

# Markscheme

**May 2018**

**Biology**

**Higher level**

**Paper 3**

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**Section A**

Question			Answers	Notes	Total
1.	a		9.0m <sup>2</sup> /9m <sup>2</sup> ✓	<i>Units required for the mark.</i>	1
1.	b		<p>a. in each quadrat determine the presence/absence «of plants» of each species ✓</p> <p>b. null hypothesis is that the presence of one is random in relation to the presence of the other plant</p> <p><b>OR</b></p> <p>alternate hypothesis is that the presence of one is associated with the presence or absence of the other ✓</p> <p>c. <math>x^2 = \sum \frac{(O - E)^2}{E}</math> ✓</p> <p>d. accept alternative hypothesis/reject null hypothesis if the difference between observed and expected is statistically significant / <math>p &lt; 0.05</math> / calculated <math>X^2</math> higher than tabulated <math>X^2</math> / critical value</p> <p><b>OR</b></p> <p>it supports the association between the two species if the difference between observed and expected is statistically significant / <math>p &lt; 0.05</math> / calculated <math>X^2</math> higher than tabulated <math>X^2</math> / critical value ✓</p>	<p><i>Allow for a word description of the calculation.</i></p> <p><i>Accept vice versa for null hypothesis.</i></p>	3 max

Question			Answers	Notes	Total
2.	a		Li <sup>+</sup> /lithium/Li ✓		1
2.	b		<p>a. medium acidified/more acidic ✓</p> <p>b. «stomach» peptidase <u>optimum pH</u> is acid/low pH</p> <p><b>OR</b></p> <p>«pancreatic/intestinal/duodenal» peptidase <u>optimum pH</u> is alkaline/«slightly» high pH ✓</p> <p>c. enzyme activity increased «for stomach peptidase»</p> <p><b>OR</b></p> <p>enzyme activity reduced «for pancreatic/intestinal/duodenal peptidase» ✓</p> <p>d. change in pH causes denaturation/change in protein/enzyme structure ✓</p> <p>e. by changing shape of active site ✓</p>	OWTTE.	3 max

(continued...)

(Question 2 continued)

Question			Answers	Notes	Total
2.	c		<p>a. changes of named independent variable ✓</p> <p>b. how enzyme activity is measured ✓</p> <p>c. other variables are controlled/kept constant <b>OR</b> control trial/experiment ✓</p>	<p><i>Variables should be named.</i></p> <p><i>One example sufficient for each.</i></p> <p><i>eg use different substrate concentration.</i></p> <p><i>eg time to produce set volume of foam.</i></p> <p><i>eg temperature kept constant.</i></p>	2 max
3.	a		<p>a. measure distance «of movement» of air bubble/water in capillary tube ✓</p> <p>b. multiply by cross section of capillary ✓</p> <p>c. record/divide by time elapsed ✓</p>	<i>Allow any other valid method.</i>	2
3.	b		<p>temperature <b>OR</b> atmospheric pressure <b>OR</b> solar radiation/light <b>OR</b> wind speed <b>OR</b> leaf area <b>OR</b></p>	<i>Do not accept humidity.</i>	1

			size of plant ✓		
Question			Answers	Notes	Total
3.	c		<p>a. increased «relative» humidity decreases water uptake  <b>OR</b>  inverse relationship ✓</p> <p>b. increased «relative» humidity lowers transpiration «rate» ✓</p> <p>c. diffusion gradient reduced «as humidity increases» ✓</p> <p>d. less loss of water through <u>stomata</u>  <b>OR</b>  <u>stomata</u> closed ✓</p>	<p><i>Accept inverse for dry/low humidity.</i></p>	<p><b>2 max</b></p>

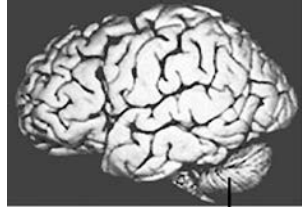
## Section B

### Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	a		a. neurons initially produce multiple dendrites/prolongations ✓ b. an axon develops in response to chemical stimuli ✓		2
4.	b		a. neurons that are stimulated develop more dendrites «than those not stimulated» ✓ b. more dendrites allow for more <u>synapses</u> ✓ c. developing neurons form multiple/new <u>synapses</u> ✓ d. <u>synapses</u> that are stimulated/used many times are fortified ✓ e. neural pruning involves the loss of unused neurons/synapses ✓ f. plasticity of the nervous system allows it to change with environment/experience/to reorganize following damage <b>OR</b> some neurons can regenerate ✓		3 max

(continued...)

(Question 5 continued)

Question			Answers	Notes	Total
5.	a	i	cerebellum properly labelled ✓	 <p>celebellum</p> <p>[Source: Reprinted by permission from Springer Nature: Nature, Pathways towards and away from Alzheimer's disease, Mark P. Mattson, © 2004]</p>	1
5.	a	ii	balance <b>OR</b> coordination <b>OR</b> motor control ✓		1

(continued...)



(Question 5 continued)

Question			Answers	Notes	Total
5.	b		a. «image II shows» reduction in size/volume/total amount of tissue/lobes ✓ b. «image II shows» increased space between foldings ✓ c. «image II shows» reduced surface area ✓	<i>Allow vice versa for image I.</i>	1 max
5.	c		a. reduced cognitive function/processing/memory ✓ b. reduced reward/pleasure perception ✓ c. depression ✓	OWTTE.	2 max
5.	d		a. brain metabolism requires large energy inputs <b>OR</b> glucose is the only source of energy of the brain ✓ b. «less glucose» means there is less respiration/metabolic reactions ✓ c. less cognitive/functional/synaptic activity ✓ d. some cell death ✓		2 max

Question			Answers	Notes	Total
6.	a		a. maintenance metabolism/respiration of the neuron ✓ b. use of Na-K/sodium-potassium pump to maintain resting potential ✓ c. cell repair consumes energy ✓	Accept valid examples of metabolism, eg transcription, etc.	2 max
6.	b		<i>S. carnaria</i> / <i>Sarcophaga carnaria</i> ✓		1
6.	c		a. energy consumption increases from rest to signalling «in all three species» ✓ b. faster transmission consumes more energy <b>OR</b> positive correlation ✓ c. doubling of transmission rate requires more than double the increase in energy consumption <b>OR</b> exponential increase <b>OR</b> the higher the energy consumption at rest the higher the energy consumption at signaling ✓		2

Question			Answers	Notes	Total
7.	a		muscle «that retracts gill» ✓		1
7.	b		less neurotransmitters/dopamine are released «to the synaptic cleft by presynaptic interneurons» ✓		1
7.	c		a. summation is the sum of all depolarization impulses/neurotransmitters released in the synapse/synaptic cleft of the effector/motor neuron ✓ b. in control more excitatory than inhibitory so effect would be excitatory ✓ c. less of each in habituated so not enough to produce action potential in the effector/motor neuron ✓		2 max
7.	d		a. amphetamines are stimulants ✓ b. increases the release of dopamine in the <u>presynaptic neuron</u> ✓ c. blocks reuptake by <u>presynaptic neuron</u> ✓ d. more dopamine in the synaptic cleft ✓ e. increased binding on / transmission by the <u>postsynaptic neuron</u> ✓		3 max

Question			Answers	Notes	Total	
8.			a. behaviour is observable impulse/reaction of an organism to «internal and external» stimuli ✓	Award <b>[5 max]</b> if no similarities are given.	6 max	
			b. exhibited behaviour results from the combination of inherited traits, experience and environment			
			<b>OR</b>			
			exhibited behaviour is a result of the combination of innate and learned behaviour ✓			
			Innate behaviour			Learned behaviour
			c. genetically inherited/instinctive			taught/based on learning/experience ✓
			d. common to all individuals of a species/not variable			not common to all individuals of a species/variable ✓
			e. not modified by environment/over time / modified over generations			modified by environment/over «short» time ✓
			f. results from natural selection			does not result from natural selection ✓
g. increases chance of survival/reproduction	may or may not increase chance of survival/reproduction ✓					
h. example «for innate behaviour» ✓						
i.	example «for learned behaviour» ✓					

**Option B — Biotechnology and bioinformatics**

Question			Answers	Notes	Total
9.	a		a. oxygen ✓ b. temperature ✓ c. pH levels ✓ d. CO <sub>2</sub> ✓		2 max
9.	b		a. name of a factor ✓ b. description ✓	eg a. pH b. lowered by «ethanoic» acid production.  eg a. increase in temperature b. due to metabolism.  eg a. increased population size/reproduction b. would limit resources.  eg a. increased metabolic waste b. causes toxic environment.	2

Question			Answers	Notes	Total
10.	a		II ✓		1
10.	b		<p>a. extracellular matrix does not let antibiotic enter <b>OR</b> has physical properties/adherence that make it hard to remove ✓</p> <p>b. emergent properties may spread/cause antibiotic resistance ✓</p> <p>c. quorum sensing communicates/signals to all cells ✓</p> <p>d. slow reproduction rate/growth makes antibiotic less effective <b>OR</b> dormant cells have lower metabolic rate so antibiotic not that effective ✓</p> <p>e. some bacteria escape the biofilm to colonize other areas/invade «renal» tissue ✓</p>		3 max
10.	c		pink/red ✓	<i>Do not accept purple or violet.</i>	1

Question			Answers	Notes	Total
11.	a		<p>a. mRNA is purified from «normal and cancer» cells ✓</p> <p>b. only expressed/transcribed genes produce mRNA ✓</p> <p>c. cDNA is «a complementary DNA copy» synthesized from mRNA «by using reverse transcriptase/transcription» ✓</p>		2 max
11.	b		<p>a. red spots are genes only expressed in cancer cells ✓</p> <p>b. green spots are genes only expressed in normal cells ✓</p> <p>c. yellow spots mean that genes are expressed in both normal and cancer cells ✓</p> <p>d. red spots mean that this gene is missing/not active in normal cells  <b>OR</b>  those «red spot» genes could be promoting cancer growth ✓</p> <p>e. green spots mean that this gene is missing in cancer cells  <b>OR</b>  missing genes could be an inhibitor of cancer ✓</p>		3 max

Question			Answers	Notes	Total
12.	a	i	BLASTp <b>OR</b> ClustalW <b>OR</b> FASTA3 ✓		1
12.	a	ii	database/named database searched to compare newly identified sequences with sequences of known function in other organisms ✓		1
12.	b		<p>a. dust mite protein has 45 % identity with CTP1 which could be unsafe ✓</p> <p>b. only 36 aligned amino acids of dust mite protein which is less than the 80 danger limit ✓</p> <p>c. both moth and soybean protein have less than 35% identity so are considered safe ✓</p> <p>d. both moth and soybean protein have more than 80 amino acids aligned so could be unsafe ✓</p> <p>e. CTP1 is not an allergen as it does not fit the criteria for any allergen</p> <p><b>OR</b></p> <p>CTP1 from the three organisms is not over the safety limit in the two categories so are considered safe ✓</p>		3 max

(continued...)



(Question 12 continued)

Question			Answers	Notes	Total
12.	c		<p>a. a DNA sequence with a promoter, a start and a stop codon ✓</p> <p>b. start codon is ATG ✓</p> <p>c. stop codon is TAA/TAG/TGA ✓</p> <p>d. nucleotide sequence with a considerable length ✓</p> <p>e. named bioinformatics software <b>OR</b> ORF finder ✓</p>	<p><i>Allow other verifiable answer.</i></p>	3 max
12.	d		<p>a. <i>physical</i>: electroporation <b>OR</b> microinjection <b>OR</b> biolistics «gunshot» ✓</p> <p>b. <i>chemical</i>: calcium chloride <b>OR</b> liposomes ✓</p>	<p><i>Allow other verifiable answer.</i></p> <p><i>Allow other verifiable answer.</i></p>	2

Question			Answers	Notes	Total
13.			<p>a. pollutants metabolized by microorganisms ✓</p> <p>b. microorganisms useful in bioremediation because they multiply very quickly «by binary fission» ✓</p> <p>c. are varied in their metabolism/inorganic reactions ✓</p> <p>d. use pollutants as energy/carbon sources ✓</p> <p>e. use pollutants as electron acceptors «in cellular respiration» ✓</p> <p>f. bioremediation may convert heavy metals into less toxic forms «in the food chain» ✓</p> <p>g. pollution incidents can involve bioremediation combined with physical/chemical procedures ✓</p> <p>h. preferable to physical methods because of cost/time ✓</p> <p>i. preferable to chemical methods which can leave toxic residues ✓</p> <p>j. different microorganisms to be used dependent on abiotic conditions ✓</p> <p>k. one named organism ✓</p>		6 max

Option C — Ecology and conservation

Question			Answers	Notes	Total
14.	a		a. <i>Tribolium</i> has more/greater fraction of biomass ✓ b. « <i>Tribolium</i> » is more efficient ✓		2
14.	b		a. release of energy by respiration used for growth/metabolism <b>OR</b> energy from respiration used for maintenance ✓ b. energy lost as heat ✓ c. uneaten/indigestible material/exoskeleton/cellulose not digested/absorbed «not passed on to the next level» ✓ d. energy in feces passed to saprotrophs ✓		3 max
15.	a		a. indirect ✓ b. negative «effect» ✓ c. top-down ✓		2
15.	b		a. sea otters have a positive «indirect» effect as sea otters feed on crabs that feed on isopods that feed on algae ✓ b. less crabs means more isopods so less algae ✓ c. less algae means more seagrass <b>OR</b> less competition between algae and seagrass ✓		2 max

(continued...)

(Question 15 continued)

Question			Answers	Notes	Total
15.	c		<p>a. the positive «bottom up» effect is due to availability of nutrients ✓</p> <p>b. «nutrients» increase abundance/plant growth rates ✓</p> <p>c. the negative «bottom-up» effect as excess of nutrients causes a bloom in algae growth/eutrophication/competition ✓</p> <p>d. limited nutrients have negative effect on seagrass «growth» ✓</p> <p>e. «excess» algae cause seagrass to die/decompose/replenish nutrients ✓</p>	<i>Do not accept answers referring to top down effects.</i>	3 max

16.	a		fundamental niche is all potential conditions a species could live in whereas realized niche is actual conditions under which the species live ✓		1
16.	b		April ✓		1
16.	c	i	<p>a. limited effect on low/stable population size from January to March ✓</p> <p>b. large effect increases population size from March to April ✓</p> <p>c. niche conditions decrease from January to March ✓</p> <p>d. niche conditions improve from March to April ✓</p>	<p>OWTTE.</p> <p>OWTTE.</p>	2

(continued...)

(Question 16 continued)

Question			Answers	Notes	Total
16.	c	ii	a. factor ✓  b. explanation ✓	<i>eg temperature.</i>  <i>eg as temperature increases in spring «March to April» so the conditions for the species are more favourable.</i>	2

17.	a		200 m/0 to 200 m ✓		1
17.	b		a. species whose numbers/abundance are affected by a particular environmental condition <b>OR</b> a species used to assess a specific environmental condition ✓  b. «the presence of disturbance adapted beetles» indicates that the environment has been disturbed ✓  c. «the presence of disturbance adapted beetles» indicates that there is an edge «within 200 m» ✓		2 max

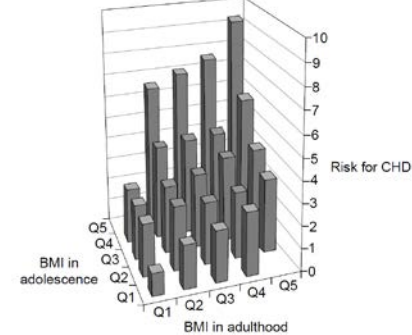
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(Question 17 continued)

Question			Answers	Notes	Total
17.	c		<p>a. small reserve has greater edge «relative to area therefore increasing edge effect» ✓</p> <p>b. changing shape can change edge length/perimeter for a given area «therefore changing edge effect» ✓</p> <p>c. «at the edge there is» interaction of two communities</p> <p><b>OR</b></p> <p>different species may be better at invading into neighbouring community</p> <p><b>OR</b></p> <p>edge favors disturbance-adapted species ✓</p>	<p><i>Accept vice versa.</i></p> <p><i>OWTTE.</i></p>	3 max

Question	Answers	Notes	Total
18.	<p>a. name of alien species <b>AND</b> where introduced ✓</p> <p>b. how/reason alien species was introduced <b>OR</b> «expected» benefit for species being introduced ✓</p> <p>c. introduced alien species can escape into local ecosystems <b>OR</b> how it became invasive ✓</p> <p>d. «reference to principle of» competitive exclusion <b>OR</b> take over the niche of other organisms ✓</p> <p>e. can reproduce more than native species ✓</p> <p>f. relationship with predators ✓</p> <p>g. reduction in the numbers of endemic species / decrease in biodiversity ✓</p> <p>h. description of another effect on this alien species ✓</p>	<p><i>Mark only the first example provided if more than one.</i></p> <p><i>Impacts must relate to named species.</i></p>	6 max

Option D — Human physiology

Question		Answers	Notes	Total
19.	a	<p><i>Hypothesis supported as:</i></p> <p>a. all subjects with a high BMI «in Q5» in adolescence had a high risk of CHD «&gt;6», even when BMI in adulthood was low «in Q2» ✓</p> <p>b. subjects with a high BMI in adulthood «Q4 and Q5» had a much higher risk of CHD if they also had a high BMI in adolescence ✓</p> <p>c. high BMI in both adolescence and adulthood increases risk ✓</p>	<p>OWTTE.</p> <p>OWTTE.</p> <p>Accept any other valid answer based on the graph.</p>  <p>[Source: From The New England Journal of Medicine, A Tirosh et al, Adolescent BMI Trajectory and Risk of Diabetes versus Coronary Disease, 364, 1315. Copyright © (2011) Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society]</p>	2 max

(continued...)



(Question 19 continued)

Question			Answers	Notes	Total
19.	b		<p>increased triglycerides/cholesterol in the blood</p> <p><b>OR</b></p> <p>presence of plaque/atherosclerosis «in arteries»</p> <p><b>OR</b></p> <p>high blood pressure/hypertension</p> <p><b>OR</b></p> <p>sedentary lifestyle/lack of exercise</p> <p><b>OR</b></p> <p>genetic/hereditary factor</p> <p><b>OR</b></p> <p>smoking</p> <p><b>OR</b></p> <p>age</p> <p><b>OR</b></p> <p>diet ✓</p>		1 max

Question			Answers	Notes	Total
20.	a		<u>stomach</u> ulcer <b>OR</b> <u>stomach</u> cancer ✓		1
20.	b		a. sight/smell/«presence of» food in stomach stimulates nervous system ✓ b. nervous system/vagus nerve stimulates gastric glands «to produce gastric acid» ✓ c. gastrin controls release of gastric acid ✓ d. parietal cells «are stimulated to» release gastric/hydrochloric acid/HCl ✓ e. acidity maintained by the proton pump/H <sup>+</sup> /K <sup>+</sup> ATPase ✓		2 max
20.	c		a. as proton pumps are inhibited less protons/H <sup>+</sup> into stomach «lumen» ✓ b. «less protons/H <sup>+</sup> in stomach» less hydrochloric acid produced ✓ <b>OR</b> stomach «contents» become less acidic ✓ c. stomach heals with higher pH ✓	OWTTE.	2 max

21.	a		the proportion/percentage increases «from 45 % to 70 %» ✓		1
21.	b		a. more erythrocytes/hemoglobin produced to compensate ✓ b. low oxygen «partial» pressure «at high altitude» ✓ c. lower oxygen saturation «of hemoglobin at high altitude» ✓ d. less oxygen carried to tissues/hypoxia ✓		2 max

(continued...)

(Question 21 continued)

Question			Answers	Notes	Total
21.	c		<p>a. induced conformational change in the structure of the hemoglobin molecule occurs ✓</p> <p>b. «this» hemoglobin has higher affinity for oxygen ✓</p> <p>c. saturation curve shifted to the left «because of low O<sub>2</sub> levels» ✓</p> <p>d. «this» hemoglobin becomes more saturated at lower partial pressures of oxygen ✓</p> <p>e. increased hematocrit/concentration of hemoglobin/red blood cells to carry more O<sub>2</sub> ✓</p>	<p><i>Allow answers in an annotated diagram.</i></p>	3 max
21.	d		<p>a. phagocytosis of erythrocytes by Kupffer cells ✓</p> <p>b. hemoglobin is split into globin and heme group ✓</p> <p>c. globin is re-used in protein synthesis ✓</p> <p>d. heme group broken down into iron and bilirubin ✓</p> <p>e. iron is carried back to the bone marrow «to produce new hemoglobin/erythrocytes» ✓</p>		3 max

Question			Answers	Notes	Total
22.	a		a. state the method/equipment ✓ b. how method/equipment works ✓ c. during exercise on treadmill/bicycle ✓	<i>eg take the pulse.</i> <i>eg count beats per minute.</i> <i>OWTTE.</i>	2
22.	b		a. muscles become less elastic <b>OR</b> less muscle tone ✓ b. cells/mitochondria less efficient ✓ c. more fat deposits <b>OR</b> blood/oxygen supply to heart tissue reduced ✓	<i>Accept other valid documented answers.</i>	2 max
22.	c		a. defibrillator is electrodes/a metal paddle/pad that is placed on the patient's chest ✓ b. the device determines whether fibrillation is happening ✓ c. a series of electrical shocks are delivered through the electrodes ✓ d. electrical impulse is used to depolarize the heart muscle ✓ e. to re-establish the function of the SA node/natural pacemaker/natural rhythm «of the heart» ✓		3 max

Question			Answers	Notes	Total
23.			<p>a. both «peptide and steroid hormones» act on target organs/cells ✓</p> <p>b. both «peptide and steroid hormones» travel through blood ✓</p> <p>c. the effect of both «peptide and steroid hormones» lasts for a longer time «than neurotransmitters»</p> <p><b>OR</b></p> <p>both are effective at very low concentrations ✓</p> <p>d. example of each type of hormone ✓</p> <p>e. steroid hormones enter cell/cross plasma membrane while peptide hormones do not ✓</p> <p>f. steroid hormones join receptor in cytoplasm while peptide hormones join receptor on membrane ✓</p> <p>g. steroid hormone-receptor complex travels to nucleus whereas peptide hormone-receptor triggers a cascade reaction/second messenger ✓</p> <p>h. steroid hormones activate genes while peptide hormones activate enzymes ✓</p> <p>i. peptide hormone requires ATP, steroid hormone does not ✓</p>	<p><i>Award [5 max] if no similarities are presented.</i></p>	<p><b>6 max</b></p>