

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**TWENTY FIRST CENTURY SCIENCE**

**A163/02**

**BIOLOGY A**

Unit 3: Module B7 (Higher Tier)

Candidates answer on the question paper  
 A calculator may be used for this paper.

**OCR Supplied Materials:**

None

**Duration: 1 hour**

**Other Materials Required:**

- Pencil
- Ruler (cm/mm)

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

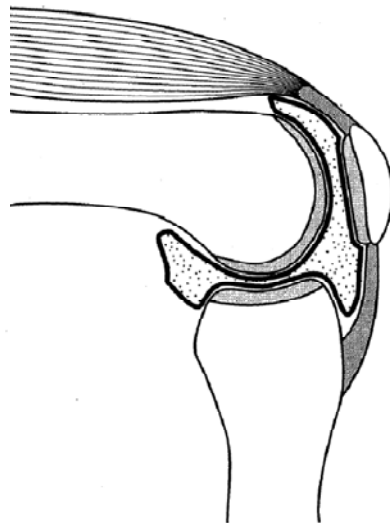
**INFORMATION FOR CANDIDATES**

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks for each question is given in brackets [ ] at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.


For Examiner's Use		
	Max	Mark
1	6	
2	12	
3	5	
4	11	
5	9	
6	3	
7	7	
8	7	
<b>TOTAL</b>	<b>60</b>	

Answer **all** the questions.

- 1 The bones of the human skeleton are held together at joints, which allow movement.  
The diagram shows the knee joint of the human skeleton.



Explain how the parts of the knee joint enable it to function.

 *The quality of written communication will be assessed in your answer to this question.*

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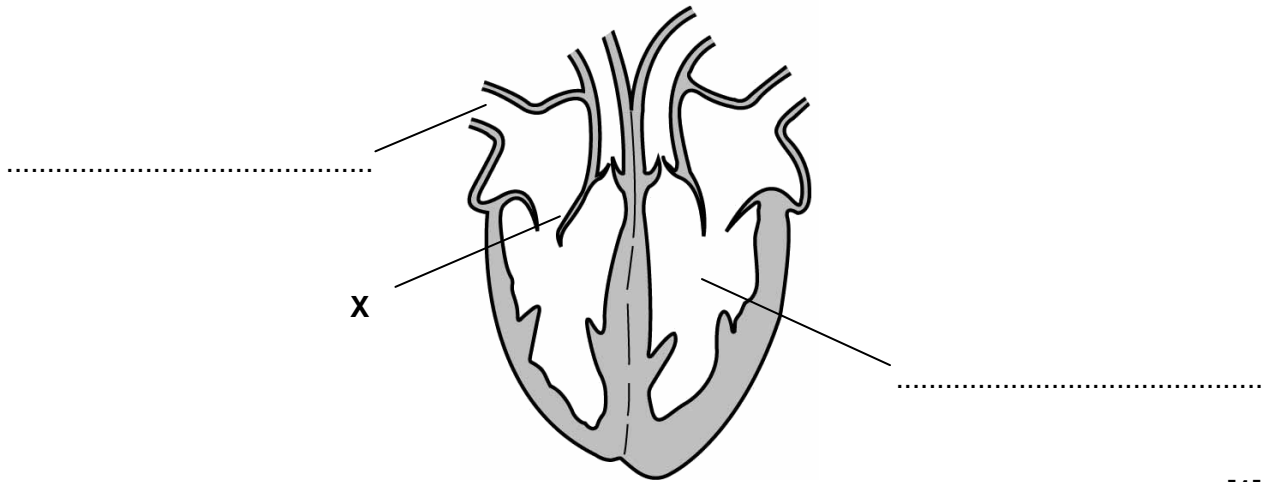
.....

[6]  
[Total: 6]

2 This question is about the heart and heart disease.

(a) Look at the diagram of the heart.

(i) Complete the two labels on the diagram below.



[1]

(ii) Suggest what would happen if structure X was faulty and the problems that this could cause.

.....

.....

..... [2]

(iii) The thickness of the walls of the four chambers of the heart is different.  
Explain why.

.....

.....

.....

..... [3]

(b) Eating too much fatty food can increase the risk of heart disease.

Read the article about heart disease.

**Heart disease is related to blood cholesterol levels**

Doctors say that the number of cases of heart disease in the population is directly related to the level of cholesterol in the blood.

People with high cholesterol are almost twice as likely to experience heart disease during their lifetime.

Men are almost twice as likely as women of having heart disease even if they have the same level of cholesterol in their blood.

Cholesterol is found in high fat foods.

This is why some people are cutting the amount of fat in their diet.

Other people think that because our body can make cholesterol, cutting down on fat in our diet is a waste of time.

(i) Describe the correlations suggested by the article.

.....

.....

..... [2]

(ii) A student concludes that the article proves that cholesterol causes heart disease?  
Is this conclusion valid? Explain your answer.

.....

..... [1]

(iii) A patient has their blood cholesterol measured.

Levels of blood cholesterol can be determined by doing a simple blood test.  
Several measurements of the same quantity may give different results.  
Suggest why repeating measurements gives a more reliable estimate of the quantity.

.....

.....

.....

..... [3]

[Total: 12]

3 Our bodies maintain a constant body temperature of 37 °C.

(a) These steps explain one way in which the body controls its own temperature.

They are in the wrong order.

- A information sent to the hypothalamus
- B blood flow to the skin's surface increases or decreases
- C receptors in the skin detect the external temperature
- D effectors in the skin increase or decrease vasodilation
- E the temperature of the body returns to the correct level
- F instructions are sent from the brain

Put the steps in the correct order by writing the letters in the empty boxes. One has been done for you.

					E
--	--	--	--	--	---

[2]

- (b) When the human body is in danger of cooling down, it responds in order to maintain its core temperature.

Draw a straight line from each **structure** to the **action** it takes to maintain core temperature.

Then draw a straight line from each correct **action** to the **role** it plays in maintaining core temperature.

structure	action	role
capillaries in skin	stop working	restricts blood flow
sweat glands	stand on end	reduces evaporation
muscles	twitch	increases insulation
	become narrower	increases respiration


[3]

[Total: 5]

4 Natural ecosystems can be unbalanced by human activity.

- (a) A gardener notices that the pond in her garden has turned green and all of the fish have died. She suspects that this may be because she used inorganic fertiliser in her garden.

Explain to the gardener how using inorganic fertiliser may have caused the effects in her pond.

* The quality of written communication will be assessed in your answer to this question.*

.....

.....

.....

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.....

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.....

.....

**[6]**

- (b) Many years ago in America, intensive wheat farming turned a grassland into a desert.

Which of these statements are possible explanations of why this intensive wheat farming was not sustainable?

Put ticks (✓) in the boxes next to the **three** correct answers.

- A desert is a stable ecosystem.
- A closed loop system became an open loop system.
- In open loop systems waste is always reused.
- The output from the ecosystem became greater than the input.
- Over-production of reproductive structures only occurs in closed loop systems.
- Ploughing soil prevents soil erosion.
- Intensive farming always results in an open loop system.

**[3]**

(c) Energy can be generated in many ways.

Which of the following ways to generate electricity could meet the requirements of a closed loop system?

Put ticks (✓) in the boxes next to the correct answers.

burning coal in a power station

generating electricity from the wind

using petrol in cars

using waves to produce electrical power

using North Sea gas for cooking

[2]

[Total: 11]





**(b)** Wheat can be genetically modified to be resistant to weed killer.

This helps farmers to keep their wheat crop free of weeds, maximise the yield and earn more profit. It also helps consumers by providing a larger supply of food.

However, some people are opposed to the genetic modification of wheat in this way for a variety of reasons. Some think it is morally wrong to alter the DNA of living things, as if human beings are “playing God”. Others have different concerns.

**(i)** Describe two other arguments **against** the genetic modification of wheat to be resistant to weed killer.

.....

.....

.....

..... [2]

**(ii)** Look at the balance of arguments for and against the genetic modification of wheat to be resistant to weed killer.

State whether you agree or disagree with this. Explain your answer.

.....

.....

..... [1]

**[Total: 9]**

6 DNA technology is used in genetic testing.

Genetic testing can be used to find out whether a person is a carrier of a genetic condition such as cystic fibrosis.

Complete these statements to show how genetic testing is carried out.

Choose from the following words.

**antibody    allele    antigen    chromosome    DNA    gene probe    nucleus**

A sample of ..... is isolated from white blood cells.

A..... with a UV fluorescing marker is added to the sample.

UV light is then used to identify if the..... is present.

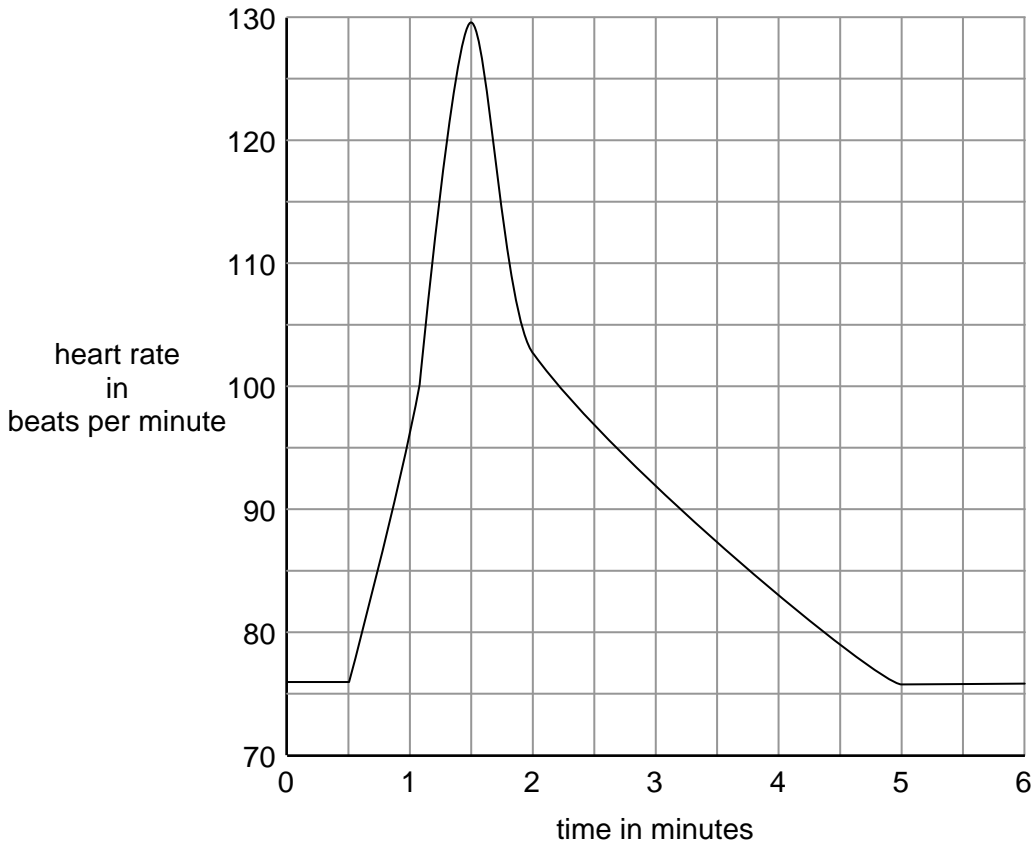
**[3]**

**[Total: 3]**

7 Steve and Mark are athletes.

Steve's heart rate is measured continuously during a standard exercise routine using a heart rate monitor.

The graph shows Steve's heart rate in beats per minute over a period of time.



(a) Use the graph to describe when Steve is resting and exercising during the six minute period.

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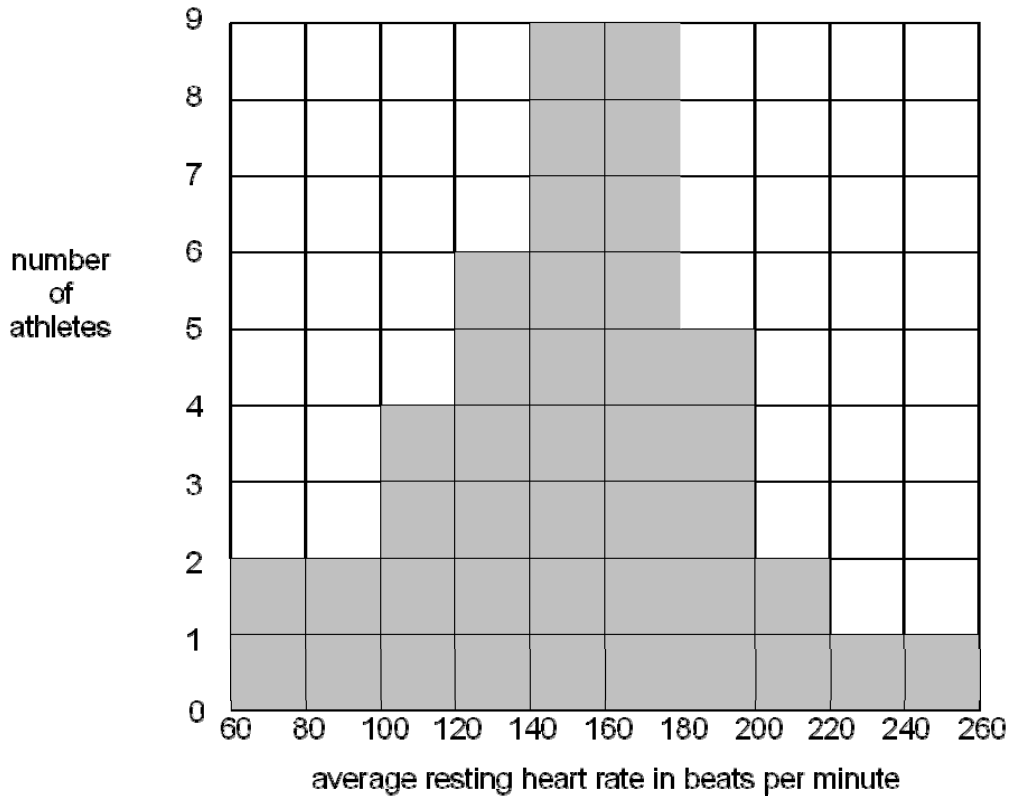
.....

..... [2]

(b) The length of recovery period following a standard exercise routine is one indicator of fitness. What is Steve's recovery period in seconds?

answer ..... s [1]

- (c) The histogram shows the recovery period for a group of 40 athletes following this standard exercise routine.



Mark's recovery period is 205 seconds.

This is in the 90<sup>th</sup> percentile of the group.

Explain what this means and what it suggests about his level of fitness.

.....

.....

..... [2]

(d) Mark's coach wants to find out how Mark is progressing in his training.

He uses measurements of recovery period following the standard exercise routine to monitor Mark's progress over several months of training.

These are the results that Mark's coach collects during the first 8 weeks.

	week							
	1	2	3	4	5	6	7	8
recovery period in seconds	210	183	207	194	199	180	197	178

Mark's coach concludes that Mark's fitness has improved over the 8 weeks.

Why do these data reduce confidence in the validity of this conclusion?

.....

.....

..... [2]

[Total: 7]

8 Jake is concerned about his weight.

(a) He is 200 cm tall and has a body mass of 76 kg.

Use this formula to calculate Jakes body mass index (BMI).

Show your working.

$$\text{BMI} = \frac{\text{mass (kg)}}{[\text{height (m)}]^2}$$

BMI = ..... [2]

(b) Look at the body mass index (BMI) table.

BMI	condition
less than 19	underweight
19 – 24	normal weight
25 – 29	overweight
30 – 40	obese
over 40	severely obese

Discuss whether Jake should be concerned about his body mass.

.....

..... [2]

- (c) Suggest reasons why the BMI table may not be an accurate way of evaluating whether a person is overweight or underweight.

.....

.....

.....

..... [3]

[Total: 7]

[Paper Total: 60]

**END OF QUESTION PAPER**



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**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**TWENTY FIRST CENTURY SCIENCE**

**BIOLOGY A**

**A163/02**

Unit 3: Modules B7 (Higher Tier)

**MARK SCHEME**

**Duration: 1 hour**

**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 <b>not</b> 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	<p><b>[Level 3]</b> Answer correctly names all major parts and correctly describes their function in allowing movement. Answer may also consider minor parts. All information in 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><b>[Level 2]</b> Answer correctly names most of the major parts and mostly describes their functions. 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><b>[Level 1]</b> Answer correctly names most of the major parts but does not correctly describe their functions <b>OR</b> correctly names one part and correctly describes its function in allowing movement. 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><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	<b>[6]</b>	<p><b>relevant points include:</b></p> <p>major parts:</p> <ul style="list-style-type: none"> <li>• the synovial fluid is liquid which reduces friction (between bones) / lubricates the joint</li> <li>• ligaments are elastic and hold bones together, allowing the bones to move but by a limited amount</li> <li>• tendons are inelastic, join muscles to bone, and transmit (pulling) force from muscle to bone</li> <li>• cartilage is smooth and protects surface of bone / reduces friction / stops bones grinding against each other / absorbs shock / prevents damage to bones</li> </ul> <p>minor parts:</p> <ul style="list-style-type: none"> <li>• synovial membrane lines the joint and secretes synovial fluid to lubricate the joint</li> <li>• knee cap (patella) protects the joint from damage and connects muscles (via tendon) of upper leg to bones of lower leg</li> </ul>
	<b>Total</b>	<b>[6]</b>	

Question			Expected answers	Marks	Additional guidance
2	(a)	(i)	<div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 10px;">vena cava</div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 150px;">left ventricle</div>	[1]	both correct = 1 mark
		(ii)	<p>(some) blood will flow backwards / from (right) ventricle to (right) atrium (when ventricle contracts)</p> <p>heart has to work harder / less efficient circulation/owtte / breathlessness / fluid build-up in lungs / weakness / dizziness / chest discomfort / swelling (of feet/ankles/abdomen)</p>	[2]	<b>accept</b> any reasonable consequence of valve leaking
		(iii)	<p>the left ventricle is the thickest because it needs most muscle to push blood round the whole body</p> <p>however the right ventricle only needs to push blood to the lungs, so needs less muscle and is therefore not as thick as the left ventricle</p> <p>while the atria are the thinnest as they only need to push blood into the ventricles</p>	[3]	

Question			Expected answers	Marks	Additional guidance
2	(b)	(i)	correlation between higher cholesterol and increased incidence of heart disease  correlation between being male and increased incidence of heart disease	[2]	
		(ii)	no because they could both be affected by some other factor / no because a correlation between a factor and an outcome does not prove that the factor caused the outcome	[1]	
		(iii)	<b>any three from:</b> can calculate the mean, which is a better estimate of the true value can estimate range within which true value probably lies can exclude outliers may reveal that some readings were affected by error eg in measurement or uncontrolled variable	[3]	
			<b>Total</b>	<b>[12]</b>	

Question		Expected answers	Marks	Additional guidance
3	(a)	C A F D B	[2]	1 mark for each 2 correct responses C before A A before F F before D D before B
	(b)		[3]	1 mark for each correct left-to-right path through
<b>Total</b>			[5]	



Question		Expected answers	Marks	Additional guidance
4	(a)	<p><b>[Level 3]</b> All main steps included in a logical sequence. All information in 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><b>[Level 2]</b> Idea of lack of light causes plant death which rots and uses up oxygen so none for animals. 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><b>[Level 1]</b> General idea that there is not enough oxygen and this causes animals to die. 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><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <ul style="list-style-type: none"> <li>• This process is eutrophication</li> <li>• Inorganic fertilisers contain nitrates, which are washed into the pond</li> <li>• Nitrates cause algae in the pond to grow</li> <li>• Algal bloom prevents light entering water</li> <li>• Algae in lower layers of water cannot photosynthesise and die</li> <li>• Bacteria use up oxygen in the water as they work to decompose the dead algae</li> <li>• Oxygen in the water is not replaced as photosynthesis has stopped everywhere but surface</li> <li>• Fish die without oxygen as they cannot respire</li> <li>• Bacteria use up more oxygen as they decompose the dead fish</li> </ul>

Question		Expected answers	Marks	Additional guidance
4	(b)	<p>... became an open loop system ... <input type="checkbox"/></p> <p>... became greater than the input <input checked="" type="checkbox"/></p> <p>Intensive farming always ... <input checked="" type="checkbox"/></p>	[3]	one mark per correct tick
	(c)	<p>... from the wind <input checked="" type="checkbox"/></p> <p>using waves ... <input checked="" type="checkbox"/></p>	[2]	one mark per correct tick
<b>Total</b>			<b>[11]</b>	

Question		Expected answers	Marks	Additional guidance
5	(a)	<p><b>[Level 3]</b>            Answer correctly uses the words ‘isolate’, ‘replicate’, ‘transfer’ and ‘vector’ to explain all of the steps in the process in the correct sequence. Suggested benefits of using human insulin are described clearly. All information in 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><b>[Level 2]</b>            Answer uses most of the underlined words to explain the process, but may omit a step or describe a step out of order. Possible benefits of using human insulin are included in the answer. 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><b>[Level 1]</b>            Answer describes some stages correctly, but omits other stages and/or confuses the order, and may not use the underlined terms. 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><b>[Level 0]</b>            Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>relevant points include:</p> <ul style="list-style-type: none"> <li>• <u>isolate</u> gene (that codes for) human insulin</li> <li>• <u>replicate</u> the gene</li> <li>• put gene into a vector</li> <li>• such as a virus or plasmid</li> <li>• use vector to <u>transfer</u> the gene into bacteria</li> <li>• idea that DNA is a universal language that can be interpreted by any organism</li> <li>• idea of expression of the gene in the bacteria (to produce human insulin)</li> <li>• human insulin is the exact match for the required hormone / animal insulin may have some differences</li> <li>• less problem of allergy/adverse reaction to human insulin</li> </ul>




Question			Expected answers	Marks	Additional guidance
5	(b)	(i)	<p><b>any two from:</b>            GM wheat may be more expensive (less affordable) for farmers / consumers            resistance gene may be transferred to other plants (in the wild)            eliminating weeds/other plants creates a (wheat) monoculture, which decreases biodiversity            may promote over-use of weed killer, which could wash into water systems and harm other living things or get into the food chain</p>	[2]	<b>reject</b> “morally wrong” / “playing God”
		(ii)	<p><i>agree or disagree because:</i>            statement that links decision to the arguments presented</p>	[1]	no marks for simply saying agree or disagree; candidate must plausibly link their decision to the arguments under consideration e.g. agree because benefits to farmers and consumers outweigh costs/risks to biodiversity, <b>ora</b>
<b>Total</b>				<b>[9]</b>	
6			DNA gene probe allele	[3]	
<b>Total</b>				<b>[3]</b>	

Question		Expected answers	Marks	Additional guidance
7	(a)	starts exercise after 30 seconds stops exercise after 1 ½ minutes  OR  resting for first 30 seconds exercising for 1 minute (then rests for 4 ½ minutes)	[2]	
	(b)	210	[1]	
	(c)	Mark is in the top 10% of values for the length of recovery period / Mark is in the top 4 out of 40 / 90% of the group have a shorter recovery period / 36 out of 40 with lower values / owtte which suggests that <u>compared to the rest of the group</u> he is less fit	[2]	
	(iii)	<b>any two from:</b> the results vary / no clear trend no knowledge of variation before the 8-week period the changes are fairly small resting heart rate is only one indicator of fitness reading only taken once per week / should have taken several readings and averaged	[2]	
		<b>Total</b>	<b>[7]</b>	

Question		Expected answers	Marks	Additional guidance
8	(a)	$76/(2)^2$ 19	[2]	correct answer without working = 2 marks
	(b)	he is (in the range for) normal weight but he is at the very bottom of the normal range, so if he loses any body mass he will become underweight	[2]	
	(c)	<b>any three from:</b> some people have larger / thicker bones different BMI tables for males and females idea that a small change at the borderline between categories (e.g. small change in weight, or rounding to whole number from 1 d.p.) may shift the BMI into a different category (e.g.. from 24 = normal to 25 = overweight) does not take age into account	[3]	<b>allow</b> one mark related to inaccuracies in measurement of BMI e.g. height will differ if measured with shoes on/off; mass will differ before/after eating / at different times of day / level of dehydration / clothes on/off; accuracy / calibration of measuring instruments may affect result;
		<b>Total</b>	<b>[7]</b>	

## Assessment Objectives (AO) Grid

(includes quality of written communication )

Question	AO1	AO2	AO3	Total
1 	6			6
2(a)(i)	1			1
2(a)(ii)		2		1
2(a)(iii)		3		3
2(b)(i)		2		2
2(b)(ii)			1	1
2(b)(iii)	2	1		3
3(a)	1	1		2
3(b)	3			3
4(a) 	5	1		6
4(b)		3		3
4(c)		2		2
5(a) 	5	1		6
5(b)(i)		2		2
5(b)(ii)			1	1
6	3			3
7(a)		2		2
7(b)		1		1
7(c)		1	1	2
7(d)			2	2
8(a)		2		2
8(b)			2	2
8(c)		2	1	3
<b>Totals</b>	<b>26</b>	<b>26</b>	<b>8</b>	<b>60</b>

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