

Markscheme

November 2020

Biology

Higher level

Paper 3

20 pages

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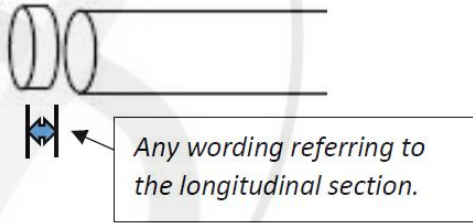
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Section A

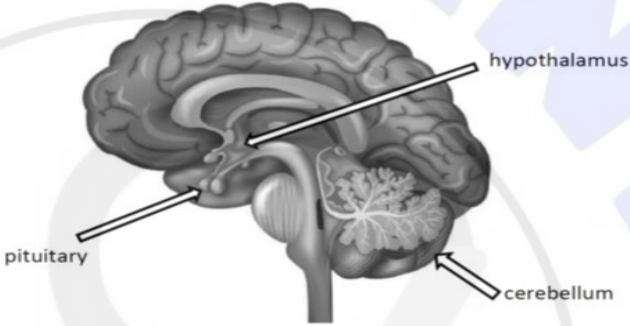
Question		Answers	Notes	Total
1.	a	<i>Calculation:</i> size of bar \div 15 μm (1.5 cm \div 15 μm or 15 000 μm \div 15 μm); <i>Answer:</i> 1000 x;	<i>First marking point is for division by 15 μm;</i> <i>Second marking point is for the correct answer; accept 930 and 1070 x.</i>	2
	b	(upper surface/epidermis usually has) fewer stomata/lower stomatal density/no stomata/OWTTE	<i>Do not accept a numerical value only.</i>	1
2.	a	<i>Independent:</i> mass; <i>Dependent:</i> (vertical) diameter;	<i>Do not accept elasticity.</i>	2
	b	a. width/depth of section/slice (of the ring); b. same animal/age/freshness/temperature;	<i>Do not accept thickness or diameter.</i> 	1 max
	c	a. veins have thinner walls (than arteries); b. veins sustain lower (blood) pressure (than arteries); c. when stretched, veins become longer (than arteries); d. veins have less muscle/elastic (fibre in their) walls (than arteries); e. veins have lower elasticity/recover less/remain more stretched (than arteries after weights removed);	<i>Accept inverse for arteries in all cases.</i> <i>Do not accept a listing of numerical values without explanation.</i>	3 max

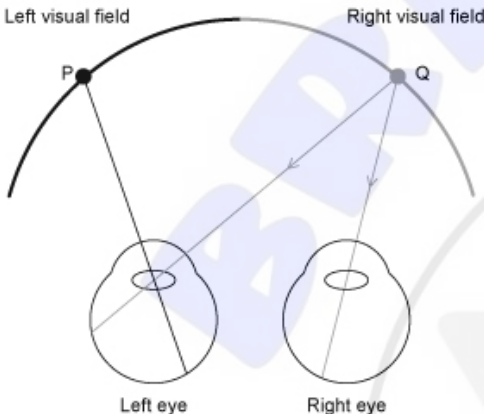
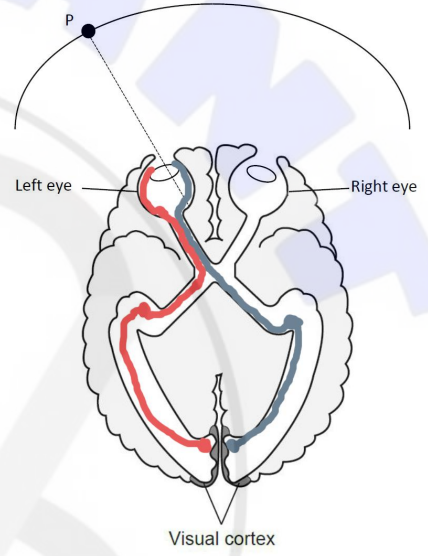
3.	a		photosynthesis/light independent reaction (of photosynthesis)		1
	b	i	the jars closer to the light had more purple colours OR the jar the furthest from the light was yellow OR purple to yellow	<i>Allow for answers indicating colours for each jar within this range.</i>	1
		ii	a. high light (intensity) increases photosynthesis; b. photosynthesis consumes CO ₂ ; c. (more photosynthesis/less CO ₂) increases pH/decreases acidity; d. less light means more respiration (than photosynthesis); e. respiration produces CO ₂ AND lowers pH/increases acidity;	<i>Allow inverse for all answers. Do not accept reference to colour only instead of pH.</i>	3 max
	c		temperature/volume of indicator/identical jars/number of beads/size of beads / density of <i>Chlorella</i> / other reasonable answer	<i>Do not accept light/pH/humidity.</i>	1

Section B

Option A — Neurobiology and behaviour

Question		Answers	Notes	Total
4.	a	a. branches (of dendrites/axons) formed OR new/more dendrites formed; b. dendrites/axons grow/get longer;		2
	b	a. neural tube differentiation/formation; b. neuron (may) migrate to other parts; c. axon (may) extend beyond the neural tube/myelinates; d. synapses develop; e. neural pruning;	<i>Do not accept "connection" instead of "synapse".</i>	2
	c	a. neural pruning; b. neurons are destroyed / apoptosis		1 max

Question			Answers	Notes	Total
5.	a	i	label to cerebellum	<p>Diagram is for 5(a)(i), (b), (c)</p> 	1
		ii	controls/coordinates (motor) movements/balance		1
	b		label to pituitary OR label to hypothalamus;	See 5ai for diagram.	1
	c		<p><i>Alternative 1:</i> a. fMRI; b. scan detects changes in blood flow/oxygen in blood OR more active parts of brain receive more blood flow;</p> <p><i>Alternative 2:</i> c. lesions/autopsy; d. part of the brain damaged OR loss of function detected;</p> <p><i>Alternative 3:</i> e. stimulation during open brain surgery; f. reaction observed;</p>	<p>The "f" must be written for fMRI. Description must relate to method named.</p>	2 max

Question		Answers	Notes	Total	
6.	a	 <p>any straight line from P passing through the lens to the retina of left eye</p>		1	
	b	i	visual cortex/occipital lobe	1	
		ii	right	See note in a.	1
	c		ganglion (cell)	1	

Q	Answers	Notes	Total
7.	<p>a</p> <p>a. (the pattern/unit is) a low frequency followed by higher frequency; b. the same pattern/unit is repeated; c. range limited to specific frequencies;</p>		2 max
	<p>b</p> <p>a. early birdsong pattern is genetically determined/innate; b. later birdsong pattern is modified based on learning from adults/other birds;</p>	OWTTE	2
8.	<p>a</p> <p><i>Strengths:</i> a. (slight) increase in mate choice at higher male brightness index; <i>Weaknesses:</i> b. dots are scattered without a trend/no clear correlation OR most females choose mates around normal (brightness); c. insufficient data/information provided;</p>	Allow any other data-based statement.	2
	<p>b</p> <p>a. natural selection favours specific types of mate selection/behaviour; b. (behaviour/mate selection) increases the chances of survival/reproduction; c. chosen organisms/males will leave more offspring; d. pass on gene(s) for behavior to offspring; e. (behaviour/allele) will become more prevalent/frequent in a population;</p>		3 max
	<p>c</p> <p><u>vampire</u> bats share blood to ensure survival;</p>	Other verified, outlined example.	1
9.	<p>a. psychoactive drugs act upon the central nervous system/alter brain function; b. psychoactive drugs are addictive; <i>Stimulants:</i> c. increase postsynaptic transmission; d. mimic the stimulation provided by the sympathetic nervous system OR mimic action of natural stimulating neurotransmitters e.g. acetylcholine; e. example: e.g. nicotine/cocaine/amphetamine; <i>Sedatives:</i> f. decrease postsynaptic transmission; g. mimic inhibition (of the parasympathetic nervous system) OR mimic action of natural inhibiting neurotransmitters e.g. dopamine; h. example: e.g. benzodiazepines/alcohol/tetrahydrocannabinol (THC);</p>		6 max

Option B — Biotechnology and bioinformatics

Question			Answers	Notes	Total
10.	a	i	2		1
		ii	a. pH decreased by citric acid; b. (pH lowered by) production of CO ₂ produced (by the fungus) in respiration; c. (pH lowered by) production of carbonic acid by CO ₂ dissolving in water;		2 max
	b		batch fermentation because the citric acid is collected at the end of the fermentation OR batch fermentation because the process was carried out over 6 days then re-set up OR diagram does not show constant supply of nutrients so it must be a batch;		1
	c		preservative/flavour	<i>Accept other verified use, e.g. buffering.</i>	1
11.	a		2006		1
	b		a. glyphosate use increased and other herbicides use decreased; b. during this period there was no increase/decrease in the EIQ OR the data shows that there was not much change in environmental impact; c. data insufficient to reach conclusion;	<i>Both must be mentioned for the mark.</i>	2

(Continued...)

(Question 11 continued)

Question		Answers	Notes	Total
	c	a. the bacterium inserts a plasmid into plant cells; b. the Ti plasmid induces tumours in plants; c. (Ti plasmid) modified to include a gene coding for glyphosate resistance; d. (Ti plasmid) integrates its DNA into the plant genome OR plasmid is used as a vector to introduce glyphosate resistance gene; e. tumour/gall tissue is cultured to form plants with the gene for glyphosate resistance;		3 max
12.	a	a. biofilm bacteria are all together while free bacteria do not interact with others; b. biofilm bacteria present emergent properties not present in free bacteria; c. <u>quorum sensing</u> only found in biofilm; d. EPS matrix only in biofilm; e. biofilm bacteria are more resistant to antibiotics/disinfectants;		3 max
	b	<i>Monochloramine not a good choice [1 max]</i> a. high concentrations/amounts are needed; b. health risks need to be assessed; <i>Monochloramine a good choice [1 max]</i> c. monochloramine is more stable; d. monochloramine range for biofilm is very extensive OR some biofilm bacteria must be highly resistant;		2 max
	c	viruses/(bacterio)phages that are specific to the bacterium are used to kill it;		1

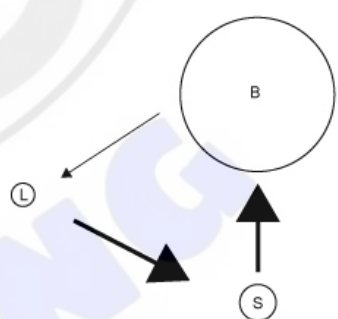
Question		Answers	Notes	Total
13.	a	a. fusion between genes of (viral) capsid and hepatitis B antigen/HBsAg; b. (transformed) virus infects tobacco plant; c. tobacco plant expresses antigen/HBsAg; d. HBsAg producing plants fed to animals; e. animals produce anti-HBsAg antibodies;		3 max
	b	as time passes, the soybean produces less antigen / stabilizes to a lower level (after 6 months)		1
	c	DNA/nucleotide sequence with a start codon and stop codon coding for a polypeptide chain;		1
	d	a. gene databank; (e.g. GenBank/NCBI); b. BLASTn to search similar DNA sequences; c. ORF finder to search for the start codon; <i>Alternative:</i> d. protein database search for antigen (sequence); e. example of database; (e.g. NCBI/SwissPro/Uniprot/PDB/other checked database); f. BLASTp to search similar protein sequences;		2 max

Question	Answers	Notes	Total
14.	<p><i>Presence of genetic material (PCR and/or microarray): [Allow 4 max]</i></p> <p><i>PCR:</i></p> <p>a. presence of the genetic material can be amplified by PCR; b. if the genetic material is RNA, a reverse transcription PCR must be performed</p> <p>OR</p> <p>using reverse transcriptase, the enzyme must first transform RNA into DNA; c. PCR primers stick to DNA; d. amplify DNA;</p> <p><i>Microarray:</i></p> <p>e. genetic material can be detected in microarray; f. probes of the DNA of the pathogen are placed on the chip; g. if the pathogen DNA is complementary, there is fluorescence;</p> <p><i>Presence of proteins: [Allow 4 max]</i></p> <p>h. presence of the proteins can be detected by ELISA; i. the test detects the antigens which are proteins of the pathogens; j. it uses antibodies stuck to a plate (which capture the pathogen antigen)</p> <p>OR</p> <p>it detects antibodies against pathogen; k. antibodies with an enzyme/fluorescence are used to reveal binding; l. metabolites of the disease detected in blood/urine;</p>		6 max

Option C — Ecology and conservation

Question		Answers	Notes	Total
15.	a	a. with <u>quadrats</u> (of 0.5 m side / 0.25m ²); b. (quadrats) position determined at fixed distance by transects OR (quadrats) position determined at random; c. random sampling / capture-recapture; d. average number calculated;		2 max
	b	a. sea otters (feeding on sea urchins) limit sea urchin population; b. the largest sea urchins are eaten; c. shown by low biomass/small size (of sea urchins); d. fewer/smaller sea urchins allow for increase in algae population; e. sea otters have a top down effect;	<i>Allow converse reasoning.</i>	3 max
	c	the sea urchins' limiting factors in their original habitat are missing OR lack of (natural) predators for sea urchins		1

Question			Answers	Notes	Total
16.	a	i	2		1
		ii	a. birds are unable to fly/swim for food; b. unable to escape predators; c. birds drown; d. birds suffocate/are strangled;		1 max
	b	i	(group) C / albatrosses, petrels and shearwaters		1
		ii	a. fill up the stomachs (of young birds) so they feel full / starve to death; b. damage the digestive system / cut the gut/stomach/oesophagus/intestines (leading to internal bleeding); c. block passage of food (causing starvation); d. cause choking (so cannot breathe); e. contain/decompose to microplastics/toxic chemicals (poisoning birds) OR toxins/microplastics in seawater build up/biomagnify (and poison wildlife);		2 max

Question		Answers	Notes	Total
17.	a	<p>a. richness refers to the number of (different) species in the environment/community/ecosystem;</p> <p>b. evenness refers to the number of individuals within each species;</p> <p>c. richness and evenness are components of biodiversity;</p> <p>d. biodiversity measured by (Simpson's) diversity index;</p>	<p>Accept converse.</p> <p>Do not accept "species" to mean "individuals of a species".</p>	2 max
	b	<p>temperature;</p> <p>precipitation;</p> <p>pH/e.g. acid rain;</p> <p>tides;</p> <p>sunlight;</p> <p>substrate;</p> <p>minerals/nutrients;</p> <p>pollutants;</p>	<p>Only mark the first two factors if more than two are stated.</p> <p>Allow any other verified factor.</p>	2 max
	c	<p>a. breeding/migration changes the number of individuals of some species;</p> <p>b. variation in some abiotic factors;</p> <p>c. food availability;</p>	<p>Accept any reasonable suggestion-that could cause a variation of number of individuals of some species reducing evenness.</p>	1 max
	d	<p><i>Gersmehl diagram showing the following:</i></p> <p>a. thick arrow from soil to biomass;</p> <p>b. thick arrow from litter to soil;</p> <p>c. thin arrow from biomass to litter;</p>		3

Question		Answers	Notes	Total
18.	a	<p>a. between 1930 and 1968 the numbers were reduced; b. after 1968/in the 1970s the numbers increased; c. in 1990s/1995 the numbers decreased again; d. lowest in 1968 and highest in 1990;</p>		3 max
	b	<p>a. relative rates of natality; b. disease/lack of food; c. competition for the same resources; d. immigration/emigration/migration;</p>		2 max
19.		<p>a. excess rains/floods/irrigation can wash away nutrients/N/P by leaching; b. excess rains/floods/irrigation can lead to waterlogged soils; c. waterlogging leads to denitrification due to anaerobic conditions; d. nutrients are added to the cycles by application of fertilizer; e. nutrients are removed by the harvesting of agricultural crops;</p> <p><i>Nitrogen:</i> f. lightning increases N in soil; g. planting legumes increases N in soil;</p> <p><i>Phosphate:</i> h. mining of P speeds up the P cycle/depletes P reserves; i. phosphorus is added to waters in detergents; j. phosphorus is mined/taken from rocks for making detergents/fertilizers;</p>		6 max

Option D — Human physiology

Question		Answers	Notes	Total
20.	a			1
	b	cannot be synthesized by the body		1
	c	250 (mL)		1

Question		Answers	Notes	Total
21.	a	a. produces acid to break down molecules; b. churns food for mechanical digestion; c. produces proteases to digest proteins/peptides;	<i>Allow pepsin. Do not allow "acid kills bacteria".</i>	2 max
	b	production of <u>hydrochloric acid/HCl</u>		1
	c	i <i>Helicobacter pylori/H. pylori</i>		1
		ii a. acidity is achieved by a proton pump/H ⁺ , K ⁺ -ATPase; b. exchange of H ⁺ from the cytoplasm for K ⁺ ions in the lumen; c. PPIs bind irreversibly to the (proton) pump; d. lowering amount of acid produced/H ⁺ ;		3 max
22.	a	a. systolic pressure increases with salt in diet during treatment; b. diastolic pressure is slightly higher/no change with salt during treatment OR diastolic pressure only changes towards the end of the period; c. (blood) pressure goes back to normal after treatment OR salt causes increased (blood) pressure; d. standard deviation values overlap therefore not statistically significant;		2 max
	b	sphygmomanometer/blood pressure <u>monitor</u> ;		1
	c	a. sinoatrial node/SAN initiates contraction of atria; b. SAN sends messages to the atrioventricular/AV node; c. AV node initiates ventricular contraction; d. through conducting fibres;		2 max

Question		Answers	Notes	Total
23.	a	a. respiring tissues produce CO ₂ ; b. CO ₂ leads to an increase in H ⁺ /decrease in blood pH; c. increased acidity/decreased pH shifts the oxygen dissociation curve to the right; d. affinity of the hemoglobin for oxygen is reduced; e. greater release of oxygen from hemoglobin (at the same partial pressure of oxygen) in tissues;		3 max
	b	a. dissolved/carried in plasma; b. forms carbonic acid/H ₂ CO ₃ (in plasma) OR as hydrogencarbonate (HCO ₃ ⁻) ions (in plasma); c. binds to hemoglobin in red blood cells;		2 max
	c	increased carbon dioxide in blood increases the rate of ventilation OR positive correlation/relationship;		1
	d	a. hemoglobin (from broken red blood cells) taken up by Kupffer cells (in the liver); b. hemoglobin broken down into heme and globin; c. globin hydrolyzed/broken down to amino acids; d. iron removed from heme group OR heme broken down to form bilirubin/bile pigment;	Do not accept red blood cells broken down into heme and globin.	3 max

Question	Answers	Notes	Total
24.	<p>a. endocrine glands secrete hormones directly into the bloodstream;</p> <p><i>Steroid hormones:</i></p> <p>b. pass through the <u>plasma</u> membrane (of target cells);</p> <p>c. bind to receptor proteins in the cytoplasm</p> <p>OR</p> <p>form a receptor–hormone complex;</p> <p>d. (receptor–hormone complex) enters the nucleus;</p> <p>e. promotes the transcription of specific genes;</p> <p><i>Peptide hormones:</i></p> <p>f. bind to receptors in the <u>plasma</u> membrane (of the target cell);</p> <p>g. (binding of hormones to membrane receptors) activates a cascade of reactions;</p> <p>h. (cascade of reactions) mediated by a second messenger (inside the cell);</p> <p>i. (cascade results in) activation of enzymes;</p>		6 max