Markscheme

May 2018

Biology

Standard level

Paper 3

19 pages

Section A

Question			Answers	Notes	Total
1.	a		a. as H_2O_2 concentration increases catalase activity increases / positive correlation (up to 70 mM) ✓ b. peak activity at approximately 70 mM ✓ c. activity decreases after the peak ✓		**2 max**
1.	b		temperature / pH / enzyme concentration / enzyme volume / quantity of bacteria ✓	*2 answers for 1 mark.*	**1**
1.	c		a. maximum peak / optimum around 70 mM ✓ b. but overlapping error bars around 70 mM ✓ c. no clear optimum / range between 60 – 90 mM ✓ d. may only be true for this strain *Vibrio rumoiensis* / other variables not reported (e.g. another form of catalase) ✓		**2 max**

Question			Answers	Notes	Total
2.	a		a. both types of mixing increase zooplankton biomass (compared to control) ✓ b. disc mixing is most effective / more effective than bubbling ✓ c. below about 7 days mixing has little effect ✓ d. rate of increased biomass falls for disc method after 13 days compared to the others ✓		**2 max**
2.	b		a. some abiotic variables can be controlled/limited/eliminated ✓ b. (near) natural environment / imitates real conditions ✓ c. on a smaller scale / easier to measure changes ✓		**2 max**
2.	c		a. temperature/sunlight may have varied between the mesocosms ✓ b. some mixing could have occurred in the control ✓ c. initial communities (of plankton) may have varied ✓ d. new water/organisms may have entered one or more of the mesocosms from the lake ✓		**1 max**
3.	a		answer between 1350nm - 1560nm (accept between 1.35 and 1.56μm) ✓	*Correct answer and units for 2 marks.*	**2 max**
3.	b		allow 27 500 – 32 500 (x/times) ✓		**2 max**
3.	c		Golgi apparatus ✓	*Accept the first answer only.*	**1**

Section B

Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	**a**		X = cerebellum ✓ Y= pituitary gland ✓		**2**
4.	**b**		perception of pleasure / control of depression / reward centre / secretes dopamine ✓		**1**
4.	**c**		*Compare:* a. both parts control higher order functions / example of higher order function ✓ b. each side controls muscle contraction on other side of body / example ✓ c. each side receives sensory input from sense organs from other side of body / example ✓ *Contrast:* d. right CH controls muscles on left side but left CH controls right side ✓ e. right CH receives sensory input from left side of body but left CH receives from right side ✓ f. Broca's / Wernicke's / speech processing in left CH only ✓ g. left CH receives sensory input from RHS of visual field in both eyes but vice versa for right CH ✓	*At least one compare and one contrast needed for 3 marks.*	**3 max**

Question			Answers	Notes	Total
5.	a		a. turning angle of control is zero degrees whereas with IGF it is much larger ✓ b. neuron extension is greater with IGF than control ✓ c. non-overlapping error bars suggest a (significant) effect on turning angle ***OR*** overlapping error bars suggest a non-significant effect on neuron extension ✓		**2 max**
5.	b		a. an axon grows from each immature neuron (in response to chemical stimuli) ✓ b. each developing neuron forms several synapses (with other neurons) ✓ c. synapses that are not used degenerate ✓ d. neural pruning / loss of unused neurons ✓ e. neural connections can change / increase with experience ✓ f. neurons may migrate and complete development at their destination ✓		**3 max**

Question			Answers	Notes	Total
6.	**a**		semicircular canal(s) ✓		**1**
6.	**b**		*Compare:* a. sound transmitted by the auditory nerve in both cases ***OR*** both change sound waves to electrical impulses ✓ *Contrast:* b. without CI cochlea stimulated by vibrations/middle ear bones whereas with CI electrical signals stimulate cochlea ***OR*** with a CI the auditory nerve is stimulated by electrodes whereas without CI the auditory nerve is stimulated by hair cells ✓	*One compare and one contrast must be given.*	**2 max**
6.	**c**		a. head movements cause fluid in the canals to move ✓ b. this deflects hair cells ✓ c. (semicircular canals) are perpendicular/right angles detecting movements in any direction/plane ✓ d. send nerve impulses to the brain (by acoustic nerve) ✓		**2 max**

Question			Answers	Notes	Total
7.			a. animal experiments give information about the brain under controlled laboratory conditions ✓ b. may not be applicable to humans / must meet high ethical standards ***OWTTE*** ✓ c. autopsy of a damaged brain may allow conclusions about the role of the affected part ✓ d. lesions/removal of part of the brain allows conclusion about functions of that part ✓ e. fMRI (scan) identifies brain activity as a result of stimulation (using a magnetic field) ✓ f. because active parts of the brain receive increased blood flow ✓ g. most direct method / least invasive ✓		**4 max**

Option B — Biotechnology and bioinformatics

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>8.</td><td>a</td><td></td><td>NH_4NO_3 / ammonium nitrate ✓</td><td></td><td>1</td></tr>
<tr><td>8.</td><td>b</td><td></td><td>food preservative, flavouring, (stabilizer) in alcohol production ✓</td><td>Two answers for 1 mark.</td><td>1</td></tr>
<tr><td>8.</td><td>c</td><td></td><td>
<table>
<tr><th></th><th>Batch</th><th>Continuous</th></tr>
<tr><td>a.</td><td>closed system / nutrients added once</td><td>open system / nutrients added continuously ✓</td></tr>
<tr><td>b.</td><td>environmental conditions not constant</td><td>environmental conditions constant ✓</td></tr>
<tr><td>c.</td><td>microbes more likely to be limited by waste / lack of nutrients</td><td>microbes less likely to be limited by waste / lack of nutrients ✓</td></tr>
<tr><td>d.</td><td>microbes more likely to evolve/mutate</td><td>microbes less likely to evolve/mutate ✓</td></tr>
<tr><td>e.</td><td>contamination less likely</td><td>contamination more likely ✓</td></tr>
</table>
</td><td>Answer does not need to be in a table.</td><td>2 max</td></tr>
<tr><td>8.</td><td>d</td><td></td><td>a. used to produce specific metabolites/chemicals/substances ✓
b. used to create/maintain optimum conditions for microorganism growth/maximum yield ✓
c. remove by-products / block competing pathways ✓
d. introduce new genes that increase efficiency/yield ✓</td><td></td><td>2 max</td></tr>
</table>

Question			Answers	Notes	Total
9.	**a**		viral/bacterial vector / (micro)injection / electroporation / liposomes / biolistics ✓		**1**
9.	**b**		a. bioinformatics allows rapid analysis of large numbers of (genetic) samples ✓ b. target genes can be identified/recognized rapidly ✓ c. target gene linked to sequences that control its regulation are also identified ✓ d. target gene introduced into host ✓		**2 max**
9.	**c**		a. bulk production of important chemicals/medicines ✓ b. resistance to certain environmental conditions/pathogens ✓ c. resistance to herbicides/pesticides / pesticide production by plants (*e.g.* Bt corn) ✓ d. increase yield/nutritional value ✓ e. increase shelf life ✓ f. example of plant modified and nature / purpose of modification ✓		**3 max**

Question			Answers	Notes	Total
10.	**a**		environmental pollution is removed by microorganisms ✓	*OWTTE*	**1**
10.	**b**		a. name of bacterium (genus required) and contaminating substance ✓ b. outline of one action of (this) bacterium to remove environmental contaminants from water or soil ✓ c. another detail of use of (this) bacterium to remove the contaminant ✓ d. advantage *e.g. environmentally damaging chemicals not required / lower cost* ✓ e. disadvantage *e.g. may take longer / environmental conditions may not suit the bacterium* ✓	*Full marks can only be given if a named example is given.* *one example:* *a. Pseudomonas (aeruginosa) to remove oil spills* *b. uses crude oil for energy / breaks down crude oil* *c. bacteria also need other chemicals/process may be speeded up by adding essential inorganic nutrients (phosphates/nitrates).*	**3 max**

Question			Answers	Notes	Total
11.			a. biofilms show properties that are not shown by the individual cells / biofilms develop emergent properties ✓ b. quorum sensing changes microbial behaviour / biofilms produce a matrix ✓ c. (matrix) hard to remove from a surface ✓ d. biofilms are tolerant to desiccation and heat shock ✓ e. biofilms may be very resistant to the action of (many) antibiotics/antimicrobial agents ✓ f. because cell division in biofilms is slow, antibiotics targeting this will be ineffective ***OR*** matrix forms a barrier to antibiotics ✓		**4 max**

Option C — Ecology and conservation

Question			Answers	Notes	Total
12.	**a**		a. occurs at the boundary between two ecosystems/habitats ✓ b. gradient of abiotic conditions at the edge ✓ c. (as a result) community differs at the edge ✓ d. community at the edge is more diverse than adjacent communities ✓		**2 max**
12.	**b**		a. number of individuals differs more than number of species between the zones ✓ b. zone E has lowest diversity / zone F has highest diversity ✓ c. zone B has higher diversity than zone E ✓ d. edge effect is evident ✓		**3 max**
12.	**c**		capture-mark-release-recapture ***OR*** quadrat / transect ✓		**1**

Question			Answers	Notes	Total
13.	a		fundamental is the potential (niche) and realized is the actual (niche) ✓	*OWTTE.*	1
13.	b		a. competition can limit the niche ✓ b. competition can limit resources ✓ c. when competition is removed the niche can expand ✓ d. can result in exclusion or removal of a species from a niche / only one species can occupy a niche ✓		2 max
13.	c		a. keystone species has a strong/disproportionate effect on a community/food web/ecosystem ✓ b. absence of keystone species would completely alter the ecosystem ✓		1 max

Question			Answers	Notes	Total
14.	a		a. (bare ground) colonized by microorganisms/pioneer species ✓ b. thin soil forms from rock fragments/decomposing organisms ✓ c. soil retains water (from melting permafrost/ice) ✓ d. grasses/small plants/herbaceous plants/grow ✓ e. (larger plants) create habitats for animals ✓ f. weather/climate may limit plant size/biodiversity ***OR*** climax community forms ✓		**3 max**
14.	b		a. buildings/roads/walking prevent plant cover/soil development/cause soil erosion ✓ b. may destroy moss/soil organisms / damage emerging vegetation ✓ c. introduce alien species ✓ d. rubbish/solid waste/pollution may impede natural development ✓ e. feces/excrement may contribute to/alter soil development / add fertilizer/pesticides to increase growth of plants ✓ f. sow seeds/planting and so alter diversity ✓ g. irrigation/drainage to affect growth ✓		**3 max**

Question			Answers	Notes	Total
15.			a. organisms have limits of tolerance and zones of stress ✓ b. listing any **two or more** abiotic factors ✓ c. example of named abiotic factor and how it affects distribution of plant/animal species ✓ d. example of another named abiotic factor and how it affects distribution of plant/animal species ✓ e. example of a third named abiotic factor and how it affects distribution of plant/animal species ✓	*Award up to 3 marks for valid examples:* *light limiting photosynthesis (in a forest)* *dissolved oxygen affecting respiration in an aquatic animal* *salinity affecting osmosis in an estuarine species* *most organisms require a suitable temperature range for their metabolism.*	**4 max**

Option D — Human physiology

Question			Answers	Notes	Total
16.	**a**		*Compare:* a. all the data has large uncertainty ***OR*** for both time periods, the largest uncertainty is in the diabetic group ***OR*** both groups (diabetic and non-diabetic) have greater uncertainty in the 2003–09 time period ✓ *Contrast:* b. higher mortality due to CHD in patients with diabetes in 87–96 ***OR*** higher mortality due to CHD in patients without diabetes in 03–09 ✓	*One comparison and one contrast for two marks.* *Accept converse answers.*	**2 max**
16.	**b**		a. claim supported for 87–96 data since patients without diabetes have lower mortality rate due to CHD ✓ b. claim possibly not supported for the 03–09 data since rate of CHD mortality is similar for the two groups ✓ c. mortality due to CHD in diabetes patients has decreased / mortality for non-diabetics has increased ✓ d. large variance/error bars/overlapping error bars for 03–09 do not allow firm conclusion ✓ e. no data on gender/age/obesity, etc. ✓	*Accept converse answers.*	**2 max**
16.	**c**		a. high cholesterol/LDL/transfats/saturated fats (may lead to atherosclerosis) ✓ b. hypertension/high blood pressure (from stress or medical condition) ✓ c. obesity / lack of exercise / smoking ✓ d. genetic predisposition ✓		**2 max**

Question			Answers	Notes	Total
17.	a		*Compare:* a. both HPV and HV deoxygenated blood ***OR*** both have high levels of CO_2 ✓ *Contrast:* b. HPV blood richer in nutrients/glucose/amino acids than HV ***OR*** HV blood lower levels of some toxins ***OR*** HV blood has higher levels of urea/cholesterol/fatty acids/glycerol/Fe^{2+} ✓	*One comparison and one contrast for two marks.* *Accept converse.*	**2 max**
17.	b		a. Kupffer cells engulf ruptured red blood cells by phagocytosis ✓ b. hemoglobin is broken down into component molecules ✓ c. some iron (from hemoglobin) transported to bone marrow/stored in liver ✓ d. protein component of hemoglobin converted to amino acids ✓ e. rest of heme component forms bile pigments ✓		**3 max**

Question			Answers	Notes	Total
18.	**a**		aids peristalsis / reduces risk of intestinal disorders/cancer/constipation / reduces hunger ✓		**1**
18.	**b**		a. combination of nervous ***AND*** hormonal control ✓ b. food in stomach stimulates chemoreceptors/stretch receptors / stretches the wall ✓ c. causes production of gastrin ✓ d. arrival of chyme to the small intestine triggers the release of hormones/secretin ✓ e. volume and composition of gastric juices are controlled ✓		**2 max**
18.	**c**		a. villi/microvilli provide large surface area ✓ b. capillary network for absorption and transport ✓ c. lacteal for absorption and transport of lipids/fatty acids/glycerol / bile resorption ✓ d. mitochondria in epithelial cells provide energy for absorption ✓		**2 max**

19.			*Causes:* a. deficiency in an essential nutrient ✓ b. excess of a nutrient ✓ c. may be due to social/socioeconomic/political factors ✓ d. unbalanced diet can result from malfunction of the hypothalamus ✓ *Consequences:* e. starvation can lead to breakdown of body tissues ✓ f. obesity can lead to other health problems/diabetes/CHD ✓ g. anorexia can lead to organ failure/serious health problems ✓ h. consequence of a **named** excess/deficiency ✓	*Maximum 3 marks if both causes and consequences not mentioned.*	**4 max**