

Markscheme

November 2023

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 underlined 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	Total
1.	a		a. I: cell(surface) membrane/plasma membrane; b. II: cell wall;	<i>a. do not accept membrane alone</i>	2
1.	b	i	salt solution OR hypertonic solution;		1
1.	b	ii	a. cells are plasmolyzed/flaccid OR plasma membrane has separated from the cell wall OR cytoplasm/cell/vacuole has shrunk/decreased in size/lost mass; b. cells have lost water (by osmosis);		2
1.	c		160;	<i>no units required</i>	1

Question		Answers	Notes	Mark
2.	a	<p><i>Similarities:</i></p> <p>a. as pH increases, enzyme activity increases (up to optimum pH) and then decreases;</p> <p>b. both enzymes show lowest activity at low pH/pH3 <u>and</u> high pH/pH11</p> <p>OR</p> <p>at extremes of pH enzyme activity is low;</p> <p><i>Differences</i></p> <p>c. optimum pH of immobilized lipase is (close to) 8 and the optimum pH of free lipase is (close to) 7</p> <p>OR</p> <p>optimum pH of immobilized lipase is more alkaline/higher than optimum pH of free lipase;</p> <p>d. immobilized enzymes are less affected by pH than free enzymes</p> <p>OR</p> <p>immobilized enzymes have more activity at most pH values (except for pH 7);</p>	<p><i>Mp a. reference to increase and decrease required</i></p> <p><i>Mp d. OWTTE the candidates may only refer to after or before pH 7 which should be awarded the mark</i></p>	3 max
2.	b	temperature / enzyme concentration / substrate concentration / time / total volume of reaction / type of substrate;		1

(continued...)

(Question 2 continued)

Question			Answers	Notes	Total
2.	c		a. to produce lactose-free milk; b. ascorbic acid production; c. citric acid production; d. bread making; e. removal of lipids from foods; f. soaps/detergents; g. other valid use of immobilized enzymes;		1 max
3.	a		8;		1
3.	b		a. (heat/94 °C) separates/denatures the DNA strands / breaks hydrogen bonds; b. (cooling/55 °C) allows primers to bind to the DNA strand / annealing (of primers); c. (heating/72 °C) allows for DNA elongation OR (heating/72 °C) allows <u>Taq</u> polymerase to synthesize new strands;	<i>Mp a. do not accept denaturing of enzymes or proteins, they must say DNA</i> <i>Mp a,b and c OWTTE</i>	2 max
3.	c		a. bands of DNA much lighter/thinner OR no bands of DNA visible; b. fewer copies of DNA;	<i>Mp b. OWTTE</i>	1 max

Section B

Option A – Neurobiology and behaviour

Question			Answers	Notes	Total
4.	a		a. cell body surface area increases AND then levels off/then rises only slightly; b. dendrite length increases AND then levels off/decreases;	<i>If they say both dendrites and cell body in the same sentence, give both marks. Increases alone is not enough for either mark.</i>	2
4.	b		neural tube/neural plate/ectoderm;		1
4.	c		a. human cortex has many folds to fit inside the cranium/skull; b. human cortex has a much larger surface area (than rat cortex); c. (larger surface area allows for) higher order functions/thinking/processing information;	<i>Allow reverse arguments</i>	2 max

Question			Answers	Notes	Total
5.	a		a clot/blockage of a blood vessel in the brain OR bleeding/rupture of a blood vessel;		1
5.	b		a. Broca's area controls speech; b. neurons in the Broca's area die; c. the patient will not be able speak/reduced speech;	<i>Mp c: do not accept lack of understanding or communication instead of inability to speak.</i>	2
5.	c		a. neuroplasticity/plasticity OR the brain's ability to reorganize itself; b. formation of new (neural) connections/synapses/pathways; c. (new neural connections/synapses) in response to new experiences/speech therapy/stimulation;		2 max

Question			Answers	Notes	Total
6.	a	i	a. (red-green) colour blindness/Daltonism; b. macular degeneration/Stargardt's disease; c. other valid example;		1 max
6.	a	ii	cone (cells);		1
6.	b	i	rod (cells);		1
6.	b	ii	ganglion (cells);		1
7.	a		<u>olfactory receptor</u> (cells);		1
7.	b		(cilia) detect chemicals/odour/smell/scent (in the air);	OWTTE	1

Question			Answers	Notes	Total
8.	a		<p>a. experiments (performed on animals) where part of brain damaged/stimulated, and consequences observed;</p> <p>b. in animals, some genes can be identified and inactivated to modify brain structure and behaviour;</p> <p>c. autopsy performed on humans that had a known disorder;</p> <p>d. brain lesions in people, caused by accidents, investigated in relation to changes in behaviour/personality/social interactions;</p> <p>e. <u>fMRI</u> can be used to detect activity in the brain;</p> <p>f. measure oxygen consumption / blood flow in the brain;</p>	<p><i>Mp a. Experiments that test reflexes such as pupil reflex are not valid, because the question is about how to identify roles of different parts of the brain. For these reflexes the roles are already known.</i></p> <p><i>The statement 'fMRI can be used to detect blood flow in the brain' would satisfy marking points e. and f. so be awarded 2 marks.</i></p>	4 max

Option B – Biotechnology and bioinformatics

Question			Answers	Notes	Total
9.	a	i	2005;		1
9.	a	ii	a. less production/lower yields, as weeds compete with crop plants (for nutrients/light/space); b. (higher costs/less profit, as) other/more herbicides are needed to kill resistant weeds; c. (higher costs/less profit, as) tillage needed to get rid of weeds;		1 max
9.	a	iii	use/introduce marker/reporter/antibiotic resistance gene OR fluorescence OR plant cells don't die if sprayed with glyphosate;		1
9.	b	i	recombinant (DNA);	<i>Do not accept transgenic DNA.</i>	1
9.	b	ii	a. an electric field is applied to cells; b. forms (temporary) pores through/ increases permeability of the cell membrane OR genes/recombinant DNA introduced through pores;	<i>Do not accept electromagnetic field or force.</i>	2

Question			Answers	Notes	Total									
10.	a	i	a. the effectiveness is measured by the size of the inhibition zone / clear area (of the agar); b. B/A and B are the most effective/have a similar effect OR C is less effective than A and B OR D has little/no effect on bacteria c. the evidence for the effectiveness comes from no inhibition in X;		2 max									
10.	a	ii	to allow time for the growth of the bacterial population OR to allow time for antibacterial agents to have effect on bacterial populations/to diffuse;		1									
10.	b		<table><tr><th>Feature</th><th>Gram positive</th><th>Gram negative</th></tr><tr><td>Colour after Gram staining</td><td>violet/purple</td><td>pink;</td></tr><tr><td>Cell wall structure</td><td>thick layer (of peptidoglycan)</td><td>thin layer (of peptidoglycan);</td></tr></table>	Feature	Gram positive	Gram negative	Colour after Gram staining	violet/purple	pink;	Cell wall structure	thick layer (of peptidoglycan)	thin layer (of peptidoglycan);	Award one mark per row	2
Feature	Gram positive	Gram negative												
Colour after Gram staining	violet/purple	pink;												
Cell wall structure	thick layer (of peptidoglycan)	thin layer (of peptidoglycan);												

Question			Answers	Notes	Total
11.	a		<p>a. <i>(hypothesis supported as)</i> smooth surface (stainless steel) has no biofilm whereas rougher surface (shrimp/crab) has more biofilm OR slightly rough surface (shrimp) has less biofilm than the very rough surface (crab) OR the rougher the surface the greater the biofilm;</p> <p>b. <i>(hypothesis not supported as)</i> more surfaces should be tested before valid conclusion can be made OR same species/material with different degrees of roughness should be tested for valid conclusions OR since different species/material were used the differences may be due to other factors;</p>		2
11.	b	i	<p>a. formation of EPS (extracellular polymeric substance/exopolysaccharide); b. cooperation/quorum sensing; c. antibiotic resistance;</p>	Accept other valid property.	1 max

(continued...)

(Question 11 continued)

Question			Answers	Notes	Total
11.	b	ii	<p><i>Either</i></p> <p>a. sewage treatment;</p> <p>b. bacteria (in trickle beds) digest/break down sewage;</p> <p><i>Either</i></p> <p>c. bioremediation of oil spills;</p> <p>d. <i>Pseudomonas</i> break down oil/use oil as energy source;</p> <p><i>Either</i></p> <p>e. bioremediation of methyl mercury;</p> <p>f. <i>Pseudomonas</i> convert (methyl mercury) to less harmful form/mercury ions used by other bacteria;</p> <p><i>Either</i></p> <p>g. another named valid example;</p> <p>h. brief account of method of another example;</p>	<p><i>Brief account must match method for 2 marks.</i></p> <p><i>Mp b. Also accept aerobic or anaerobic bacteria.</i></p>	<p>2 max</p>

Question			Answers	Notes	Total
12.			a. (deep-tank) batch fermentation; b. penicillin is a secondary metabolite; c. oxygen is supplied to the fermentation tank as the fungus needs aerobic conditions; d. corn syrup added as a nutrient causes faster growth; e. optimum temperature/pH must be maintained for enzymes/ <i>Penicillium</i> growth; f. penicillin is extracted/purified/filtered/crystalized;	<i>Mp e: enzyme activity or Penicillium growth must be mentioned for the mark</i>	4 max

Option C – Ecology and Conservation

Question			Answers	Notes	Total
13.	a	i	absorption/uptake (by plants) OR leaching;	<i>Do not accept weathering or soil erosion. Do not accept runoff as this from the surface and the litter, not the soil.</i>	1
13.	a	ii	<p>The diagram illustrates a nutrient cycle involving three main components: a tree (B), litter (L), and soil (S). Arrows show the following flows: from the tree (B) to litter (L), from litter (L) to soil (S), from soil (S) back to the tree (B), and from soil (S) to the ground (labeled X/weathering). There is also an arrow pointing from the ground towards the litter (L).</p>		1
13.	b		a. (due to high rate of) decay/decomposition / activity of decomposers; b. encouraged by high temperatures/high humidity (in forest floor);	<i>Mp b. must make reference to high/elevated temperature or humidity</i>	2 max

Question		Answers	Notes	Total
14.	a	<p>a. ingesting microplastics (significantly) reduces the ability to jump high so less successful / more easily trapped by predators;</p> <p>b. no significant difference in frequency of jumps so no change in success / the ability to escape from predators</p> <p>OR</p> <p>microplastic group jumps more often so more successful in escaping from predators;</p> <p>c. it is not clear from the data whether the height or frequency of jumps is more important in allowing beachhoppers to escape from predators;</p>		<p>2 max</p>
14.	b	<p>a. animals/marine mammals/turtles get entangled in plastics so they may drown/have their ability to catch food impaired/suffer wounds /movement impaired;</p> <p>b. (macroplastics break down and) can concentrate/may release chemicals that can enter marine food chains/bioaccumulate/biomagnify;</p> <p>c. ingested plastics may block the gut/damage stomach linings, so animals cannot feed;</p> <p>d. ingested plastics may prevent marine animals from breathing / cause suffocation / choking;</p> <p>e. large plastic patches block light for photosynthesis;</p>		<p>2 max</p>

Question			Answers	Notes	Total
15.	a		<p>A as it has the greatest core area / smallest edge / less edge effect</p> <p>OR</p> <p>A as it has more stable conditions/less interaction with other environments/less exposure to other species/predators/less edge to escape from;</p>		1
15.	b		<p>a. corridors allow organisms to move between fragmented/isolated habitats;</p> <p>b. organisms can find better living conditions such as food resources/shelter/nesting;</p> <p>c. more successful reproduction / allows genetic variation / maintains/increases gene pool;</p> <p>d. corridors allow species to migrate in response to climate change;</p> <p>e. example of corridors;</p>	<p><i>Mp c. Do not accept increasing biodiversity</i></p> <p><i>Mp e. Examples of corridors include tunnels under busy roads/green corridors/elephant corridors in India</i></p>	3 max

Question			Answers	Notes	Total
16.	a		acorn barnacles;		1
16.	b		primary consumers/second trophic level/herbivores;		1
16.	c		a. (Pisaster) has a disproportionate effect (on the community); b. it feeds on all the organisms in the community; c. it maintains/regulates populations of other species/autotrophs; d. it maintains species diversity/biodiversity OR if eliminated species diversity/biodiversity is decreased;	<i>Mp b and c: Accept named examples.</i>	2 max

Question			Answers	Notes	Total
17.			<p>a. endangered species removed from/preserved outside their natural habitat; b. (endangered due to) predators/competition by alien species/pollution/climate change/poaching; c. used to back up in situ conservation; d. captive breeding of animals ensures reproduction, so population increases OR assisted reproduction methods can be used OR maintains genetic diversity; e. plants can be grown in botanic gardens OR plant seeds stored in seed banks; f. allows to raise awareness and gain support / enhances education / provides research opportunities;</p>	<p><i>Accept examples for marking points a. and b.</i></p>	<p>4 max</p>

Option D – Human physiology

Question			Answers	Notes	Total										
18.	a	i	mouse/dog/snake/rabbit/goat;		1										
18.	a	ii	antioxidant / keeps epithelia healthy / prevents scurvy / synthesis of collagen / iron absorption;		1										
18.	b		<table><tr><th>Hormone</th><th>Secreted by</th></tr><tr><td>PYY3-36/PYY</td><td>small intestine;</td></tr><tr><td>insulin</td><td>pancreas;</td></tr><tr><td>leptin</td><td>adipose/fat tissue;</td></tr><tr><td>ghrelin</td><td>stomach;</td></tr></table>	Hormone	Secreted by	PYY3-36/PYY	small intestine;	insulin	pancreas;	leptin	adipose/fat tissue;	ghrelin	stomach;	Award [1] for each correct row	2 max
Hormone	Secreted by														
PYY3-36/PYY	small intestine;														
insulin	pancreas;														
leptin	adipose/fat tissue;														
ghrelin	stomach;														

Question			Answers	Notes	Total
19.	a	i	labelled arrow from arteriole to sinusoid and any hepatocyte OR labelled arrow directly from sinusoid to any hepatocyte;	<i>Do not accept a direct arrow from the arteriole to hepatocytes.</i>	1
19.	a	ii	labelled arrow from any hepatocyte to sinusoid then towards central vein OR labelled arrow from any hepatocyte to sinusoid;	<i>Do not accept a direct arrow from the hepatocyte to the central vein.</i>	1
19.	b		a. amino acids broken down; b. <u>glucose</u> can be stored as / released from <u>glycogen</u> ; c. vitamin A/B ₁₂ /D/K can be stored; d. plasma proteins / named plasma protein produced; e. synthesis of cholesterol OR surplus cholesterol converted to bile salts; f. iron is stored; g. fatty acids stored as lipids/fats;	<i>Mp c: Do not accept unspecified vitamin.</i> <i>Do not accept produce/secrete bile, detoxify alcohol as these are not nutrients.</i>	2 max
20.	a		(villus) epithelial (cell);		1
20.	b		a. it is adapted for absorption of nutrients; b. many mitochondria provide ATP (for active transport); c. presence of <u>microvilli</u> increases surface area; d. more channel proteins for facilitated diffusion; e. large number of pinocytic vesicles allow absorption of some foods by endocytosis;	<i>For mp b and d idea of greater amount than normal needed for the mark.</i>	3 max

Question			Answers	Notes	Total
21.	a	i	to regulate/set/start (the rhythm of) the heartbeat/cardiac cycle;		1
21.	a	ii	electrocardiograph/electrocardiogram/ECG OR stethoscope;		1
21.	b		a. it picks up the (electrical) impulses from the sinoatrial node/SAN; b. it passes the (electrical) impulses to the ventricles (via the Purkinje fibres) OR it makes the ventricles contract; c. it delays the transmission of the electrical impulses OR allows atria to contract before ventricles;	<i>Do not accept 'messages'</i>	2 max

Question		Answers	Notes	Total
22.		<p>a. malnutrition caused by deficiency or excess of nutrients OR malnutrition is caused by an imbalance of nutrients;</p> <p><i>Deficiency of: (Max 2 marks)</i></p> <p>b. amino acids, leading to body not synthesizing proteins required/hemoglobin/plasma proteins/poor growth/intellectual disability; c. calcium, leading to rickets/poor bone mineralization/osteomalacia OR any other mineral deficiency + consequence; d. vitamin D, leading to poor absorption of calcium/osteomalacia/poor bone mineralization OR any other vitamin deficiency + consequence; e. overall food deficiency/anorexia leads to wasting of muscles/body tissues;</p> <p><i>Excess of: (Max 2 marks)</i></p> <p>f. fats/cholesterol/salts leading to cardiovascular diseases/hypertension/ atherosclerosis; g. carbohydrates/sugars, leading to diabetes <u>type 2</u>; h. food/named nutrient leading to obesity;</p>	<p><i>In the first alternative of mp a. both the idea of deficiency and excess needed.</i></p> <p><i>The candidates should give the name of the substance and not only list the consequences</i></p> <p><i>Accept any other food taken in excess and the health consequence.</i></p>	<p>4 max</p>