Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2023

Biology

Standard level

Paper 3

18 pages

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 semi colon (;) 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.

Section A

Question			Answers	Notes	Marks
1	a		Golgi (apparatus/body) /vesicles;	*Do not allow vacuoles*	**1**
1	b		modifying/sorting/packaging protein/lipid/polysaccharides ***OR*** creation of lysosomes;	*E.g. proteins, lipids, polysaccharide* *If vesicles are given for 1a, allow transport of protein/lipid/polysaccharides*	**1 max**
1	c		allow any answer between 8000 - 10 000 (X);		**1**
1	d		greater magnification led to discovery/detail of structures (not visible with a light microscope) ***OR*** greater resolution allowed details of cells to be seen;	*Qualification needed as well as the term*	**1**
2	a		a. as light intensity increases photosynthesis increases; b. (this shows that) light (intensity) is the limiting factor; c. above 450 (au)/plateau light (intensity) is **not** the limiting factor / has **no** effect on rate; d. (above 450/plateau) some other factor is limiting photosynthesis; e. example of another limiting factor;	*Do not accept definition of limiting factor – response must refer to graph and explanation must be given.* e.g. CO_2, temperature	**3 max**
2	b		temperature/pH/carbon dioxide concentration/wavelength of light/species;		**1**
2	c		a. photosynthesis leads to the uptake of carbon dioxide/CO_2; b. less CO_2 makes water less acidic/more alkaline / less reaction with CO_2 to form H^+ ions; c. decrease in concentration of hydrogen/H^+ ions (leads to an increase in pH);	*Mpb must refer to CO_2*	**2 max**

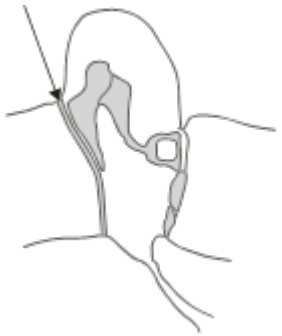
Question			Answers	Notes	Marks
3	a		to ensure that expired air flows through tube II/soda lime/ (not tube I) ***OR*** to prevent inspired air backflow/flowing through the soda lime /tube II;		**1**
3	b		downward stroke (on the graph paper);	*OWTTE*	**1**
3	c		a. inspiration by the subject removes some of the oxygen/O_2; b. the carbon dioxide/CO_2 produced by the subject is removed/absorbed by the soda lime; c. this reduces the total volume of air in the box/chamber; d. (therefore) the pen makes a lower trace with each breath;		**3 max**

Section B

Option A — Neurobiology and behaviour

Question			Answers	Notes	Marks
4	**a**		memory/emotions/speech/higher order thinking;	*Any verifiable example of higher order thinking*	**1**
4	**b**	**i**	0.4–0.5 (mm)	*Accept any value within this range.*	**1**
4	**b**	**ii**	a. number of branches (points) decrease; b. greatest reduction of branch points at shallow depths; c. shorter branches (length); d. less variation in branch length (compared with control); e. neurons cannot form synapses;		**2 max**
4	**c**		a. axons grow, branch and form dendrites; b. new synapses form; c. stimuli maintain synapses ***OR*** lack of stimuli eliminates synapses; d. elimination of synapses is neural pruning; e. plasticity allows for reorganization/memory/repair of central nervous system/CNS;		**3 max**

Question			Answers	Notes	Marks
5	**a**		retina/fovea;		**1**
5	**b**	**i**	a. 450-455 to 650–660 (nm);	*Both needed for the mark*	**1**
5	**b**	**ii**	a. different cone cells absorb light over a range of wavelengths; b. wavelengths overlap; c. colours are perceived by the relative stimulation of each cone cell; d. at 510nm green is stimulated (more than red); e. at 610nm red is stimulated (more than green);		**2 max**

Question			Answers	Notes	Marks
6	a		Eardrum  [Source: Gopalan, MK and Menon, UK, 2016. Construction of a 3D Model of Epitympanic Folds and Space. *Journal of Biocommunication*, [e-journal] 40(1). Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9139137/ [Accessed 3 January 2020].		**1**
6	b		ossicles/ear bones/named bones amplify/increase vibrations/sound ***OR*** vibrations/sounds amplified/increase because the oval window is smaller diameter than the eardrum ***OR*** loud noises are dampened by contraction of muscles between the ossicles/named bones;		**1**

Question			Answers	Notes	Marks
7	**a**		a. ectoderm cells differentiate to form the neural plate; b. neural plate border region forms the neural folds; c. the folds form a groove; d. (infolded) groove closes / folds fuse together; e. the tube end forms the brain;		**3 max**
7	b		*Similarities/Comparison:* a. both control higher order functions / example of a function; b. both control contraction of skeletal muscle; c. both receive stimuli from sensory organs; *Differences/Contrast:* d. right (hemisphere) receives sensory input from left side of body but left receives sensory input from right side ***OR*** right controls activity of skeletal muscles on left side of body but left controls muscles on right side; e. Broca's area/speech in left side only; f. right receives sensory input from left side of visual field in both eyes but left receives sensory input from right side of visual field in both eyes;	*At least **one** similarity and **one** difference required for full marks.*	**4 max**

Question			Answers	Notes	Marks
8	a		a. high population growth rate (of *Aspergillus niger*/microorganism); b. synthesis of commercially useful product/citric acid; c. breakdown of organic waste/apple;		**2 max**
8	b		a. cooling jacket prevents high temperature from metabolism; b. oxygen/O_2 bubbled in to replace oxygen/O_2 used by respiration; c. release valve prevents high pressure from metabolic gases released; d. alkali reduces acidity from carbon dioxide/CO_2 made in respiration; e. continuous fermenter removes metabolic toxins;		**1 max**
8	c		*Similarities:* a. both produce metabolites using (large scale) culture of microorganisms ***OR*** both use probes to monitor conditions; *Differences:* b. continuous culture has nutrients added continually, batch at the start ***OR*** continuous harvesting compared with the end in batch culture ***OR*** better control of conditions in continuous culture;		**2**

Question			Answers	Notes	Marks
9	a		a. Ti plasmid is extracted from *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		increased natural selection for glyphosate-resistance / removes non-resistance (in weed species) ***OR*** glyphosate-resistance gene transferred from crop by pollinators/cross contamination;		**1**
9	c		a. strong correlations; b. many hospitals / over long period/20 years; c. correlation is not evidence of causation; d. experimental evidence required to confirm causal link; e. no data relating to ethnicity/gender (so more details required);		**3 max**

Question			Answers	Notes	Marks
10	a		peptidoglycan;		1
10	b		a. bioremediation is the use of microorganisms to remove contaminants from environment; b. microorganisms used in bioremediation of saline environments must be able to tolerate high salt concentrations; c. *Marinobacter* (h*ydrocarbonoclasticus)* is able to degrade benzene; d. *Marinobacter* uses benzene as a source of carbon compounds (for cellular respiration); e. *Marinobacter is* less effective in freshwater;	*Halophilic is in the stem – must have explanation*	3 max
10	c		a. biofilms are groups of bacteria that grow together on a surface; b. biofilms have emergent properties/properties not present in the individual organisms; c. formation of exopolysaccharides/EPS; d. EPS holds the bacteria together (to form the biofilm); e. quorum sensing occurs; f. triggers expression of genes that lead to formation of biofilms; g. biofilm increases effectiveness of bioremediation;		4 max

Option C — Ecology and conservation

Question			Answers	Notes	Marks
11	**a**		(efficiency of) poultry production is greater than beef;	*Accept vice versa*	**1**
11	**b**		more of the energy consumed in feed is lost as heat/wastes in beef than in poultry ***OR*** longer lifespan of cattle ***OR*** poultry may be housed ***OR*** cattle feed on more indigestible fibre;	*Allow vice-versa* *Do not accept reference to size difference*	**1 max**
11	**c**		a. animals remove nutrients from systems by feeding/being eaten; b. nutrients added to systems by fertilizers/manure; c. fertilizer/manure/organic matter run-off can affect other ecosystems; d. deforestation results in leaching/loss of nutrients; e. pesticides may affect decomposers;		**2 max**
12	**a**		Hawaii because (the larger the island) more habitats/ecosystems expected;	*Reason required*	**1**
12	**b**		a. colonization by pioneer species/bacteria/lichens; b. erosion (of lava) leads to formation of soil; c. organic matter/soil accumulates; d. colonization by mosses/other plants/climax species; e. plants provide habitats/food for consumers;		**2 max**

Question			Answers	Notes	Marks
13	a		body wall: triclosan; gut wall: PBDE;		2
13	b		a. concentration of chemical/triclosan increases at each trophic level; b. *Arenicola*/other primary consumers take in triclosan from the sand/ocean floor; c. triclosan is stored in tissues of organisms; d. species at higher trophic levels must feed on increasing numbers of prey; e. *Clupea* and *Scomber* (feed on all lower trophic levels therefore) accumulate high levels of triclosan; f. high levels of triclosan in species at the top of food web eaten by humans;	*For mpc accept gut wall*	3 max

Question			Answers	Notes	Marks
14	**a**		allow **one** answer between 63 – 68 (%);		**1**
14	**b**		a. reduced rates of seed germination; b. reduced dispersal; c. decreased population size/possible extinction of *R.kurrangii*;		**2 max**
14	**c**		a species that has a disproportionate impact on the structure/function of an ecosystem;	*OWTTE* *Do not accept food web or food chain instead of ecosystem.*	**1**
14	**d**		a. *(in situ* conservation) is carried out in natural habitats/reserves ***OR*** cassowary can be maintained in its natural habitat; b. provides protection for ecosystem/habitat/community; c. cassowary can maintain its role in the habitat / maintain the food web; d. cassowary populations may be monitored so any action can be taken; e. natural environment allows normal behavioural development; f. reserves can help to raise public awareness /allow scientific study; g. reserves can be used to introduce individuals from breeding programs into natural environments;		**4 max**

Option D — Human physiology

Question			Answers	Notes	Marks
15	**a**		*Strengths:* a. conditions increase with BMI categories; b. large sample; *Weaknesses:* c. CVD is highest in overweight women ***OR*** little difference between normal and obese values for CVD; d. no information on age/ethnicity/behaviour / how data was collected; e. data may not be statistically significant / numbers in each category not provided;	*Both strengths and weaknesses for max 3*	**3 max**
15	**b**		a. adipose/fat storage tissue releases the hormone leptin; b. the (appetite) control centre is in the hypothalamus/brain; c. PYY/insulin/leptin detected by the hypothalamus/brain/appetite control centre; d. leads to feelings of satiation/suppression of appetite; e. ghrelin (from stomach) increases appetite;		**2 max**
15	**c**		amylase/lipase/peptidase/protease;		**1**

Question			Answers	Notes	Marks
16	a		increase the pH of the stomach ***OR*** the pH would be less acidic/higher/more alkaline;		**1**
16	b		a. pepsin has low optimum pH/has optimum pH of 2; b. hydrochloric acid reduces the pH; c. activates enzymes that digest proteins; d. denatures proteins / breaks <u>hydrogen bonds</u>;	*mp d: Do not accept breaks down proteins*	**2 max**

17	a		a. Kupffer cells engulf/phagocytose the red blood cells/erythrocytes; b. hemoglobin is split into heme group and globin; c. globins are hydrolysed/broken down into peptides/amino acids; d. iron is removed from heme; e. breakdown of heme forms bile salts/bilirubin;		**3 max**
17	b		<u>protein</u> synthesis;	*Do not accept secretion*	**1**

Question			Answers	Notes	Marks
18	a		repolarization (of the ventricles);	*Do not accept ventricular diastole*	**1**
18	b		a. cells are Y-shaped / form an interconnected network with other cells; b. allows impulses to be transferred to many cells; c. (intercalated) discs/continuous cytoplasm between cells; d. allows for rapid movement of electrical impulses between cells;	*Accept an annotated diagram* *Do not accept wording as in the stem.* *For mpd accept allow greater efficiency OWTTE but not effectiveness as that is in the stem*	**2 max**
18	c		a. cardiac muscle tissue is myogenic; b. the electrical signal is initiated in the sinoatrial node/SAN/pacemaker; c. the signal spreads over the atria causing them to contract; d. the signal passes to the atrioventricular/AV node; e. signal is delayed (by 0.1 seconds as it passes through the AV node) ***OR*** delay in contraction of the ventricles; f. the signal passes (from the AV node) to conducting fibres; g. fibres ensure ventricles contract <u>together;</u>	*For mp f accept Purkinje fibres or Bundle of His*	**4 max**