

Markscheme

November 2018

Biology

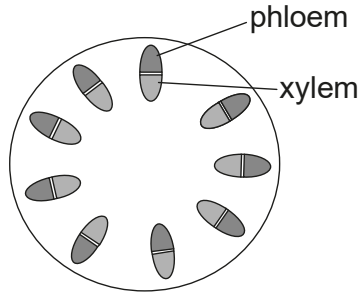
Higher level

Paper 3

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Section A

Question		Answers	Notes	Total
1.	a	12 breaths per minute/6 litres per minute ✓	<p>Accept answers from 11 to 12 breaths per minute.</p> <p>Accept answers from 5.5 to 6 litres per minute.</p> <p>Answer must include breaths or litres and a standard unit of time.</p> <p>Correct: eg: 12 breaths / minute eg: 0.1 L sec⁻¹ or 6 L min⁻¹</p> <p>Incorrect: eg: but 12 breaths = 0 marks</p>	1
1.	b	<p>a. the volume of air per breath increases OR the volume of each breath reaches a maximum/levels off OR frequency of ventilation/breaths per minute increases ✓</p> <p>b. exercise increases «rate of cellular» respiration/energy use/blood CO₂/acidity ✓</p> <p>c. exercise causes increased demand for oxygen/removal of carbon dioxide ✓</p> <p>d. maximum rate/depth of ventilation is determined by the capacity of the student ✓</p>		2 max
1.	c	«total resting lung volume» would be greater ✓		1
1.	d	<p>a. type I pneumocytes carry out gas exchange ✓</p> <p>b. type II pneumocytes secrete surfactant/fluid OR type II pneumocytes create a moist surface inside the alveoli OR type II pneumocytes reduce surface tension between alveoli OR type II pneumocytes prevent the sides of the alveolus adhering to each other ✓</p>	<p>OWTTE</p> <p>OWTTE</p>	2

Question		Answers	Notes	Total
2.	a	a. X: phloem ✓ b. Y: xylem ✓		2
2.	b	$A-B = \frac{7 \text{ mm}}{400}$ OR 17.5 μm ✓	Accept answers in the range of 17 to 19 μm	1
2.	c	a. stem vascular tissue is in bundles ✓ b. «bundles» form a ring c. phloem is towards outside «of bundle» OR xylem is towards centre «of bundle» ✓	Allow answers in an annotated drawing 	2 max

Section B

Option A — Neurobiology and behaviour

Question		Answers	Notes	Total
4.	a	a. «the process shows» the growth of an axon/dendrites/extensions ✓ b. differentiation/forming a specialized neuron ✓ c. responding to a chemical stimulus ✓		2 max
4.	b	a. the neuron forms synapses/multiple connections «with other neurons» OR a neural network forms OR more dendrites ✓ b. some synapses/connections in excess of what is required OR some synapses/connections not used ✓ c. it could be removed by neural pruning/apoptosis ✓ d. it could migrate to another place ✓		2 max
4.	c	a. allows brain to change/adjust/make new synapses throughout lifetime/with experience/learning ✓ b. allows regeneration of neurons after brain trauma OR allows other areas «of the brain» to take over a function after brain trauma ✓ c. selective advantage/increases chance of survival ✓	OWTTE	1 max

Question			Answers	Notes	Total
5.	a		<p><i>similarity:</i></p> <p>a. as body size increases, brain volume increases for smaller mammals OR «weak» positive correlation ✓</p> <p><i>contrast:</i></p> <p>b. humans do not fit the trend/are the exception ✓</p>		2 max
5.	b		<p>a. human <u>cortex</u> has a larger total volume/is larger than gorilla's ✓</p> <p>b. human <u>cortex</u> has more folding/area «to accommodate within the cranium» ✓</p>		1 max
5.	c	i	speech production/language processing ✓		1
5.	c	ii	<p>cognitive processing of motivation/pleasure/reward OR modulates the effects of «the neurotransmitter» dopamine OR involved in learning ✓</p>		1
5.	c	iii	swallowing/breathing/heart rate/digestion/sneezing/coughing/vomiting ✓		1

Question			Answers	Notes	Total
6.	a		a. with each trial the drawings get better/less errors OR each day the patient becomes better at drawing the star ✓ b. by day 3 the patient makes few mistakes/less fluctuations ✓ c. even though left hand went through fewer trials, still an improvement ✓ d. practice improves the behaviour OR learning occurs «over time» with repetition ✓		3 max
6.	b		right handed, as the patient made fewer mistakes with this hand OR right handed as fewer trials with left hand OR not possible to draw conclusion as the trends are the same for both but left hand trials end after a few trials ✓	Must give reason for the mark OWTTE	1
6.	c	i	a. learning by trial and error OR reward/punishment to reinforce behaviour ✓ b. example ✓	eg: mice given food when finding their way across a maze will perform better the second time	2
6.	c	ii	a. a form of learning where the young animal fixes its attention on the first object seen ✓ b. example ✓	eg: a duckling seeing a human after hatching will follow that human	2

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	d	a. slow-acting neurotransmitters affect learning/memory ✓ b. «slow-acting neurotransmitters» trigger the release of secondary messengers «in postsynaptic neuron» ✓ c. synaptic transmission is enhanced OR increase in the number of receptors in the postsynaptic membrane ✓ d. modulate/reduce/increase fast synaptic transmission «in the brain» ✓		2 max
7.		a. males' long feathers/plumage/bright colours attract mate OR dance/vocalizations attract mate ✓ b. males compete for the females to reproduce ✓ c. characteristics also make males more vulnerable to predation ✓ d. males survive despite having huge tails/extreme features ✓ e. «natural selection» has benefited the most colourful/attractive males with best reproductive success/fitness/passing genes to offspring ✓	OWTTE	3 max

Question	Answers	Notes	Total
8.	<p>a. photoreceptors/cones/rods detect «reflected» light/stimulus ✓</p> <p>b. cones found in fovea «of retina» and rods found all over retina ✓</p> <p>c. rods active in low-intensity/dim light ✓</p> <p>d. cones active in high-intensity/bright light ✓</p> <p>e. rods give black and white vision ✓</p> <p>f. cones detect colours ✓</p> <p>g. bipolar neurons/cells synapse with multiple rods but «only» with individual cones ✓</p> <p>h. bipolar neurons/cells «in the retina» form synapses with ganglion cells ✓</p> <p>i. electrical/nerve impulses travel to brain/occipital lobe via the optic nerve ✓</p> <p>j. right field of vision from both eyes sent to the left part of the visual cortex through the chiasma «and vice versa» ✓</p>	<p><i>Allow answers in annotated diagrams</i></p> <p>OWTTE</p> <p>OWTTE</p> <p>OWTTE</p>	<p>6 max</p>

Option B — Biotechnology and bioinformatics

Question		Answers	Notes	Total
9.	a	a. bacterial/ <i>B. subtilis</i> adhere to surfaces ✓ b. «bacteria/ <i>B. subtilis</i> » grow surrounded by EPS/exopolysaccharide/extracellular polymeric substance matrix ✓ c. «bacteria/ <i>B. subtilis</i> growing in a biofilm» are highly resistant to antimicrobial agents ✓ d. «bacteria/ <i>B. subtilis</i> in biofilms» cooperate through quorum sensing ✓		2 max
9.	b	a. example of where biofilm cause problems ✓ b. description of problems ✓	eg: clogging/corrosion of pipes/water systems ✓ slows down/interrupts/clogs water supply systems ✓ OR eg: contamination of surfaces in food production ✓ causes food transmitted diseases ✓ OR eg: plaque formation on teeth ✓ causes cavities ✓ OR eg: catheter clogging ✓ causes urinary infections ✓	2 max

Question		Answers	Notes	Total
10.	a	bacteria OR archaeans OR methanogens ✓	Accept a named bacterium	1
10.	b	continuous because there is a constant input of raw materials ✓		1
10.	c	a. pH/acidity/alkalinity ✓ b. foam ✓ c. metabolites ✓ d. substrate ✓ e. oxygen ✓ f. carbon dioxide ✓ g. temperature ✓ h. pressure ✓	Accept other valid condition	3 max
10.	d	methane ✓		1
10.	e	a. mixing substrate to increase contact with bacteria OR preventing sedimentation ✓ b. avoids formation of biofilms ✓ c. aeration for aerobic bacteria ✓		2 max

Question		Answers	Notes	Total
11.	a	a. by detecting a marker/resistance/sequencing gene ✓ b. the offspring produce yellow rice ✓	Accept PCR to detect the marker gene.	1 max
11.	b	a. biopharming is the introduction of genes into another species for medical use ✓ b. β-carotene/provitamin A is added to rice to prevent «night» blindness/diseases ✓ c. through genetic engineering ✓		2 max
11.	c	a. «Ti/tumour inducing» plasmid of <i>A. tumefaciens</i> /bacterium causes tumours/galls ✓ b. Ti incorporates genes «of β-carotene synthesis» OR Ti is used as a vector of the gene «for β-carotene» ✓ c. recombinant plasmids reintroduced into <i>A. tumefaciens</i> /bacterial cells ✓ d. bacteria infect rice plant cells ✓ e. the newly incorporated gene produces β-carotene/Golden Rice ✓		3 max
11.	d	sequence shown on alignment: Corn TESVYSAALALGIANQLTNI LRDVGEDARRGRIYLPQDELA Daffodil AESVYNAALALGIANQLTNI LRDVGEDARRGRIYLPQDELA ***** Corn QAGLSDEDIFKGVVTRWRNFMKRQIKRARMFFEEAERGVN Daffodil EAGLSDEDVFTGKVTDKWRSFMKRQIKRARTFFEQAEGVT ***** * * * * * Corn [ELSQASRWPVWASLLLYRQILDEIEANDYNNFTKRAYV]GKG Daffodil [ELSQASRWPVWASLLLYRQILDEIEANDYNNFTKRAYV]SKV ***** * Corn KKLLALPVAYGKSLLLPCSLRN---GQT Daffodil KRLAALPLAYGKSLLIPLSLRPPSLSKA * * * * * * * * * * * * * * * *		1

(continued...)

(Question 11 continued)

Question		Answers	Notes	Total
11.	e	a. BLASTp aligns amino acids «of proteins» ✓ b. BLASTn aligns nucleotides «of DNA/RNA» ✓ c. amino acid sequence is shown therefore BLASTn would not work ✓		2
11.	f	a. dashes are shown where there is no alignment ✓ b. due to lack of amino acids on one of the sequences ✓ c. in order to make them align the computer introduces gaps ✓ d. the sequence with dashes does not include the sequence of the other protein shown ✓		3 max

Question	Answers	Notes	Total
12.	<p>a. blood/urine cultures to diagnose bacterial infections ✓</p> <p><i>ELISA:</i></p> <p>b. «ELISA» uses antibodies specific to pathogen antigen ✓</p> <p>c. the antibodies are linked to an enzyme ✓</p> <p>d. after binding of the antibody enzyme complex samples are washed to remove unbound complex ✓</p> <p>e. is added for the enzyme which changes colour «if they join with an antigen» ✓</p> <p><i>MICROARRAY:</i></p> <p>f. test for specific mRNA sequences «using a microtiter plate» ✓</p> <p>g. reverse transcriptase used to make cDNA from mRNA, linked with fluorescent dye ✓</p> <p>h. «laser» light detects when cDNA and DNA hybridize which confirms presence of protein ✓</p> <p><i>PCR:</i></p> <p>i. detection of genetic material from the pathogen is obtained using a PCR «by using primers based on pathogen sequences» ✓</p> <p>j. if DNA/RNA is amplified «more than control» then infection is confirmed ✓</p> <p>k. problems of false positive or false negative «in test result interpretation» ✓</p>		6 max

Option C — Ecology and conservation

Question		Answers	Notes	Total
13.	a	Japanese stiltgrass ✓		1
13.	b	produce seeds which spread when cutting OR avoid vegetative proliferation/cloning OR may provide habitats for other species ✓	<i>Accept any other reasonable answer</i>	1
13.	c	a. «biotic» competition with native plants OR disrupt the food chain/ecosystem ✓ b. competition for abiotic factors ✓ c. reduce competitive exclusion OR avoid overlapping niches ✓ d. can cause changes to soil ✓ e. break/damage/cause death/extinction of native plants ✓	<i>Accept an example of an abiotic factor such as light/space/water/etc</i> <i>eg: Rhododendrons/conifers acidify the soil, making it difficult for other species to grow</i>	2 max
13.	d	a. «control» introduced species should only target alien plants OR «control» introduced species should not outcompete endemic species ✓ b. should not upset food chains/habitats ✓ c. should have some natural control/predator ✓ d. should not spread outside required area/not become invasive themselves OR field testing for effectiveness ✓	<i>OWTTE</i>	2 max

Question		Answers	Notes	Total
14.	a	there is exchange of matter/energy OR there is an exchange between the surface of the water and the atmosphere ✓	<i>eg: matter could be nutrients/gas/water/minerals/etc; energy could be heat or light</i>	1
14.	b	soil and no fish «mesocosm» AND soil and fish «mesocosm» ✓	<i>Both mesocosms required Accept answers such as “the two with soil”.</i>	1
14.	c	a. zooplankton feed on bacteria reducing their numbers ✓ b. fish feed on zooplankton «therefore» increasing bacterial population ✓		2
14.	d	a. conditions closer to levels experienced naturally by the organism ✓ b. natural variation of abiotic variables ✓ c. more natural behaviour/interactions ✓ d. not harm organisms by removing them from natural habitat ✓	<i>OWTTE Accept examples, eg: temperature, dissolved oxygen</i>	2 max

Question			Answers	Notes	Total
15.	a		«group» I ✓		1
15.	b	i	number of individuals of a species ✓		1
15.	b	ii	tolerance rating of that species ✓		1
15.	c		a. group V organisms «could» contain indicator species ✓ b. group V organisms can survive in polluted environments «while others cannot» ✓ c. they have a high tolerance/BI index OR «relative number of» indicator species can be used to calculate the value of a biotic index ✓ d. the more group V present could indicate more pollution ✓ e. absence of group V could indicate a cleaner environment ✓	OWTTE	3 max

Question		Answers	Notes	Total
16.	a	<p>a. phosphate-rich rocks/resource is limited ✓</p> <p>b. demand exceeds availability of phosphorus OR there is greater consumption than P available ✓</p> <p>c. cycling of phosphorus is slow ✓</p> <p>d. as crops are removed, the phosphate levels within the soil is continually depleted ✓</p> <p>e. there is no biological/industrial way to replenish the mineral «fast enough» OR «phosphate» fertilizers need to be added «to replenish it in the soil» OR «lost phosphate» does not go back in the cycle ✓</p>	OWTTE	3 max
16.	b	<p>a. <u>phosphates</u> are leached to lakes/rivers ✓</p> <p>b. induces incremental growth of plants/bloom/algae ✓</p> <p>c. algae do not let light go through water so less photosynthesis ✓</p> <p>d. plants/algae die/decay ✓</p> <p>e. bacterial decomposition consumes the oxygen ✓</p> <p>f. creating state of hypoxia OR greater biochemical oxygen demand ✓</p> <p>g. causing death of «aerobic» organisms ✓</p>	eg: fish	3 max

Question	Answers	Notes	Total
17.	<p>a. «keystone species» have a main/disproportionate role in the maintenance of the structure of a community ✓</p> <p>b. not necessarily top predator/most abundant species OR affect other organisms even if they have a small biomass/productivity</p> <p>c. may impact a top-down/bottom-up control ✓</p> <p>d. «if removed» cause increase in populations of secondary consumers and decrease of primary consumers ✓</p> <p>e. «if removed» may cause loss of balance in food chain/community ✓</p> <p>f. «if removed» may cause «drastic» loss of biodiversity OR extinction of species ✓</p> <p>g. example of named keystone species ✓</p> <p>h. example of role in the environment where they are found ✓</p> <p>i. example of change if removed ✓</p>	<p><i>This question can be answered by referring to one specific species</i></p> <p>OWTTE</p> <p><i>eg: honey bees</i></p> <p><i>eg: pollinate flowers</i></p> <p><i>eg: plant reproduction is reduced</i></p>	<p>6 max</p>

Option D — Human physiology

Question		Answers	Notes	Total																				
18.	a	<u>small</u> intestine ✓		1																				
18.	b	a. hemoglobin «from red blood cells» broken down into heme and globin ✓ b. iron removed from heme ✓ c. «remainder of» heme group transformed to bilirubin ✓ d. «surplus» cholesterol is converted to bile salts ✓ e. bilirubin and bile salts form bile ✓		3 max																				
18.	c	a. use as energy source «for cellular respiration» OR «long term» energy storage ✓ b. fat tissue for «heat» insulation ✓ c. protects axons by myelin sheath OR other function of fats ✓	Accept first <u>function</u> written only	1 max																				
18.	d	a. microvilli/brush border to increase surface area ✓ b. numerous mitochondria for energy for active transport ✓ c. have transport proteins for specific nutrients ✓ d. single layer of cells/short distance allowing for diffusion ✓	Explanation must be included for each characteristic eg: glucose, amino acids	2 max																				
18.	e	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 20%; text-align: center;">Process</th> <th style="width: 20%; text-align: center;">Fat</th> <th style="width: 20%; text-align: center;">Glucose</th> <th style="width: 10%;"></th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>Transported in micelles</td> <td style="text-align: center;">yes</td> <td style="text-align: center;">no</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>b.</td> <td>Absorption mostly into lacteals</td> <td style="text-align: center;">yes</td> <td style="text-align: center;">no</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>c.</td> <td>Transported from gut in blood</td> <td style="text-align: center;">no</td> <td style="text-align: center;">yes</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table>		Process	Fat	Glucose		a.	Transported in micelles	yes	no	✓	b.	Absorption mostly into lacteals	yes	no	✓	c.	Transported from gut in blood	no	yes	✓	Award [1] for each correct row Award the mark only for rows containing two correct answers, ie: no blanks accepted	3
	Process	Fat	Glucose																					
a.	Transported in micelles	yes	no	✓																				
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Question		Answers	Notes	Total	
19.	a	<p>a. both males and females have higher «mean/range» SBP as weight increases OR both males and females have highest SBP for overweight BMI ✓</p> <p>b. «SPB» males «slightly» greater than females in all BMIs ✓</p> <p>c. similar values/no/little difference between underweight and normal weight in females but «visible/obvious» difference in males ✓</p> <p>d. range of SBP narrower in «overweight» females than males ✓</p>		2 max	
19.	b	i	«at rest/chronic/constant» higher than normal «120 mmHg» systolic blood pressure is an indicator of hypertension ✓	OWTTE	1
19.	b	ii	<p>stroke ✓</p> <p>thrombosis ✓</p> <p>blood clot ✓</p> <p>heart attack ✓</p> <p>heart failure ✓</p> <p>aortic aneurysms ✓</p> <p>coronary heart disease/CHD ✓</p> <p>peripheral arterial disease ✓</p> <p>atherosclerosis ✓</p>	Award up to [2 max] for the first two answers given	2 max
19.	c		<p><i>blood pressure:</i> sphygmomanometer/blood pressure monitor OR description how this is used ✓</p> <p><i>heart rate:</i> taking pulse manually/using a blood rate monitor/stethoscope «to count the beats» ✓</p>	OWTTE	2

Question			Answers	Notes	Total
20.	a	i	breast ✓		1
20.	a	ii	FSH ✓		1
20.	a	iii	estrogen OR progesterone ✓		1
20.	b		a. growth and development of the breast/mammary gland ✓ b. lactation/synthesis of milk ✓ c. maintenance of milk secretion ✓		2 max
20.	c		a. oxytocin ✓ b. antidiuretic hormone/ADH/vasopressin ✓		2

21.			<p>a. pH of blood is regulated to stay within a narrow range/7.35 <u>to</u> 7.45 ✓</p> <p>b. increase in CO₂ produced during aerobic respiration «during exercise» ✓</p> <p>c. CO₂ reacts with water to form carbonic acid ✓</p> <p>d. chemoreceptors detect drop in blood pH «when CO₂ concentration rises» OR «increase in» CO₂ lowers blood pH ✓</p> <p>e. carbonic acid dissociates to form hydrogen carbonate ions and hydrogen ions ✓</p> <p>f. hydrogencarbonate is alkaline/increases pH/neutralizes H⁺ ions ✓</p> <p>g. hydrogen ions bind to plasma proteins/hemoglobin ✓</p> <p>h. stimulation of breathing centre/medulla oblongata OR ventilation rate increased ✓</p> <p>i. faster diffusion/removal of CO₂ «in alveoli/lungs» ✓</p>	<p><i>If values provided, both required</i></p> <p><i>Allow formula</i> <i>OWTTE</i></p>	6 max
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