

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

BIOLOGY A

A162/02

Unit A162: Modules B4, B5, B6 (Higher Tier)

MARK SCHEME

MAXIMUM MARK 60

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
not/reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant - applies to neutral answers
allow/accept	=	answers that can be accepted
(words)	=	words which are not essential to gain credit
<u>words</u>	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)

work done = 0 marks
 work done lifting = 1 mark
 change in potential energy = 0 marks
 gravitational potential energy = 1 mark

5. Annotations:
 The following annotations are available on SCORIS.

✓	=	correct response
✗	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt not given
ECF	=	error carried forward
^	=	information omitted
I	=	ignore
R	=	reject
6. If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Eg

For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth 0 marks.

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth one mark.

Put ticks (✓) in the two correct boxes.

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth one mark.

8. The list principle:
If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

Always check the additional guidance.

If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.

If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.

Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	


the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

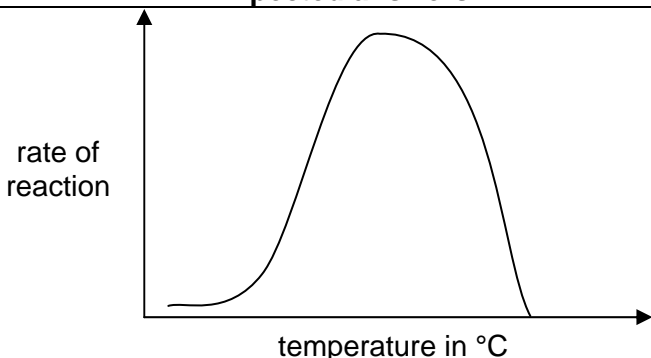
Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	x	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	x		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:
- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
 - Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
 - *For a general correlation between quality of science and quality of QWC:* determine the level based upon which level descriptor best describes the answer; you may awarded either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
 - *For high-level science but very poor QWC:* the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
 - *For very poor or totally irrelevant science but perfect QWC:* credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.


Question		Expected answers	Marks	Additional guidance										
1	(a)	<p>any two from: oxygen is used in aerobic respiration / oxygen is not used in anaerobic respiration</p> <p>lactic acid/lactate/ethanol is produced in anaerobic respiration / lactic acid/lactate/ethanol is not produced in aerobic respiration</p> <p>aerobic respiration releases more energy per glucose molecule / anaerobic respiration releases less energy per glucose molecule</p>	[2]											
	(b)	glucose → lactic acid	[1]	<p>both required for the mark accept "lactate" instead of lactic acid reject carbon dioxide and ethanol (as this is anaerobic respiration in muscle cells, not plant cells/microorganisms/yeast) reject formulae</p>										
	(c)	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; vertical-align: top; width: 50%;">structure in the muscle cell</td> <td style="text-align: center; vertical-align: top; width: 50%;">role in respiration</td> </tr> <tr> <td style="text-align: center; border: 1px solid black; padding: 5px;">mitochondria</td> <td style="text-align: center; border: 1px solid black; padding: 5px;">contains enzymes for anaerobic respiration</td> </tr> <tr> <td style="text-align: center; border: 1px solid black; padding: 5px;">cell membrane</td> <td style="text-align: center; border: 1px solid black; padding: 5px;">contains the genetic code for enzymes</td> </tr> <tr> <td style="text-align: center; border: 1px solid black; padding: 5px;">DNA in nucleus</td> <td style="text-align: center; border: 1px solid black; padding: 5px;">allows dissolved gases and water to pass freely</td> </tr> <tr> <td style="text-align: center; border: 1px solid black; padding: 5px;">cytoplasm</td> <td style="text-align: center; border: 1px solid black; padding: 5px;">contains enzymes for aerobic respiration</td> </tr> </table>	structure in the muscle cell	role in respiration	mitochondria	contains enzymes for anaerobic respiration	cell membrane	contains the genetic code for enzymes	DNA in nucleus	allows dissolved gases and water to pass freely	cytoplasm	contains enzymes for aerobic respiration	[1]	all four correct lines = 1 mark
structure in the muscle cell	role in respiration													
mitochondria	contains enzymes for anaerobic respiration													
cell membrane	contains the genetic code for enzymes													
DNA in nucleus	allows dissolved gases and water to pass freely													
cytoplasm	contains enzymes for aerobic respiration													
Total			[4]											

Question		Expected answers	Marks	Additional guidance
2	(a)	6CO ₂ <u>and</u> 6O ₂	[1]	both required for the mark, in correct order
	(b)	(the rate of) photosynthesis can be limited by carbon dioxide, light intensity and temperature in group A , light intensity or temperature is limiting the rate of photosynthesis (at high carbon dioxide levels) in group B there is greater light intensity / higher temperature so a faster rate of photosynthesis is possible before light intensity/temperature becomes limiting	[4]	accept “brighter” / “warmer” etc.
Total			[5]	

Question	Expected answers	Marks	Additional guidance
3	<p data-bbox="237 212 282 244">(a) </p> <p data-bbox="376 212 1104 515">[Level 3] Answer correctly and clearly describes the lock and key model, notes that chips/potatoes contain starch and explains that substrate specificity is why digestion of starch molecules in the chips by salivary amylase will start in the mouth but digestion of protein molecules in the chicken will not. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks)</p> <p data-bbox="376 547 1104 850">[Level 2] Answer correctly describes some aspects of the lock and key model but may not use the appropriate terminology and may not make clear the importance of the specificity of the active site on the salivary amylase molecule for the shape of the starch molecule. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks)</p> <p data-bbox="376 858 1104 1161">[Level 1] Answer demonstrates understanding that salivary amylase will start to digest starch in the chips but will not digest protein in the chicken, but does not clearly attribute this to the specificity of the enzyme's active site for the shape of the starch molecule. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks)</p> <p data-bbox="376 1169 1104 1249">[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p data-bbox="1227 212 1529 244">relevant points include:</p> <ul data-bbox="1227 244 2063 619" style="list-style-type: none"> • chips/potatoes/plants contain starch (as an energy store) • salivary amylase has an active site • the shape of the active site complements the shape of a starch molecule • only a starch molecule will fit into the enzyme's active site and form an enzyme-substrate complex • this is the 'lock and key' model • chicken meat is made of protein, not starch • protein will not fit into the enzyme's active site • and will not form an enzyme-substrate complex • so will not be digested

Question		Expected answers	Marks	Additional guidance
(b)	(i)	 <p>rate of reaction</p> <p>temperature in °C</p>	[1]	as temperature increases the rate should climb to an optimum, then drop to zero
	(ii)	the optimum temperature for the enzyme / the maximum rate of reaction occurs at around 40 °C which is close to human body temperature	[2]	
	(iii)	lower/different pH will change the <u>shape</u> of the <u>active site</u> , which will affect the ability of the enzyme to form an enzyme-substrate complex this means the rate of reaction will be higher if the pH is closer to the enzyme's optimum pH, or lower if the pH is further from the enzyme's optimum pH	[2]	
Total			[11]	

Question		Expected answers	Marks	Additional guidance
4	(a)	bases amino acids	[1]	both required for the mark must be in correct order
	(b)	<p>The nucleus divides during cell growth. <input type="checkbox"/></p> <p>The chromosomes are copied to form new strands of DNA. <input checked="" type="checkbox"/></p> <p>The number of organelles in each cell decreases as the cell grows. <input type="checkbox"/></p> <p>Together when the cell divides during mitosis. <input type="checkbox"/></p> <p>The number of chromosomes doubles in each cell before the cell divides. <input checked="" type="checkbox"/></p>	[1]	both required for the mark
	(c)	cells made by meiosis contain half the number of chromosomes of the parent cell but cells made by mitosis have the same number of chromosomes. this is important because meiosis produces gametes, which fuse with other gametes during fertilisation to make a cell/zygote with the correct number of chromosomes	[2]	accept "meiosis produces variation" for 1 mark
		Total	[4]	


Question		Expected answers	Marks	Additional guidance
5	(a)	cells in meristem tissue are the only cells in the seedling that divide (by mitosis) and allow the seedling to grow/elongate by producing new cells	[2]	
	(b)	<p> [Level 3] Answer correctly describes the production, distribution and effect of auxin at the shoot tip under conditions of directional light. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks)</p> <p>[Level 2] Answer may correctly identify some aspects of auxin activity at the shoot tip under conditions of directional light but may not make the correct links between events. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks)</p> <p>[Level 1] Answer refers to phototropism and/or diffusion of auxin but without describing the details correctly. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <ul style="list-style-type: none"> • auxin is produced by the tip of the stem • auxin diffuses down into the lower tissues of the stem • (strong) directional light causes the auxin to diffuse towards the darker side of the stem • auxin promotes cell division/growth • higher auxin concentration on the darker side of the stem increases the division/growth rate on this side • more/faster division/growth on the darker side produces a stem that is curved towards the directional light source • this is phototropism <p>ignore references to the shoot “bending” towards the light without this being linked to growth</p> <p>reject references to light destroying/breaking down auxin</p>

Question		Expected answers	Marks	Additional guidance
5	(c)	<i>disagree because:</i> observations/data that agree with a prediction <u>increase confidence</u> in the explanation but this does not <u>prove</u> that the explanation is correct	[2]	
Total			[10]	

Question		Expected answers	Marks	Additional guidance
6	(a)	<i>the conclusion is not correct because:</i> the rate of cell division is constant between 6 and 24 hours / there are two rounds of division between each time point	[1]	no mark for saying the conclusion is not correct, only for saying why
	(b) (i)	recording to the nearest thousand made the cell count appear the same even though different numbers of cells were present / there may have been a counting error cells were dividing but an equal number of cells died as were formed	[2]	
	(ii)	cells may only divide at a specific temperature / within a certain temperature range but would be able to survive (without dividing) even if the temperature was higher or lower than this	[2]	
	(c)	inactive genes (in the nucleus) need to be reactivated/switched on	[1]	
Total			[6]	

Question		Expected answers	Marks	Additional guidance
7	(a)	Peter	[1]	
	(b)	Sarah because she is using storage and retrieval of information	[2]	
Total			[3]	

8	(a)	<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">component</th> <th style="text-align: left;">part of the reflex</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 5px;">muscle cells in the iris</td> <td style="border: 1px solid black; padding: 5px;">processor</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">light sensitive cells in the retina</td> <td style="border: 1px solid black; padding: 5px;">effector</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">central nervous system</td> <td style="border: 1px solid black; padding: 5px;">receptor</td> </tr> </tbody> </table>	component	part of the reflex	muscle cells in the iris	processor	light sensitive cells in the retina	effector	central nervous system	receptor	[2]	
component	part of the reflex											
muscle cells in the iris	processor											
light sensitive cells in the retina	effector											
central nervous system	receptor											
	(b)	any two from: stepping grasping sucking	[2]	accept "suckling" for sucking								
Total			[4]									




Question	Expected answers	Marks	Additional guidance
9	<p> [Level 3] Answer clearly links paroxetine to serotonin synapses, describes the blocking of serotonin removal sites, and attributes the subsequent propagation of nerve impulses to the increased concentration of serotonin allowing increased binding to receptors on the next neuron. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks)</p> <p>[Level 2] Answer describes the correct mode of action but does not provide all of the details, or does not get the order quite right, or does not use all of the correct technical terms. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks)</p> <p>[Level 1] Answer may compare the action of paroxetine to the action of Ecstasy/MDMA but does not provide many details of how it works. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <ul style="list-style-type: none"> • paroxetine could work in the same way as Ecstasy/MDMA • at <u>synapses</u> (in the brain) • that use serotonin as a <u>transmitter substance</u> • by blocking sites where serotonin is removed from the synapse <ul style="list-style-type: none"> • when a nerve impulse is transmitted across the synapse, serotonin is released from the first neuron and binds to receptors on the membrane of the second/next/relay neuron • this causes nerve impulses in the second neuron <ul style="list-style-type: none"> • serotonin is not removed from the synapse, which leads to an increased concentration of serotonin in the synapse • more serotonin molecules are able to bind to receptors on the second neuron • and this causes more nerve impulses in the second neuron
	Total	[6]	

Question		Expected answers	Marks	Additional guidance
10	(a)	1.04	[1]	accept "104" if the candidates has <u>clearly</u> given the unit as "cm"
	(b)	<i>neuron A because:</i> the speed of the nerve impulse is slow (which indicates that it does not have/has lost the fatty sheath) and it is long enough to reach from the toes to the spinal cord / neuron D would not be long enough to reach from the toes to the spinal cord	[2]	no marks for neuron A , only for the justification of the choice
		Total	[3]	

Question	Expected answers	Marks	Additional guidance
11	<p>any four from:</p> <p>the patient could benefit if a treatment for the brain injury is developed</p> <p>the knowledge gained may help to treat other people / benefit to society outweighs cost to individual / more people will benefit in the long term</p> <p>Stuart could use (non-invasive) procedure(s) that will not cause damage/pain to the patient</p> <p>research that uses human participants can yield more useful information than research that uses models/simulations/animals/other organisms</p> <p>if Stuart wants to study the effects of brain damage on language/intelligence/etc this can only be done using humans</p> <p>the patient may have given their consent / volunteered to be part of the research</p> <p>a study that uses humans can get consent from the participants, but a study that uses other organisms/animals can not</p>	[4]	<p>credit any appropriate named procedure (e.g. MRI, PET, CAT scan)</p>
	Total	[4]	

Assessment Objectives (AO) Grid

(includes quality of written communication )

Question	AO1	AO2	AO3	Total
1(a)	2			2
1(b)	1			1
1(c)	1			1
2(a)	1			1
2(b)	1	2	1	4
3(a) 	3	3		6
3(b)(i)		1		1
3(b)(ii)		1	1	2
3(b)(iii)	1	1		2
4(a)		1		1
4(b)	1			1
4(c)	2			2
5(a)	1	1		2
5(b) 	5	1		6
5(c)			2	2
6(a)			1	1
6(b)(i)		1	1	2
6(b)(ii)		1	1	2
6(c)		1		1
7(a)		1		1
7(b)	1	1		2
8(a)	1	1		2
8(b)	2			2
9 	3	3		6
10(a)		1		1
10(b)			2	2
11		4		4
Totals	26	25	9	60