Markscheme

November 2024

Biology

Standard level

Paper 3

17 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.

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*** (or words to that effect) in the "Notes" column.

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**		a. partially/semi permeable/selective <u>membrane</u> (to water); b. solute molecules/ions cannot pass through membrane; c. different solute/water concentrations/concentration gradients/osmolarity; d. suitable temperature (for osmosis to occur);		**2 max**
1.	**b**		a. calculate <u>percentage</u> difference in mass; b. plot (percentage change) mass against concentration; c. concentration of solutes in potato tissues corresponds to 0/zero/no mass change ***OR*** where the line (of best fit) crosses the mass change at zero is the potato tissue concentration;	*Accept the correct calculation for percentage (final mass – initial, divided by initial and times 100).* *Accept annotated graph.*	**2 max**
1.	**c**		Any number from 0.31 mol dm^{-3} to 0.39 mol dm^{-3};	*Units required*.	**1**

Question			Answers	Notes	Total
2.	**a**	**i**	cellulose;		**1**
2.	**a**	**ii**	glucose;	*Ignore reference to alpha (beta is correct).*	**1**
2.	**b**		a. dialysis tubing represents intestine wall/membrane/villus/microvillus; b. water represents the blood; c. molecules move into the water by diffusion; d. only smaller molecules/glucose can pass through the dialysis tubing ***OR*** larger molecules/starch cannot pass through the dialysis tubing; e. starch must be broken down/digested (into glucose); f. (limitation of model is that) no active transport occurs;	*For mp a do not accept intestine alone.* *For mp d reference to size is needed.*	**4 max**
3.	**a**		75;		**1**
3.	**b**		a. temperature; b. area of cut surface; c. volume/depth of extract; d. time they are exposed/left; e. age/degree of ripening of the apples;		**1 max**
3.	**c**	**i**	citric acid/lower pH/acidity stops the enzyme/PPO working ***OR*** lemon juice contains antioxidant/chemical which inhibits oxidation;		**1**
3.	**c**	**ii**	prevents air/oxygen/O_2 reaching enzyme/apple;		**1**

Section B

Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	**a**	**i**	X: neural tube; Y: ectoderm;	*Both needed.*	**1**
4.	**a**	**ii**	a. ectoderm cells differentiate to form neural plate; b. neural plate border region forms neural folds; c. the folds form a groove; d. (infolded) groove closes/folds fuse together;		**2 max**
4.	**b**		incomplete closure of the neural tube;		**1**

Question			Answers	Notes	Total
5.	**a**		closer to the cut more dendrites become axons / vice-versa ***OR*** further from the cut more axons regrow;		**1**
5.	**b**		a. plasticity is the modification of nervous system resulting from experience/repetitive actions; b. forms basis of memory; c. allows the nervous system to rewire connections/form new synapses; d. neural pruning eliminates unused/weak synapses; e. enables healthy areas of nervous system to take over functions from damaged areas ***OR*** allows regeneration of neurons after trauma;		**3 max**
5.	**c**	**i**	fMRI/MRI/CT/CAT (scan);		**1**
5.	**c**	**ii**	***Similarities:*** 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:*** 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.*	**3 max**

Question			Answers	Notes	Total
6.	**a**		a. controls involuntary/unconscious functions; b. example of an ANS response; c. maintains homeostasis ***OR*** comprises sympathetic and parasympathetic systems;	*For mp b do not accept swallowing.* *Examples: heart rate, breathing etc.*	**2 max**
6.	**b**		medulla (oblongata)/brain stem/hypothalamus;		**1**
6.	**c**		thermoreceptors detect temperature (change) ***OR*** chemoreceptors detect chemicals ***OR*** mechanoreceptors detect texture;	*Both receptor and stimulus required.*	**1**

7.			a. (cone cells) are photoreceptors; b. (different cone cells) respond to wavelengths of red, green and blue light; c. found in retina; d. concentrated in the fovea; e. function best in bright light; f. high visual acuity/well defined images; g. one bipolar cell transmits impulse from cone cell to ganglion cells;	*mp b: 3 colours must be stated.*	**4 max**

Option B — Biotechnology and bioinformatics

Question			Answers	Notes	Total
8.	**a**		(waste) organic matter/vegetables/manure/sewage;		**1**
8.	**b**		methane/CH_4;		**1**
8.	**c**		a. bacteria break down organic matter; b. archaeans produce methane; c. occurs under anaerobic conditions/no oxygen required;		**2 max**
8.	**d**		a. batch is a closed system, continuous is an open system; b. batch has nothing added during the process, continuous has nutrients continuously added; c. batch has products removed at end of the process, continuous has products continuously removed;	*Allow a statement such as 'only batch has….' provided contrasting words have been used*	**2 max**

Question			Answers	Notes	Total
9.	a		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;		**3 max**
9.	b		a. biofilm/slime grows on rocks/stones/other surfaces; b. sewage/waste water is trickled over the biofilm; c. organic substances in sewage are trapped in the layer of the biofilm; d. microorganisms in the biofilm consume/feed on the organic substances in the sewage; e. (mostly) in aerobic conditions;		**3 max**

Question			Answers	Notes	Total
10.	**a**		a. continuous length of DNA/codons; b. does not contain stop codons within it; c. may be transcribed into mRNA ***OR*** may be translated into a polypeptide/protein; d. more chance of representing a gene if sequence is found in multiple genomes;		**2 max**
10.	**b**		a. (search for) start codon; b. read sequence in codons/base triplets; c. up to stop codon;	*Accept named start codon*.	**2 max**

11.			a. methyl mercury is highly toxic; b. mercury-resistant (*Pseudomonas)* strains isolated from polluted water; c. *(Pseudomonas)* biofilms are grown; d. methyl mercury converted/decomposed to (methane and) mercury ions; e. insoluble mercury can be separated from wastewater; f. genetically modified strains may be used in the future;		**4 max**

Option C — Ecology and conservation

Question			Answers	Notes	Total
12.	**a**		number of different species present;		**1**
12.	**b**		a. temperature; b. rain/snowfall/water/humidity; c. mineral availability/pH; d. light; e. wind;	Do not accept resources for mp c.	**2 max**
12.	**c**	**i**	a. reindeer increase species richness; ***OR*** species richness decreases when reindeer excluded; b. reindeer increase species richness most in warmer temperatures; c. reindeer have little/no effect on species richness at normal temperatures;		**2 max**
12.	**c**	**ii**	a. reindeer waste fertilizes plants; b. breakdown of biomass occurs faster at warmer temperatures; c. more nutrients available; d. more seed germination;	*For mp b accept saprophytic activity.*	**2 max**
12.	**d**		preserve reindeer herds/do not exclude reindeer (to preserve species richness);		**1**

Question			Answers	Notes	Total
13.	**a**		a. (primary succession) occurs on lava/bare rock; b. lichens/bacteria/pioneer species colonise lava/rock; c. erosion (of lava/rock); d. organic material/decomposition/soil accumulates; e. mosses/small plants grow; f. plants provide habitats/food for consumers;		**3 max**
13.	**b**	**i**	a. squirrel obtains food; b. spruce seeds are distributed further from parent tree **OR** burying seeds helps germination/growth/protects them;		**2**
13.	**b**	**ii**	primary consumer;		**1**

14.			a. arrows represent the flow of nutrients (between stores); b. width/size of arrows represents quantity; c. named example of a flow;	*For mpc: weathering, leaching, precipitation, detritus.*	**2 max**

Question			Answers	Notes	Total
15.			a. methyl mercury enters the environment through pollution/human activity; b. aquatic plants/plankton/microorganisms absorb methyl mercury ***OR*** smaller organisms take up methyl mercury through food intake; c. larger organisms consume more prey (due to energy losses) ***OR*** methyl mercury is moved up the food chain/trophic levels; d. biomagnification ***OR*** concentration of methyl mercury increases at each trophic level; e. (methyl mercury) accumulates in (fatty) tissues of fish / bioaccumulation; f. eating these fish can cause a build-up of methyl mercury in human tissues;		**4 max**

Option D — Human physiology

Question			Answers	Notes	Total
16.	**a**		decreases blood flow ***OR*** narrowing of arteries/plaque formation ***OR*** increases blood pressure/hypertension;		**1**
16.	**b**		a. genetic factors; b. intake of high cholesterol/fatty foods; c. lack of exercise; d. smoking/excessive alcohol intake/liver damage; e. age; f. gender;		**2 max**
16.	**c**		transports cholesterol (from cells/tissues) to the liver ***OR*** (HDL) combines with cholesterol ***OR*** (HDL) is needed because cholesterol is hydrophobic/insoluble;		**1**
16.	**d**		a. hepatocytes/liver process cholesterol; b. cholesterol is converted to bile (salts); c. bile (salts) excreted from the body (in feces);		**2 max**

Question			Answers	Notes	Total
17.	**a**		systolic pressure is due to (ventricle) contraction and diastolic pressure due to (ventricle) relaxation ***OR*** systolic measurement is higher than diastolic;		**1**
17.	**b**		*short term*: a. increase in heart rate/pulse; *long term*: b. heart muscle gets stronger/more efficient/greater cardiac output ***OR*** heart volume increases/heart gets bigger ***OR*** resting heart rate/pulse decreases;		**2**

Question			Answers	Notes	Total
18.	**a**		Proton pump inhibitors;		**1**
18.	**b**		a. needed for digestion/hydrolysis reactions; b. activates/provides optimal conditions for enzymes/proteases/pepsin; c. destroys harmful pathogens in food;		**2 max**
19.	**a**		cannot be synthesized in the body ***OR*** must be included in the diet;		**1**
19.	**b**		a. vitamin D ensures sufficient calcium is absorbed in the digestive system; b. needed for hardening/mineralization/density of bones; c. body mass/weight causes weakened bones to bend; d. lack of vitamin D/calcium leads to osteomalacia/osteoporosis/rickets; e. can be prevented with sun exposure/suitable diet/supplements;	*Vice versa for mp a and b.*	**3 max**
20.			a. changes in bile production/jaundice; b. impaired glycogen storage and release; c. reduced regulation/storage of nutrients/iron/vitamin A/vitamin D; d. decreased synthesis of plasma proteins/albumin/fibrinogen; e. reduced ability to detoxify substances/alcohol/drugs; f. impaired recycling/breakdown of hemoglobin/red blood cells; g. may cause fatty liver/cancer/cirrhosis/scarring of liver tissue;		**4 max**