

Markscheme

November 2016

Biology

Standard level

Paper 3

*This markscheme is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.*

Section A

Question		Answers	Notes	Total
1.	a	a. allow gases to pass between mouse and soda lime ✓ b. prevent mouse getting in contact with soda lime ✓ c. prevent mouse from being in contact with faeces/urine/droppings ✓		1 max
	b	a. more oxygen in inhaled air than in exhaled air OR mouse uses oxygen in respiration ✓ b. carbon dioxide exhaled / produced by mouse is absorbed by the soda lime ✓ c. difference in volume is oxygen used by mouse OR the volume/concentration/pressure of oxygen in the jar falls ✓ d. «this» sucks the coloured liquid up the tube ✓ e. volume of oxygen consumed equals the increase in volume of coloured water in the tube ✓	<i>Source/mouse must be mentioned for marking point b – not just “soda-lime absorbs CO₂”.</i>	3 max
	c	a. oxygen released during photosynthesis ✓ b. plants use carbon dioxide (released by respiration) ✓ c. if carbon dioxide is too low in concentration then photosynthesis will be eliminated/reduced ✓ d. results in an inaccurate/low measure of the oxygen that is consumed ✓ e. perform experiment in dark to prevent photosynthesis OR cover bell jar to exclude light to prevent photosynthesis ✓	<i>Do not accept plants convert carbon dioxide to oxygen.</i>	3 max

Question		Answers	Notes	Total
2.	a	a. different types/amounts of starch ✓ b. grains are different sizes/numbers OR time taken for amylase to penetrate differs between grains OR seed coat thickness varies OR different surface area to volume ratio ✓		1 max
	b	placed in the same waterbath OR use metal hot-blocks ✓	Allow any viable suggestions. Do not accept refrigeration (as enzyme need warmer temperatures) Do not accept monitored by a thermometer as this does not keep constant temperature. Do not accept “keep in a temperature controlled environment” as too vague.	1
	c	a. there should only be one variable in the experiment OR the only difference between the tubes should be the type of grain OR experiment should be fair/reliable/consistent ✓ b. experiments should have a control ✓ c. less enzyme may make the reaction go slower OR more enzyme may make the reaction go faster OR changing the amount of enzyme could affect the rate of reaction ✓		2 max

Question		Answers	Notes	Total
3.	a	<u>small</u> intestine ✓	<i>Do not accept villi/villus or intestine alone.</i>	1
	b	epithelium ✓	<i>Do not accept microvilli/brush border.</i>	1
	c	a. calculation shown with accurate measurement of length of villus OR $\frac{53}{0.8}$ or $\frac{54}{0.8}$ or $\frac{55}{0.8}$ «mm» ✓ b. 67 or 68 or 68 ✓	<i>For the first marking point to be awarded, the measurement must be between 53 and 55 mm.</i> <i>Allow any value between 67 and 69 inclusive.</i> <i>Accept decimals e.g. 68.75.</i> <i>Allow ECF from first marking point.</i>	2

Section B

Option A — Neurobiology and behaviour

Question		Answers	Notes	Total
4.	a	left ear would hear everything but the right ear would not «at higher frequencies» OR cannot hear all high frequencies of speech (with both ears) ✓	<i>Allow numerical responses in support of the answer.</i>	1
	b	a. the bones in the middle ear amplify/make sounds louder ✓ b. the audiogram shows the woman needs louder sounds to hear with her right ear ✓	<i>Allow vice versa. Could use data to support answer.</i>	2
	c	a. sounds/vibrations make the fluid/liquid in the cochlea move/vibrate ✓ b. amount of movement is proportional to the amplitude /loudness/ of the sound ✓ c. amount of movement is proportional to the frequency/wavelength/pitch ✓ d. hair cells located within organ of Corti ✓ e. (hair cells have) nerve cells connected to auditory nerve OR nerve cells transmit impulses to brain ✓	<i>OWTTE.</i>	3 max
5.	a	a. infolding of the <u>ectoderm</u> /neural plate ✓ b. formation of the <u>neural tube</u> OR <u>neurulation</u> ✓	<i>“Ectoderm” is essential for the mark. “Neural tube” or “neurulation” is essential for the mark.</i>	2
	b	elongation / forms a tube ✓		1

Question		Answers	Notes	Total
	c	a. neural tube/structure X does not close properly ✓ b. folic acid/folacin/folate/vitamin B9 deficiency ✓ c. may be due to mutation / genetic condition ✓		1 max

Question			Answers	Notes	Total
6.	a	i	cerebellum ✓		1
	a	ii	a. coordinates the actions of muscles OR motor control ✓ b. important in balance/movement/muscle tone/posture ✓	<i>Do not allow ECF.</i>	2
	b		a. «higher order functions are» controlled by the cerebral hemispheres ✓ b. the human brain has more folding of the (cerebral) <u>cortex</u> than the baboon brain ✓ c. «folding» allows for more surface area / more synapses ✓ d. «more cerebral cortex» without increasing cranium size ✓ e. frontal lobe is larger proportion in the human brain than in the baboon brain ✓	<i>Do not allow answers relating to size as diagrams are not to scale and size is not “visible”.</i> <i>Do not accept cerebellum unless a higher order function is given.</i>	2 max

Question		Answers	Notes	Total
7.	a	<p><i>I</i>: conjunctiva/sclera AND <i>II</i>: iris/cornea ✓</p>	<i>To award [1] both answers are needed.</i>	1
	b	<p>a. bright lights causes the pupil to constrict/iris to increase in size ✓ b. low light causes the pupil to dilate/iris decrease in size ✓ c. these are reflex actions ✓ d. the test for brain damage is to (briefly) shine a bright light in the eyes ✓ e. slow or unresponsive change in pupil size indicates brain damage/concussion ✓ f. different response of each eye indicates brain damage/concussion ✓</p>		4 max

Option B — Biotechnology and bioinformatics

Question		Answers	Notes	Total
8.	a	<i>Aspergillus/A niger/Aspergillus niger</i> ✓		1
	b	enzymes work optimally/well/efficiently at this temperature ✓	<i>“Enzyme” is essential for the mark.</i>	1
	c	a. sugar consumption continues to increase because it is used in respiration / produces energy ✓ b. products inhibit the reaction so no increase in citric acid OR negative feedback inhibits the reaction so no increase in citric acid OR decrease in pH may inhibit the enzymes ✓		2 max
	d	a. add a sour/acidic flavour to food/drink / change flavor / enhance taste ✓ b. can act as a preservative in food/drink/cosmetics ✓ c. controls pH in food/drink/cosmetics ✓	<i>“Do not accept “food additive”.</i>	2 max

Question		Answers	Notes	Total
9.	a	a. metal/tungsten/gold/bullet is coated with DNA/gene ✓ b. «this DNA is» fired in to a leaf containing the target cells ✓ c. DNA is released and incorporated in to some of the cells ✓	<i>Biolistics on its own not accepted.</i> <i>Accept any plant part, plant suspension, etc.</i>	2 max
	b	marker genes can be detected easily and show the gene has been inserted ✓	<i>Allow a specific example (eg, green fluorescent protein).</i>	1
	c	a. a length of DNA that codes for a polypeptide/protein OR length of DNA that can be translated ✓ b. begins with start codon/TAC/ATG/DNA for methionine ✓ c. stop codon occurs after sufficient length ✓	<i>OWTTE.</i>	2 max

Question		Answers	Notes	Total
	d	a. name of GM plant ✓ b. source of the inserted gene OR organism used for transfer ✓ c. purpose of the transfer ✓ d. how it increases yield ✓	eg: Soybean. eg: (Cry1Ac gene) from <i>Bacillus thuringiensis</i> . eg: plasmid from <i>Agrobacterium tumefaciens</i> . eg: increased resistance to glyphosate herbicide. eg: reduced competition with weeds killed by glyphosate.	3
10.	a	a. the properties of the biofilm are greater than the sum of their individuals ✓ b. the properties are not predictable from looking at the individual ✓ c. quorum sensing ✓ d. adhere to a variety of substances ✓ e. resistant to antibiotics / antimicrobial ✓ f. formation of EPS ✓	<i>Cooperative aggregates on its own is not accepted.</i>	2 max

Question	Answers	Notes	Total
<p>b</p>	<p><i>award [2 max]:</i></p> <p>a. oil spills ✓</p> <p>b. oil is used as an organic source by the bacterium OR the bacterium changes the crude oil into less harmful substances ✓</p> <p><i>award [2 max]:</i></p> <p>c. mercury from paint/fluorescent lights can leak into soil/water OR can form methyl mercury which travels along food chain/bioaccumulation ✓</p> <p>d. bacteria can remove methyl group from the methyl mercury/reduces toxicity ✓</p>	<p><i>Allow other verified examples that include the danger to the environment (problem) and how the bacterium improves the situation (solution).</i></p>	<p>4 max</p>

Option C — Ecology and conservation

Question		Answers	Notes	Total
11.	a	realized is actual niche, fundamental is potential niche ✓		1
	b	a. must spend some of their time under water / prevent dehydration ✓ b. need water for food/nutrients ✓ c. need water for reproduction ✓ d. more accessible to their predators ✓ e. there are no rocks for them to live on OR there is no suitable habitat for them ✓		2 max
	c	a. <i>Chthamalus</i> and <i>Balanus</i> / both have a reduced distribution ✓ b. they are in competition for part of the habitat on the rock ✓ c. <i>Balanus</i> occupies some of the habitat of the fundamental niche of <i>Chthalamus</i> OR where the fundamental niche overlaps <i>Balanus</i> prevails/survives ✓ d. the distribution of <i>Balanus</i> is unchanged in areas colonized by <i>Chthalamus</i> ✓ e. <i>Balanus</i> is in competition with other species closer to low water ✓		3 max

Question		Answers	Notes	Total								
12.	a	<table border="1"> <thead> <tr> <th><i>ecosystem</i></th> <th><i>numeral</i></th> </tr> </thead> <tbody> <tr> <td><i>tropical rainforest</i></td> <td>IV ✓</td> </tr> <tr> <td><i>desert</i></td> <td>II ✓</td> </tr> <tr> <td><i>tundra</i></td> <td>I ✓</td> </tr> </tbody> </table>	<i>ecosystem</i>	<i>numeral</i>	<i>tropical rainforest</i>	IV ✓	<i>desert</i>	II ✓	<i>tundra</i>	I ✓	Award [2] if all three are correct, [1 max] if one or two are correct and [0] if none correct.	2 max
		<i>ecosystem</i>	<i>numeral</i>									
		<i>tropical rainforest</i>	IV ✓									
		<i>desert</i>	II ✓									
<i>tundra</i>	I ✓											
a. litter is dead plant material on the ground ✓	Numbers alone do not constitute an explanation.											
b. conditions in tropical rainforests are ideal to decompose plant material OR conditions in taiga do not favour decomposition of litter ✓												
c. decomposition returns nutrients to soil ✓ OR nutrients in taiga remain in the litter and not in the soil ✓												
d. tropical rainforests have more saprotrophs/decomposers OR taiga have fewer saprotrophs/decomposers ✓												
13.	a	<p>a. same richness as they have the same number of species/total of individuals ✓</p> <p>b. field 1 has more evenness as more even distribution of numbers among the species ✓</p>	Allow vice versa.	2								

Question		Answers	Notes	Total
	b	<p>a. the higher the number the more diverse/biodiverse is the field OR $D = \frac{N(N-1)}{\sum n(n-1)} \checkmark$</p> <p>b. field 1 shows greater diversity/biodiversity (as it has a higher value) \checkmark</p>		2
14.	a	the number of people with malaria increased \checkmark		1 max
	b	<p>a. choice has to be made between damage to environment or increase in malaria \checkmark</p> <p>b. DT may lead to biomagnification/bioaccumulation in food chains OR taken up by species in lower trophic levels becoming more concentrated at higher trophic levels \checkmark</p> <p>c. causes harm to consumers at end of food chain OR example «eg: thin egg shells of falcons» \checkmark</p> <p>d. DDT is shown to be effective in reducing malaria \checkmark</p> <p>e. possible partial solution to be selective in areas sprayed with DDT \checkmark</p> <p>f. may kill insects that are not pests \checkmark</p>		4 max

Option D — Human physiology

Question		Answers	Notes	Total	
15.	a	a. patients with anorexia nervosa do not eat sufficient food/protein/amino acids ✓ b. heart muscles used as an energy source ✓ c. reduced body mass reduces requirement for muscle mass in ventricle ✓	<i>Starving = insufficient food</i>	2 max	
	b	decreased left ventricle mass/pressure therefore more time needed to contract ✓			1
	c	atrioventricular/AV valve closing <u>and</u> semilunar/SV valves closing ✓			<i>Both valves need to be addressed for the mark.</i>

16.	a	24 % ✓		1
	b	a. appetite control (centre) is located in the hypothalamus ✓ b. leptin is a hormone made by fat/adipose cells ✓ c. to inhibit appetite/feeling of hunger OR promotes feeling of satiety/fullness ✓ d. the drug mimics the action of leptin ✓ e. (reduced hunger) leads to less food intake/weight loss ✓		3 max

Question			Answers	Notes	Total
17.	a		50 «g» ✓		1
	b		water balance/osmoregulation/transmit impulses along nerves/muscle contraction/blood pressure/ sodium potassium pump/sodium-glucose cotransporter / sodium-amino acid cotransporter ✓		1
	c		whole milk because it contains more fat/energy ✓	<i>Reason is required.</i>	1
	d		a. skimmed milk has more calcium so better ✓ b. both milks have the same amount of vitamin D so no difference between the two ✓	<i>Skimmed milk alone is worth no marks. Two reasons are required for both marks.</i>	2

18.	a	i	Kupffer cell ✓		1
	a	ii	a. they are macrophages/phagocytes ✓ b. break down red blood cells ✓ c. separates heme (group) from (protein) globin chain ✓	<i>There is no ECF here.</i>	2 max

Question	Answers	Notes	Total
<p>b</p>	<p>a. «jaundice is» a yellowish pigmentation of the skin/whites of eyes ✓</p> <p>b. caused by high levels of bilirubin in blood/tissues ✓</p> <p>c. comes from breakdown of red blood cells ✓</p> <p>d. results from the breakdown of the heme group of hemoglobin ✓</p> <p>e. released into blood when excess is produced ✓</p> <p>f. released into blood when bile ducts blocked ✓</p> <p>g. normally excreted with bile ✓</p> <p>h. jaundice is often seen in liver disease such as hepatitis/liver cancer/chronic alcoholism/cirrhosis OR newborn/neonatal jaundice «due to immature liver» ✓</p>	<p><i>Simply stating “caused by high levels of bilirubin” is not enough for marking point b. However “tissues” may be implied as part of the answer to marking point a.</i></p>	<p>4 max</p>