

Markscheme

May 2018

Biology

Standard level

Paper 2

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Extended response questions - quality of construction

- Extended response questions for SLP2 carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.
- **[1]** for quality is awarded when:
 - the candidate's answers are clear enough to be understood without re-reading.
 - the candidate has answered the question succinctly with little or no repetition or irrelevant material.

Section A

Question			Answers	Notes	Total
1.	a	i	cricket ✓		1
	a	ii	25 – 4 = 21kg «more required for cattle» ✓	<i>Must state unit kg.</i>	1
1.	a	iii	cricket ✓		1
1.	b	i	a. mealworms have more isoleucine/leucine/valine than cattle ✓ b. cattle have more lysine/methionine/phenylalanine/threonine ✓ c. the total proportion of these amino acids is «slightly» greater in cattle (188 to 176) ✓		1 max
1.	b	ii	a. cattle as they are more closely related to humans ✓ b. cattle as they are more likely to have proteins with a similar amino acid composition to humans ✓ c. cattle as they contain a «slightly» higher proportion of «essential» amino acids required in human diet (188 to 176) ✓	<i>OWTTE.</i>	1 max
1.	c		a. mealworms contribute much less to global warming than other traditional farm livestock for protein production ✓ b. mealworms require less land use than other traditional farm livestock for protein production ✓	<i>Accept converse or OWTTE.</i>	2

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	d	<p>a. cell respiration required to generate heat (lost to environment) to maintain body temperature ✓</p> <p>b. birds/chickens and mammals/cattle carry out cell respiration at higher rate than insects ✓</p> <p>c. «chickens/cattle therefore» generate more CO₂ per kg protein produced ✓</p> <p>d. «chickens/cattle» need more food/land area to produce body mass ✓</p> <p>e. feed conversion ratios are lower in mealworms/insects/cold blooded animals as they do not need to maintain a constant body temperature (accept converse) ✓</p>		2 max
1.	e	<p>a. insects/crickets have the highest edible percentage ✓</p> <p>b. insects have the lowest feed conversion ratio/produce the most edible mass per kg of food they eat ✓</p> <p>c. insects supply amino acids required in the human diet ✓</p> <p>d. insects cause less global warming/use less land area per kg of protein produced ✓</p> <p>e. in western countries, there is a disgust factor/cultural factors about eating insects which would need to be overcome before they could be used as a significant food source ✓</p> <p>f. insects may supply less proportions/content of amino acids required in human diets ✓</p>		3 max

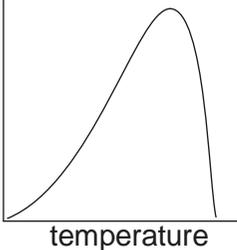
Question			Answers	Notes	Total
2.	a		a. I. <u>cytosine</u> ✓ b. II. sugar-phosphate/covalent/phosphodiester bond ✓ c. III. <u>phosphate</u> ✓ d. IV. <u>deoxyribose</u> ✓	<i>Award [1] for any two correct responses.</i>	2 max
2.	b	i	a. decided to combine what was known about chemical content of DNA with information from X-ray diffraction studies ✓ b. built <u>scale</u> models of components of DNA ✓ c. then attempted to fit them together in a way that agreed with the data «from separate sources» ✓ d. made several arrangements of scale model until found best one that fitted all the data ✓	<i>OWTTE.</i>	2 max
2.	b	ii	a. associated with «histone» proteins in eukaryotes but not prokaryotes ✓ b. is linear in eukaryotes but circular in prokaryotes ✓ c. in cytoplasm in prokaryotes, but within nucleus in eukaryotes. ✓		1 max
2.	c	i	unwinds/separates strands/double helix (by breaking hydrogen bonds) ✓		1
2.	c	ii	a. links nucleotides together to form a new strand of DNA ✓ b. uses pre-existing strand of DNA as template ✓ c. makes covalent bonds between nucleotides ✓		2

Question			Answers	Notes	Total												
3.	a	i	I. cell wall ✓ II. nucleus/chromatin ✓	<i>Both needed.</i>	1												
3.	a	ii	a. necessary for photosynthesis/converts light energy into chemical energy ✓ b. contains chlorophyll to absorb light ✓ c. (contains enzymes) for production of carbohydrate/glucose/starch ✓		2 max												
3.	a	iii	a. produce flowers ✓ b. enclosed seeds/have fruit ✓		1 max												
3.	b		<table border="1"> <thead> <tr> <th></th> <th>autotroph</th> <th>heterotroph</th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>inorganic source of carbon</td> <td>organic source of carbon compounds ✓</td> </tr> <tr> <td>b.</td> <td>synthesizes organic molecules from inorganic sources ✓</td> <td>obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓</td> </tr> <tr> <td>c.</td> <td>autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓</td> <td>heterotrophs require chemical energy from ingested nutrients ✓</td> </tr> </tbody> </table>		autotroph	heterotroph	a.	inorganic source of carbon	organic source of carbon compounds ✓	b.	synthesizes organic molecules from inorganic sources ✓	obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓	c.	autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓	heterotrophs require chemical energy from ingested nutrients ✓	<i>Table format not required. Must be paired statements.</i>	2
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(continued...)

(Question 3 continued)

Question		Answers	Notes	Total
3.	c	<p>a. energy enters ecosystems from the <u>Sun</u> / continuous supply from the <u>Sun</u> ✓</p> <p>b. light energy is converted into chemical energy and lost with movement along food chains OR energy needs to be «constantly» added «to ecosystem» as lost with movement along food chains / energy lost as <u>heat</u> with movement along food chains ✓</p> <p>c. nutrients are recycled within ecosystems / nutrients in an ecosystem are finite and limited ✓</p> <p>d. nutrients not lost but transformed into different compounds ✓</p> <p>e. nutrients «carbon compounds»/energy flow through food chains by means of feeding ✓</p>		3 max

Question		Answers	Notes	Total
4.	a	<p>a. axes labelled correctly: x-axis as temperature AND y-axis as rate of reaction/enzyme activity ✓</p> <p>b. correct shape of graph: increases gradually to max and then decreases more rapidly ✓</p>	<p>eg:</p>  <p><i>Fall should be at least twice as steep as rise.</i></p>	2
4.	b	<p>a. enzymes are proteins with specific 3-D geometry/shape ✓</p> <p>b. enzymes with <u>active site</u> that binds with the substrate/reactants ✓</p> <p>c. active site shape only allows it to bind with specific substrates «with complementary shapes» ✓</p> <p>d. when enzyme-substrate complex formed allows reaction to occur ✓</p> <p>e. products are released and enzyme returns to original shape and can be reused OR denaturing changes shape «of active site» so changes ability to bind with substrate ✓</p>	<p><i>Accept marks from clear annotated diagrams.</i></p>	3 max

Section B

Clarity of communication: [1]

The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question		Answers	Notes	Total
5.	a	<p>a. <u>phospholipid bilayer</u> – with head and tails ✓</p> <p>b. hydrophilic/phosphate/polar heads AND hydrophobic/hydrocarbon/fatty acid/non-polar tails labelled ✓</p> <p>c. <u>integral/intrinsic protein</u> – embedded in the phospholipid bilayer ✓</p> <p>d. <u>protein channel</u> – integral protein showing clear channel/pore ✓</p> <p>e. <u>peripheral/extrinsic protein</u> – on the surface ✓</p> <p>f. <u>glycoprotein</u> with carbohydrate attached ✓</p> <p>g. <u>cholesterol</u> – shown embedded in bilayer ✓</p>	<p><i>Award [1] for each structure clearly drawn and correctly labelled.</i></p> <p><i>Both needed.</i></p>	4 max

(continued...)

(Question 5 continued)

Question		Answers	Notes	Total
5.	b	a. «simple» diffusion of nutrients along/down a concentration gradient ✓ b. example of simple diffusion, eg: fatty acids ✓ c. facilitated diffusion of nutrients involves movement through <u>channel proteins</u> ✓ d. example of nutrient for facilitated diffusion eg: fructose ✓ e. active transport of nutrients against a concentration gradient / involving <u>protein pumps</u> ✓ f. example of active transport, eg: (iron) ions/glucose/amino acids ✓ g. endocytosis / by means of vesicles ✓ h. example of nutrient for endocytosis, eg: cholesterol in lipoprotein particles ✓		4 max

(continued...)

(Question 5 continued)

Question		Answers	Notes	Total
5.	c	<p>a. nerve impulses are action potentials propagated along axons of neurons ✓</p> <p>b. resting potential is -70 mV OR relatively negative inside in comparison to the outside ✓</p> <p>c. Na⁺/K⁺ pumps maintain/re-establish «the resting potential» ✓</p> <p>d. more sodium ions outside than inside «when at the resting potential» OR more potassium ions inside than outside «when at the resting potential» ✓</p> <p>e. action potential stimulates «wave of» depolarization along the membrane/axon ✓</p> <p>f. «when neuron is stimulated» if threshold potential is reached Na⁺ channels open ✓</p> <p>g. sodium ions diffuse/move in ✓</p> <p>h. «Na⁺ move in» causing depolarization / inside of the neuron becomes more positively charged than the outside of the neuron ✓</p> <p>i. potassium ion channels open OR potassium ions diffuse/move out ✓</p> <p>j. «K⁺ move out» causing repolarization ✓</p> <p>k. local currents OR description of Na⁺ ion diffusion between depolarized region and next region of axon to depolarize ✓</p> <p>l. myelination increases propagation speed/allows saltatory conduction ✓</p>	<p>Accept any of the points clearly explained in an annotated diagram.</p>	<p>7 max</p>

(Plus up to [1] for quality)

Question		Answers	Notes	Total
6.	a	a. decomposition of dead organic material «by saprotrophic bacteria» ✓ b. «decomposition» leads to CO ₂ formation/regeneration due to respiration ✓ c. «saprotrophic bacteria only» partially decompose dead organic matter in acidic/anaerobic conditions in waterlogged soil ✓ d. results in peat formation in bogs/swamps ✓ e. photosynthetic bacteria/cyanobacteria fix CO ₂ in photosynthesis ✓		3 max
6.	b	a. problem results from excessive use of antibiotics by doctors/veterinarians/in livestock OR low antibiotic doses taken by patients (not finishing treatment) ✓ b. natural variation exists in any population of bacteria making some resistant to a specific antibiotic ✓ c. variation arises from mutation OR antibiotic resistance can be transferred between bacteria by plasmids ✓ d. antibiotic kills all bacteria except those that are resistant ✓ e. resistant bacteria survive, reproduce and pass on resistance to offspring ✓ f. soon population is made of mainly antibiotic resistant bacteria ✓ g. this is an example of natural selection «increasing frequency of characteristics that make individuals better adapted to environment» ✓		4 max

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	c	<p>a. genetic modification carried out by gene transfer between species ✓</p> <p>b. genes transferred from one organism to another produce the same protein/amino acid sequence ✓</p> <p>c. due to universality of genetic code OR organisms use same codons of mRNA to code for specific amino acids ✓</p> <p>d. mRNA for required gene extracted/identified ✓</p> <p>e. DNA copies of mRNA made using reverse transcriptase ✓</p> <p>f. PCR used (to amplify DNA to be transferred) ✓</p> <p>g. genes/DNA transferred from one species to another using a vector ✓</p> <p>h. plasmid acts as vector to transfer genes to bacteria/<i>E. coli</i> ✓</p> <p>i. plasmid cut open at specific base sequences using restriction endonuclease OR plasmid cut to produce blunt ends then extra cytosine/C nucleotides added OR sticky ends made by adding extra guanine/G nucleotides OR mention of sticky ends if not gained already ✓</p> <p>j. cut plasmids mixed with DNA copies stick together (due to complementary base pairing) ✓</p> <p>k. DNA ligase makes sugar-phosphate bonds to link nucleotides of gene with those of plasmid ✓</p> <p>l. bacteria that take up plasmid are identified ✓</p> <p>m. (genetically modified) bacteria will reproduce carrying the transferred gene ✓</p> <p>n. example – eg: as production of human insulin using <i>E. coli</i> bacteria ✓</p>	<p>Accept any of the points clearly explained in an annotated diagram.</p>	<p>8 max</p>

(Plus up to [1] for quality)