Markscheme

May 2024

Biology

Standard level

Paper 3

24 pages

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Subject Details: Biology SL Paper 3 Markscheme

Candidates are required to answer **all** questions in Section A and **all** of the questions from **one** option in Section B. Maximum total = **35 marks**.

1. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a semicolon (;) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative word is indicated in the "Answers" column by a slash (*/*). Either word can be accepted.

6. An alternative answer is indicated in the "Answers" column by "***OR***". Either answer can be accepted.

7. An alternative markscheme is indicated in the "Answers" column under heading ***ALTERNATIVE 1*** *etc*. Either alternative can be accepted.

8. Words inside brackets ( ) in the "Answers" column are not necessary to gain the mark.

9. Words that are <u>underlined</u> are essential for the mark.

10. The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

11. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the "Answers" column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by ***OWTTE***.

12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.

14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

Section A

Question			Answers	Notes	Total
1.	**a**		49±1µm / 0.049mm / 0.0049cm / 49000nm / 4.9 x 10^{-5}m;	*Units required.* *Working is not required.*	**1 max**
1.	**b**		a. animal/cheek cells do not have a cell wall; b. cell/plasma membrane is flexible/fluid; c. fluid movement in/out cell/vacuole affects shape; d. plant cells have rigid/cellulose cell wall;	*d. Cell wall must have some indication of structural support.*	**2 max**
1.	**c**		cells would shrink/crenate/lose water;		**1**
1.	**d**		bacteria because they are (very) much smaller than cheek cell ***OR*** bacteria are introduced through food/air/water ***OR*** ideal conditions/pH/temperature/moisture for bacterial growth;	*Both organism and reason are needed.*	**1**

Question			Answers	Notes	Total
2.			a. cytoplasm/cytosol; b. 70S ribosomes; c. nucleoid region/naked DNA; d. plasma/cell membrane; e. plasmid;	*Clear drawing with correct labelling needed.* *Do not accept chromosome, cell wall, pili, flagellum or outside wall labelled as plasma membrane.* *Maximum 2 marks if any eukaryotic organelle is drawn.*	**3 max**

Question			Answers	Notes	Total
3.	a		a. increase in growth rate; b. (increases) with both CO_2 alone and CO_2 combined with green algae; c. may not be significant as error bars (CO_2 alone & CO_2 combined with green algae) overlap ***OR*** significant increase compared to the natural environment/control;		**2 max**
3.	b		a. less competition in mesocosm; b. fewer organisms feeding on it; c. valid named factor may limit growth in their natural environment ***OR*** more carbon dioxide so more photosynthesis (in mesocosm);	*Accept converse.* *Do not accept added nutrients in mesocosms.* *c. e.g. temperature variation/pollution/light.*	**1 max**
3.	c		creates a controlled environment ***OR*** easier to measure/observe changes / manipulate variables;		**1**

Continued…

Question 3 continued

Question			Answers	Notes	Total
3.	**d**		a. appropriate size of mesocosm; b. brief outline of habitat ***OR*** suitable environmental conditions (for organisms); c. introduce producers/autotrophs/named example; d. decomposers/saprotrophs/named example must be present; e. expose container to (natural) light;	*No marks for sealing the mesocosm as this is in the stem.*	**3 max**

Section B

Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	**a**		a. Alzheimer's disease brain is smaller / has less volume/mass than normal brain; b. decreased <u>cerebral cortex</u> in Alzheimer's disease compared to normal brain ***OR*** less folding/more space between folds of <u>cerebral cortex;</u> c. ventricles/spaces/lesions in the brain larger in Alzheimer's disease than normal brain; d. <u>cerebellum</u> is (slightly) smaller in Alzheimer's disease than normal brain;	*Accept vice versa.* *c. OWTTE*	**2 max**
4.	**b**	**i**	cerebral hemisphere/cerebral cortex/cerebrum;		**1**
4.	**b**	**ii**	memory/emotions/judgment/language/learning;	*Accept other valid examples of higher order function.* *If more than two functions are given, mark only the first two.*	**2 max**
4.	**c**		action potentials/impulses inhibited/slowed ***OR*** no/reduced synaptic transmission;		**1**

Question			Answers	Notes	Total
5.	**a**		a. ectoderm cells differentiate to form neural plate; b. neural plate border region forms neural folds; c. folds move inwards / form a groove; d. groove closes / folds fuse together; e. forms brain **and** spinal cord;	*Accept annotated diagram.*	**3 max**
5.	**b**		cell differentiation;	*Allow a description of differentiation e.g. development of axons etc.*	**1**
5.	**c**		neural tube fails to close completely;	*Do not allow incomplete closure of spinal cord.*	**1**

Question			Answers	Notes	Total
6.	**a**		controls <u>involuntary</u> functions;		**1**
6.	**b**		brain <u>stem</u> /medulla (oblongata)/hypothalamus;		**1**
6.	**c**		a. occurs when bright light enters eye; b. light stimulates photoreceptors; c. iris (circular) muscles contract / pupil will get smaller; d. involuntary/autonomic response; e. protects the eye/retina from bright light/prevents excess light from entering the eye; f. failure of pupil reflex may indicate damage to brain stem/medulla (oblongata);		**3 max**

Question			Answers	Notes	Total
7.			a. thermoreceptors/heat receptors sense temperature change; b. mechanoreceptors/touch receptors provide information on the texture/density; c. chemoreceptors/taste buds on the tongue detect chemicals/taste; d. several types of chemoreceptors/taste buds; e. mechanoreceptors/touch receptors prevent choking/promote swallowing; f. stimulus causes nerve impulses to be sent to central nervous system/CNS/brain; g. central nervous system/CNS/brain perceives taste / coordinates an appropriate response;		**4 max**

Option B — Biotechnology and bioinformatics

Question			Answers	Notes	Total
8.	**a**	**i**	exponential (phase);		**1**
8.	**a**	**ii**	a. continual supply of product; b. fermenter/equipment may be used without shutting down (for cleaning); c. maximum efficiency;		**1 max**
8.	**b**		pH, temperature, concentration of oxygen, concentration of carbon dioxide, agitation/stirring, substrate concentration, toxic products;	*Accept first two*	**2 max**
8.	**c**		citric acid;	*Accept any other verified example.*	**1 max**

Question			Answers	Notes	Total
9.	**a**		a. Ti plasmid is extracted from a bacterium/*Agrobacterium/A. tumefaciens*; b. gene for glyphosate-resistance is inserted into Ti plasmid; c. recombinant plasmid/plasmid with glyphosate-resistance gene is re-inserted into *Agrobacterium*; d. *Agrobacterium* is allowed to infect cells of the target plant species; e. the recombinant/infected cells develop into adult plants that are glyphosate-resistant; f. marker gene inserted to identify successful recombinants;		**3 max**
9.	**b**		a. herbicide does not damage soybeans but kills weeds; b. greater crop yields as crops grow without competition from weeds; c. Less labor required to remove weeds; d. other herbicides have long term effects/pollute due to slow breakdown in soil;	*A reason must be given.*	**2 max**
9.	**c**	**i**	2008/2009;		**1**
9.	**c**	**ii**	a. reduce possibility of glyphosate-resistance weeds; b. cost of seeds/herbicides; c. ethical/political reasons/avoiding genetically modified crops/organic farming;		**1 max**

Question			Answers	Notes	Total
10.	**a**	**i**	a. ideal conditions/pH/temperature/moisture for bacterial growth; b. bacteria are introduced through food; c. lack of oral hygiene;		**1 max**
10.	**a**	**ii**	a. cooperation/quorum sensing (leads to biofilm formation); b. produce extracellular polysaccharide so bacteria stick together;		**1 max**
10.	**b**		a. biofilm microorganisms/bacteria resistant to antimicrobial agents in toothpaste/mouthwash; b. bacteriophages destroy bacteria; c. bacteriophages do not harm human cells; d. one type of bacteriophage would only target one species of bacteria ***OR*** many different bacteriophages required;		**2 max**

Question			Answers	Notes	Total
11.			a. bacteria/archaeans break down organic matter/biomass/agricultural waste; b. under anaerobic conditions; c. biogas produced is (mostly) methane; d. biogas may be used to produce electricity/used as fuel; e. reduces need to burn fossil fuels; f. organic matter/biomass/agricultural waste is available/sustainable/inexpensive; g. biogas may be produced by small-scale fermenters / can be stored in tanks; h. reduces amount of garbage in landfills;		**4 max**

Option C — Ecology and conservation

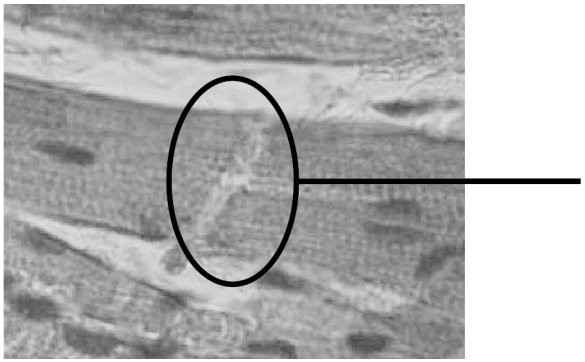
Question			Answers	Notes	Total
12.	**a**		a. competitive exclusion / cannot occupy the same niche; b. avoid competition for space/food/nesting sites; c. size of bird affected by habitat/food sources; d. crows more easily adapt to urban areas/populated places/humans;		**2 max**
12.	**b**		a. positive correlation / as human population increases so does crow population; b. crow population slows 2000 - 2010 while human continues to increase; c. correlation does not mean causation; d. other factors may have caused increase in crow population;		**2 max**
12.	**c**		a. geography/climate/natural disasters; b. food/resource availability; c. habitat /environment change / human interference; d. shelter/breeding territories/nesting sites/availability of mates; e. presence of predators; f. competition (from other species);		**3 max**

Question			Answers	Notes	Total
13.	**a**		communities of organisms (in the ecosystem) change over time;	*Should be a reference to organisms for the mark; OWTTE*	**1**
13.	**b**		a. ground cover/trees/vegetation destroyed by fire; b. roots destroyed by fire; c. soil exposed to rain/melting snow/wind; d. changes in soil structure reduces water absorption/retention / dries out;	*d. Do not accept soil is burnt or change in nutrients/pH*	**2 max**
13.	**c**		a. soil depth/quantity; b. soil composition; c. presence of organisms/biodiversity;		**2 max**

Question			Answers	Notes	Total
14.	**a**		comb jellyfish **and** zooplankton;	***Both*** *required for 1 mark.*	**1**
14.	**b**		a. a biological control competes/kills the invasive species ***OR*** *B. ovata* competes with *M.leidyi;* b. other organisms/environmental changes may have affected *M. leidyi*; c. biological controls may disrupt ecosystem/food web in other ways / become invasive; d. biological controls avoid chemicals ***OR*** self-sustaining; e. more data needed before decision;	*This can be answered in general or with reference to B.ovata; either is acceptable*	**3 max**

Question			Answers	Notes	Total
15.			a. both methods ensure continuing survival of species/recover endangered species; b. *in situ* (conservation) occurs in natural habitat; c. *ex situ* (conservation) takes place outside original/natural habitat / occurs in artificial/controlled habitat; d. *in situ* not as disruptive; e. *in situ* encourages conservation of natural habitat; f. *ex situ* may be last chance for survival / increase breeding ***OR*** needed if species too rare to be left in the wild; g. one example of either type of conservation;	*Max 3 marks if only in situ or ex situ discussed;* *Or converse for marking points d and e*	**4 max**

Option D — Human physiology

Question			Answers	Notes	Total
16.	**a**		 [Source: Dr. S. Girod, Anton Becker, CC BY-SA 3.0 http://creativecommons.org/licenses/by-sa/3.0/, via Wikimedia Commons.Source adapted.]		**1**
16.	**b**		a. allows faster action potentials/impulses (to spread rapidly through heart); b. (cardiac) cells coordinated/act together; c. strengthens (ventricular) contraction; d. stabilizes/holds (cardiac) cells together (during contraction);		**2 max**
16.	**c**		a. pacemaker generates an electrical pulse/signal; b. stimulates AV node/heart (muscles/ventricles) to contract; c. replaces (damaged) sinoatrial node/SAN; d. corrects abnormal heart rate;	*b. do not allow SAN.*	**2 max**

Question			Answers	Notes	Total
17.	**a**		a. (the bacterium) produces a toxin; b. toxin enters/binds to intestinal/epithelial cells; c. causes ions (Cl^- and HCO_3^-) to move into lumen of intestine; d. water leaves the cells by <u>osmosis</u>; e. causing watery feces/diarrhea;	*e. Do not accept diarrhea alone – watery or similar required.*	**3 max**
17.	**b**		dehydration (of cells/tissues) ***OR*** electrolyte/Na & K imbalance;		**1**

Question			Answers	Notes	Total
18.	**a**		a. controlled by both nervous **and** hormonal systems; b. sight/smell of food causes acid secretion; c. food stimulates stretch receptors in stomach; d. impulses sent to brain; e. stomach secretes hormone/gastrin; f. gastrin/hormone stimulates the release of more stomach acid;		**2 max**
18.	**b**		a. proton pump inhibitor drugs reduce stomach acidity; b. stomach acidity is not sufficient to kill the bacteria; c. (infectious) bacteria not destroyed in the stomach may colonize/grow in the intestine;		**2 max**

Question			Answers	Notes	Total
19.	**a**	**i**	23 - 24 (%);	*Unit not required.*	**1**
19.	**a**	**ii**	high in sodium ***OR*** low nutritional value ***OR*** high in fat/energy/kilojoules/kJ / leads to obesity;		**1**
19.	**b**		hypertension/high blood pressure;	*Do not accept heart attack or stroke.*	**1**

Question			Answers	*Notes*	Total
20.			a. caused by build-up of bilirubin (in blood and tissues); b. (excess bilirubin) caused by disorder of liver/gall bladder/other medical issue; c. blocked bile duct/gallstones prevents excretion of bilirubin; d. excessive breakdown of red blood cells increases bilirubin levels; e. jaundice may result in brain damage in <u>babies</u>; f. may result in itchiness in adults;	*a. Do not accept bile.* *b. Accept for medical issue: hepatitis, liver/pancreatic cancer, cirrhosis, parasite infection/malaria.*	**4 max**