Biotechnology and bioinformatics

Question			Answers	Notes	Total
9.	a	i	16 mm <i>or</i> 1.6 cm ✓	<i>units required</i> Allow 15 mm to 17 mm, or 1.5 cm to 1.7 cm	1
9.	a	ii	tetracycline was more effective in inhibiting/killing the bacteria ✓		1
9.	a	iii	a. it contained no antibiotic ✓ b. it was a control «with only water» ✓ c. the antibiotic it contained was not effective against the bacterium/bacterium is resistant to antibiotic ✓		1 max
9.	b		a. use the <u>Gram staining</u> procedure ✓ b. Gram-positive bacteria take up/retain «crystal violet» stain ✓ c. «Gram-positive bacteria» appear purple-coloured seen through a microscope ✓		2 max
9.	c	i	«a system of» behaviours triggered as a function of population density ✓		1
9.	c	ii	a. allows a broader range of habitat «for colonization» ✓ b. biofilms are resistant to physical forces/heat shock/desiccation/physical wiping ✓ c. biofilms can withstand nutrient deprivation ✓ d. resistance to changes in pH ✓ e. resistance to antibiotics ✓ f. avoid phagocytosis ✓		3 max

Question		Answers	Notes	Total
10.		a. <u>enzymatically</u> remove wall from plant cell to make protoplast ✓ b. use liposome ✓ c. get genes of choice into the vesicle/liposome ✓ d. get protoplast to fuse with the vesicle/liposome ✓		3 max
11	a	thrive/live in a salt rich environment ✓		1
11.	b	1 mol m <sup>-3</sup> ✓		1
11.	c	<i>Marinobacter</i> ✓	Allow other correct responses eg: <i>Dechloromonas</i> , <i>Haloferax</i> , <i>Pseudomonas</i> , <i>Fusarium</i> , <i>Halomonas</i> , <i>Halococcus</i> , <i>Halobacterium</i> , <i>Haloarcula</i> , <i>Haloarchaea</i> , <i>Fundibacter</i> , <i>Fusarium</i> , <i>Alcanivorax</i> , <i>Dietzia</i>	1
11.	d	a. energy gained from the benzene ✓ b. benzene acts as a source of carbon ✓		1 max

Question			Answers	Notes	Total
12.	a	i	0.1 ✓		1
12.	a	ii	a. the numbers in the table represent differences in a gene since evolving from a common ancestor/genetic similarity/how closely related species are ✓ b. the differences are a result of mutations ✓ c. the longer two species are isolated, the more mutational differences there are ✓ d. 1 and 2/2 and 3 have most differences so are probably more distantly related ✓ e. 2 and 4 have fewest differences so are probably most closely related ✓		3 max
12.	a	iii	a. nucleotides could have changed several times ✓ b. nucleotides could have reverted to the original, therefore the change is not recorded as such ✓ c. natural selection may protect/retain certain sequences ✓		1 max
12.	b		a. amino acid ✓ b. RNA nucleotides ✓	<i>Do not accept "proteins" or "RNA molecules"</i>	1 max
12.	c		a. <i>example of software</i> : BLAST/BLASTn ✓ b. compares nucleotide sequences to sequence databases ✓ c. calculates the statistical significance of differences ✓ d. much faster than aligning sequences by hand ✓ e. give different weightings/scores to gaps «therefore different possible alignments» ✓		2 max

Question	Answers	Notes	Total
13.	a. biopharming is production of recombinant proteins/drugs by using transgenic animals ✓ b. the gene for antithrombin is cut from human DNA ✓ c. the gene is combined with the gene producing milk protein/casein ✓ d. the recombinant gene is inserted into an embryo of the goat ✓ e. the embryo is implanted in a female goat ✓ f. a promoter sequence is transferred with the gene for antithrombin to ensure that the gene is activated in cells that produce milk ✓ g. a signal sequence is transferred with the gene ✓ h. to ensure that the mRNA is translated by ER ribosomes ✓ i. the offspring of the goat are tested for antithrombin in their milk ✓ j. offspring with the recombinant gene are selected for breeding ✓ k. antithrombin is isolated from the milk and purified ✓ l. many goats with the recombinant gene allow large scale production of antithrombin ✓	<i>Accept other milk producing farm animal eg: goat, sheep, camel</i>	<b>6 max</b>

## Option C — Ecology and conservation

Question		Answers	Notes	Total
14.	a	a. as population increases so does phosphate production/positive correlation ✓ b. since 1985 phosphate production has not risen while population has continued to increase ✓		2
14.	b	leaching/soil erosion, run-off/removed by the harvesting of agricultural crops ✓		1
14.	c	a. phosphorus is important as a fertilizer ✓ b. a drop in phosphate could lead to less agricultural output ✓ c. «this could mean» less food available for increasing population ✓		2 max
15.	a	nutrient flow ✓		1
15.	b	a. the circle would be «relatively» smaller <b>OR</b> litter layer is less ✓ b. warmer weather favours the decomposition of litter/results in thicker arrow between litter and soil ✓ c. more rainfall favours the decomposition of litter/results in thicker arrow between litter and soil ✓ d. greater number of saprophytes/decomposers in rain forest ✓ e. nutrients would be stored in biomass/biomass circle would be larger ✓		3 max

Question			Answers	Notes	Total
16.	a	i	predation was greater in those born in captivity ✓		1
16.	a	ii	a. the marmots have experience with/recognize predators ✓ b. parents shield them from predators <b>OR</b> parents teach them about predators ✓ c. those born in the wild are favoured in <u>natural selection</u> ✓		2 max
16.	b		<i>ex situ</i> is in artificial environment, <i>in situ</i> is in natural environment ✓	<i>Accept examples as long as it is clear one is natural and one artificial</i>	1

Question			Answers	Notes	Total
17.	a	i	a. overall the grey squirrel distribution has increased «and the red squirrel decreased» ✓ b. in 2010 the grey squirrel was found in areas where it was previously not found ✓ c. grey squirrel has dominated/red squirrel virtually eliminated ✓	OWTTE	2 max
17.	a	ii	a. no predators ✓ b. ample food supply/habitats ✓ c. few competitors ✓ d. resistant to disease ✓ e. high reproductive rate ✓ f. no physical barrier to prevent spread of grey squirrels on mainland ✓		2 max
17.	b		a. competitive exclusion states two species that occupy a similar niche in the same location cannot coexist ✓ b. one of the two competitors will always have an advantage over the other ✓ c. leads to extinction/displacement/evolution of the second competitor ✓ d. grey squirrels have replaced/occupied niches formerly occupied by red squirrels <b>OR</b> habitats favour the grey squirrel in competition for the niche ✓ e. the niche of one competitor/both competitors becomes narrower ✓		3 max



Question		Answers	Notes	Total
18.	a	herbivore/primary consumer ✓	<i>Do not accept second trophic level</i>	1
18.	b	a. keystone species have a disproportionate effect on the biological community ✓ b. removal of the sea bream «due to fishing» ✓ c. results in more sea urchins ✓ d. which significantly reduce the producers/seagrass ✓	<i>Do not accept first trophic level for mpd</i>	3 max
19.		a. snails in the ecosystem are captured and marked ✓ b. they are released back in to the ecosystem and allowed to mix ✓ c. a second sample of snails are captured in the ecosystem and those that are marked are counted ✓ d. sufficient time given between first and second sample to allow for mixing ✓ e. the ratio of the first sample size to those recaptured marked = the ratio of the number in the second sample to the population/formula ✓ f. area of habitat determined ✓ g. assumes sample size is large enough to be significant ✓ h. assumes there is no emigration/immigration/death of snails ✓ i. assumes the marking of the snail does not affect their survival ✓ j. assumes no misidentification of species ✓ k. assumes marked snails do not lose their marks ✓		6 max

## Option D — Human physiology

Question			Answers	Notes	Total
20.	a		the drug does not appear to improve strength as less mass can be lifted «by arms and legs» ✓		1
20.	b		a. occurs naturally so hard to tell whether it has been injected ✓ b. HGH has very short half life ✓		1
20.	c		a. peptide hormones do not enter the cell ✓ b. they bind to receptors/proteins in the plasma membrane of the target cell ✓ c. a secondary messenger initiates the cell response ✓ d. causes a cascade of actions that changes the cell's physiology ✓ e. cAMP is a common secondary messenger ✓		3 max
21.	a	i	a. heartbeat too slow/fast/irregular/tachycardia/fibrillations ✓ b. sinoatrial node is malfunctioning ✓ c. pathway that conducts electrical impulses generated by the sinoatrial node is impaired ✓	<i>Do not accept heart attack</i>	1 max
21.	a	ii	a. a pacemaker contains a battery and pulse generator <b>OR</b> it is connected to the heart by wires/cables ✓ b. it detects that the heart's natural rhythm is incorrect ✓ c. it sends electrical impulses to correct the heartbeat/it replaces sinoatrial node ✓ d. provide a regular impulse/constant rhythm ✓		2 max

(continued...)

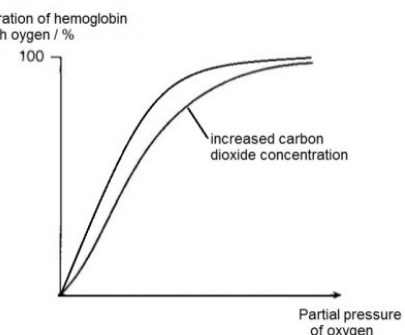
(Question 21 continued)

Question			Answers	Notes	Total
21.	b	i	intercalated disc ✓		1
21.	b	ii	a. branching provides larger surface area of contact between cells <b>OR</b> is branched to allow groups of cells to work together/synchronize ✓  b. intercalated disks hold cells together so they cannot separate <b>OR</b> intercalated discs allow easy transfer of electrical impulses between cells ✓  c. contain large numbers of mitochondria ✓  d. gap junctions «in intercalated discs» form channels that allow continuous flow of cytoplasm between cell ✓	<i>For mpa, accept branching allows connection to multiple cells</i>	2 max
22.	a		a. mass/volume of water ✓ b. mass of avocado ✓		2
22.	b		a. heat loss to the air ✓ b. heat transferred to the apparatus ✓ c. avocado may not be fully dried/incomplete combustion of avocado ✓		1 max
22.	c	i	helps in movement of food along alimentary canal/peristalsis/decreases transit time <b>OR</b> regulates bowel action <b>OR</b> prevents cancer/constipation/heart attack ✓		1 max
22.	c	ii	essential amino acids must be included in the diet <u>and</u> the body cannot make them «whereas the body can synthesize non-essential amino acids» ✓		1

Question		Answers	Notes	Total
23.	a	a. causes inflammation ✓ b. digestion of stomach lining by pepsin and HCl/gastric juice ✓ c. called «gastric» ulcer ✓		2
23.	b	neutralizes the acid the stomach secretes that kills bacteria ✓		1
23.	c	a. release of gastric juices stimulated by gastrin ✓ b. gastrin stimulates secretion of gastric hydrochloric acid ✓ c. from the parietal cells «of the stomach» ✓ d. gastrin release stimulated by presence of polypeptides/amino acids in stomach ✓ e. gastrin stimulates release of pepsinogen by chief cells «of the stomach» ✓ f. drop in pH/excess acid/secretion of secretin/somatostatin inhibits gastrin secretion ✓		3 max
24.	a	a. X: «type I» pneumocyte ✓ b. Y: endothelial cells ✓	Accept endothelium/capillary wall	2

(continued...)

(Question 24 continued)

Question		Answers	Notes	Total
24.	b	<ul style="list-style-type: none"> <li>a. diagram showing normal oxygen dissociation curve ✓</li> <li>b. diagram showing curve with increased CO<sub>2</sub> to the right ✓</li> <li>c. both axes correctly labelled ✓</li> <li>d. where tissues are respiring there is a higher concentration of CO<sub>2</sub> ✓</li> <li>e. exercise increases the amount of CO<sub>2</sub> in the blood ✓</li> <li>f. an increase in CO<sub>2</sub> lowers the pH of the blood ✓</li> <li>g. a lower pH causes hemoglobin to release oxygen ✓</li> <li>h. lower pH decreases hemoglobin affinity for O<sub>2</sub>/changes hemoglobin conformation ✓</li> <li>i. oxygen is released in tissue where it is required for respiration ✓</li> <li>j. this is known as the Bohr effect/shift ✓</li> <li>k. at the lungs the low concentration of CO<sub>2</sub> means oxygen attaches to hemoglobin ✓</li> <li>l. «Bohr» effect particularly important during exercise ✓</li> </ul>	<p>Saturation of hemoglobin with oxygen / %</p>  <p>Partial pressure of oxygen</p> <p>Apply [4 max] if no diagram.</p>	6 max