GCSE

WJEC GCSE in

BIOLOGY

APPROVED BY QUALIFICATIONS WALES

SAMPLE ASSESSMENT MATERIALS

Teaching from 2016

This Qualifications Wales regulated qualification is not available to centres in England.

For teaching from 2016
For award from 2018

GCSE BIOLOGY

SAMPLE ASSESSMENT MATERIALS

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Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

BIOLOGY

UNIT 1: CELLS, ORGAN SYSTEMS AND ECOSYSTEMS
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**10**	
3.	**11**	
4.	**6**	
5.	**7**	
6.	**11**	
7.	**6**	
8.	**6**	
9.	**7**	
10.	**7**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **7** is a quality of extended response (QER) question where your writing skills will be assessed.
.

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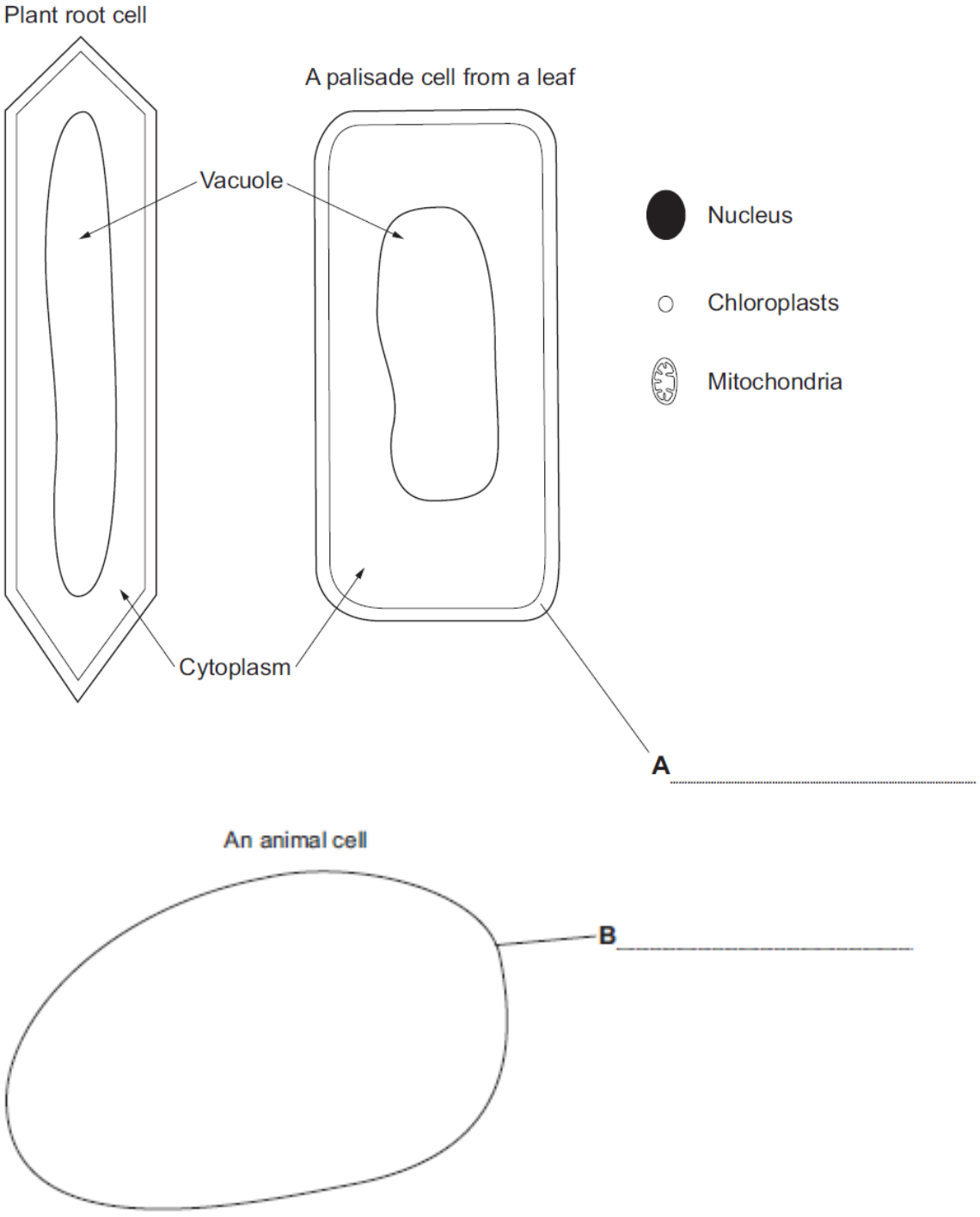
*Answer **all** questions*

1. The drawings show sections through three different cells and some structures normally found in SOME of them.

(a) Using the key given, carefully **draw** chloroplasts, mitochondria and a nucleus where they belong in the cells below in their correct positions. [7]



(b) **Label** the parts **A** and **B** on the diagrams. [2]

9

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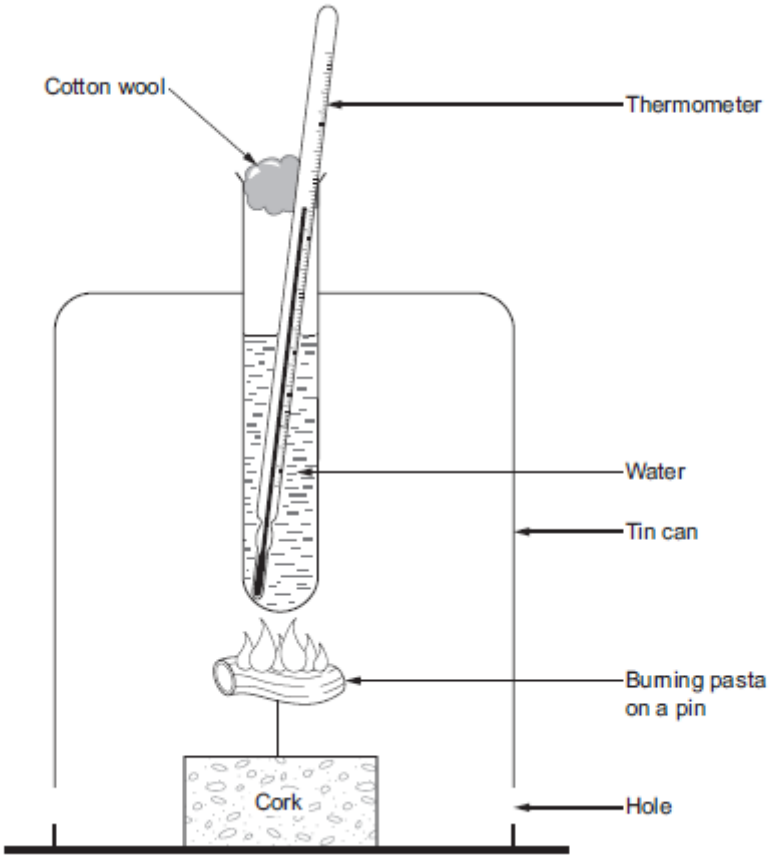
2. The apparatus shown can be used to calculate the energy in pasta.



The results can be used as shown:

Temperature of the water at start	= 20 °C
Temperature of the water after burning the pasta	= 80 °C
Temperature increase	= *y*
Mass of pasta before burning	= 1.5 g
Mass of pasta remaining after burning	= 1.0 g
Mass of pasta burnt	= *x* g
Mass of water	= 20.0 g

(a) Calculate the value of: [2]

(i) *y* ..... °C

(ii) *x* ..... g

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(b) Calculate the heat released from 1 g pasta using the following equation: [2]

$$\frac{20.0 \times y \times 4.2}{1000 \times x}$$

heat released = ...kJ/g

(c) State **one** way in which you would modify the apparatus to improve the accuracy of this experiment. [1]

.....

.....

(d) The table gives information about food values in a large cup (200 cm^3) of six different hot drinks.

Drink	**Energy (kJ)**	**Fat (g)**	**Sugar (g)**
black coffee	28	0	0
chocolate mocha with whole milk	1698	20	43
cappuccino with skimmed milk	316	0	9
café latte with whole milk	838	11	15
café latte with skimmed milk	511	0	16
café americano	48	0	0

Use the information in the table to answer the following questions.

(i) Which drink gives least energy? [1]

.....

(ii) What is the main difference in the nutritional content of skimmed milk and whole milk? [1]

.....

(iii) Which drink should be avoided by someone who is obese and give **two** reasons for your answer. [3]

.....

.....

10

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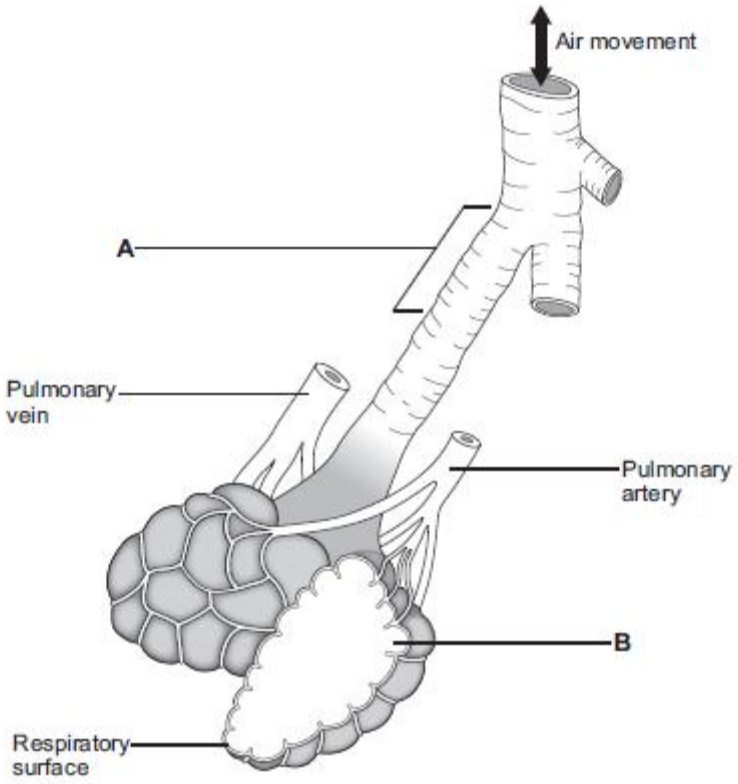
3. The diagram shows some of the structures in a human lung.



(a) (i) **On the diagram**, **draw one arrow** on the pulmonary artery, to show the direction of blood flow. [1]

(ii) Name parts **A** and **B**. [2]

A .....

B .....

(iii) State **two** ways in which the respiratory surface of the lungs is adapted to help oxygen pass into the blood. [2]

I .....

II .....

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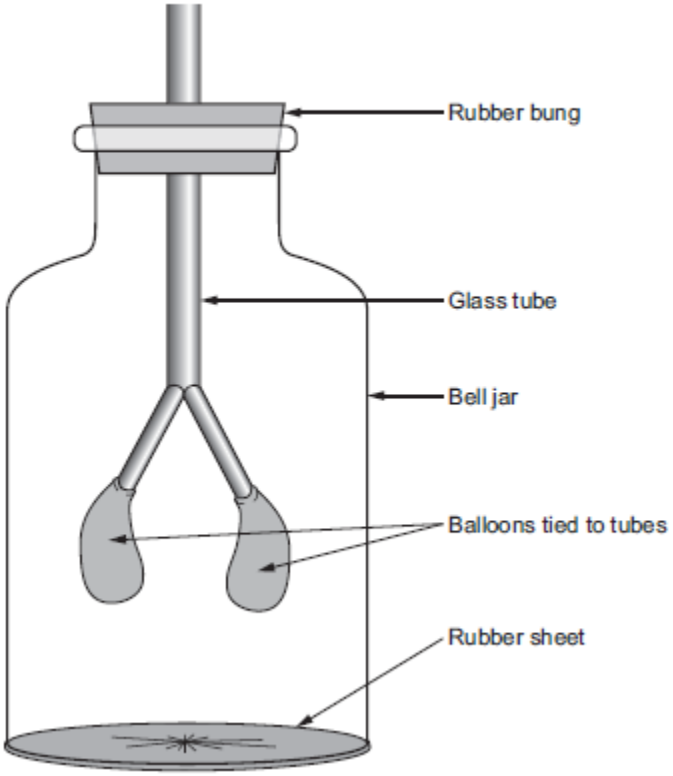
(b) A model of the respiratory system is shown below.



(i) Which of the labelled structures must move to cause air to pass in? [1]

.....

(ii) What part of the respiratory system is represented by:

I the glass tube; [1]

.....

II the balloons? [1]

.....

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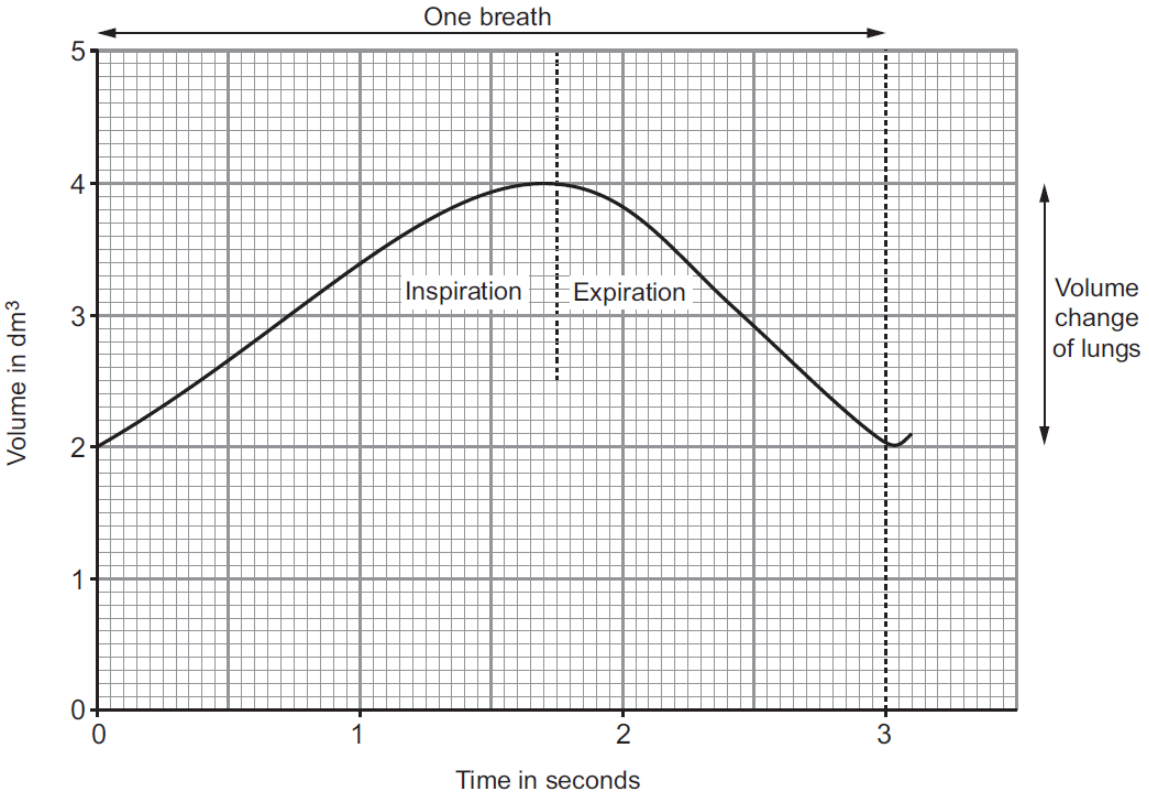
(c) The graph below represents the change in volume of the lungs during deep breathing.



Using the graph above:

(i) Calculate the volume of air taken into the lungs during one breath. [1]

volume of air = ... dm^3

(ii) Air entering the lungs contains 20 % oxygen. Calculate the volume of oxygen in **one** breath taken into the lungs. [2]

volume of oxygen = ...dm^3

11

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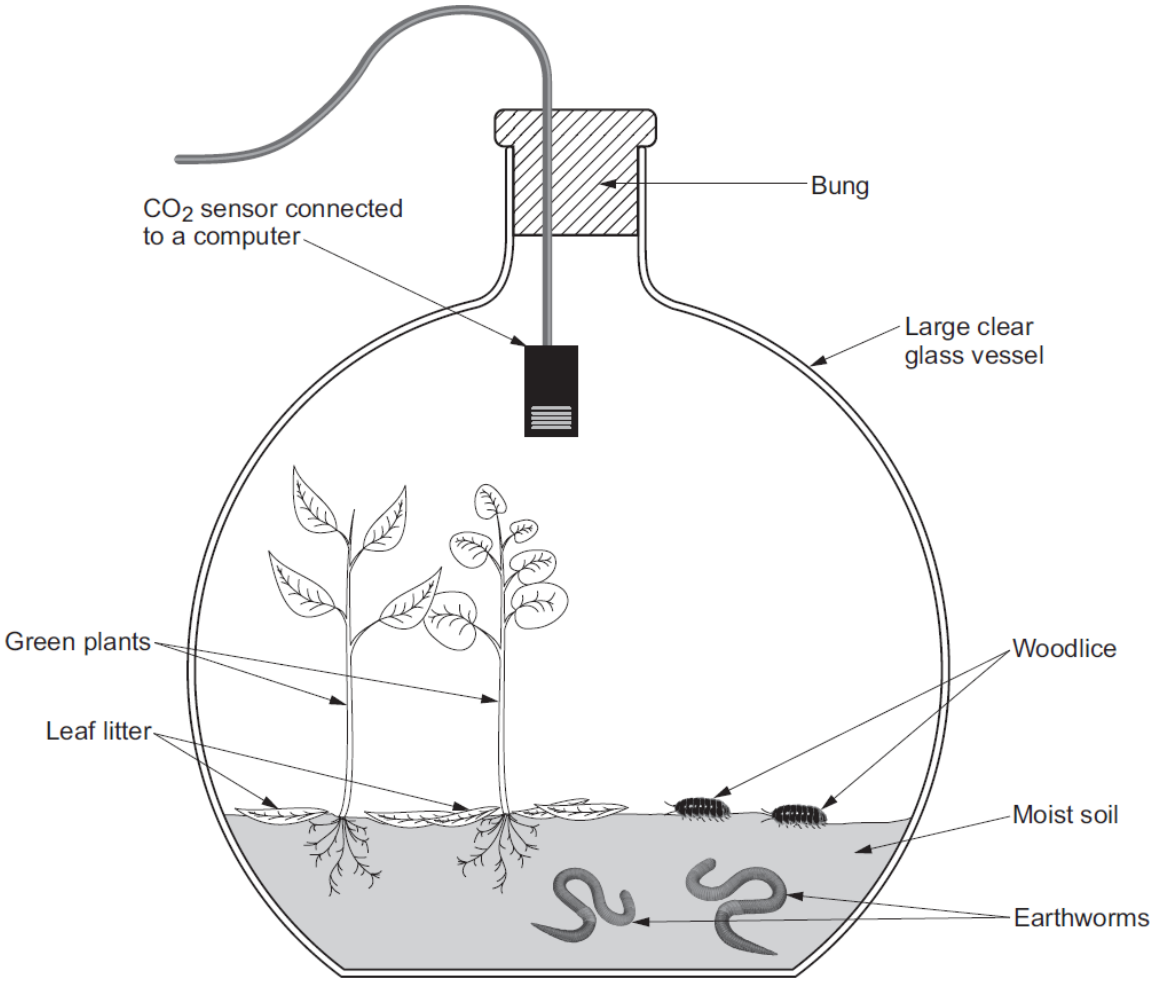
4. A "bottle garden" was set up in a school laboratory and kept near a window.

A carbon dioxide sensor was inserted as shown in the diagram and linked to a computer data logger so that the concentration of carbon dioxide could be monitored over a day.



(a) State the importance of the: [2]

(i) bung;

.....

(ii) clear glass to the plants.

.....

(b) Give **two** ways in which the plants in the bottle garden are important to the animals. [2]

.....

.....

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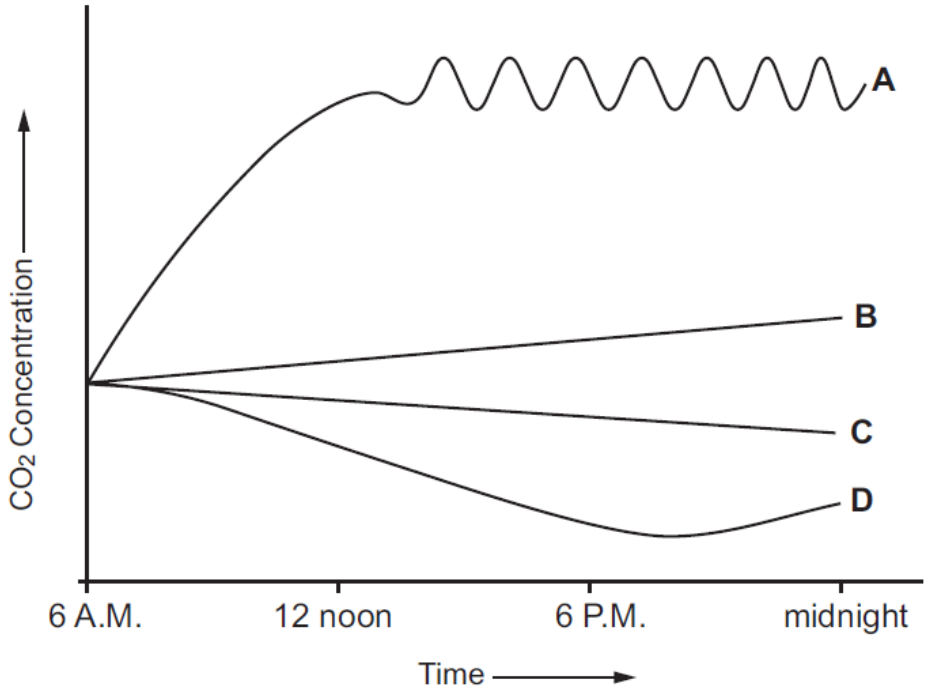
(c) The graph shows the changes in carbon dioxide concentration in the bottle garden over a period of time under different conditions.



(i) Which line (**A** - **D**) best shows the change in carbon dioxide concentration in the bottle garden during the day? [1]

.....

(ii) If the bottle garden was covered by a black cloth, which line (**A** - **D**) would represent the carbon dioxide concentration during a day? [1]

.....

6

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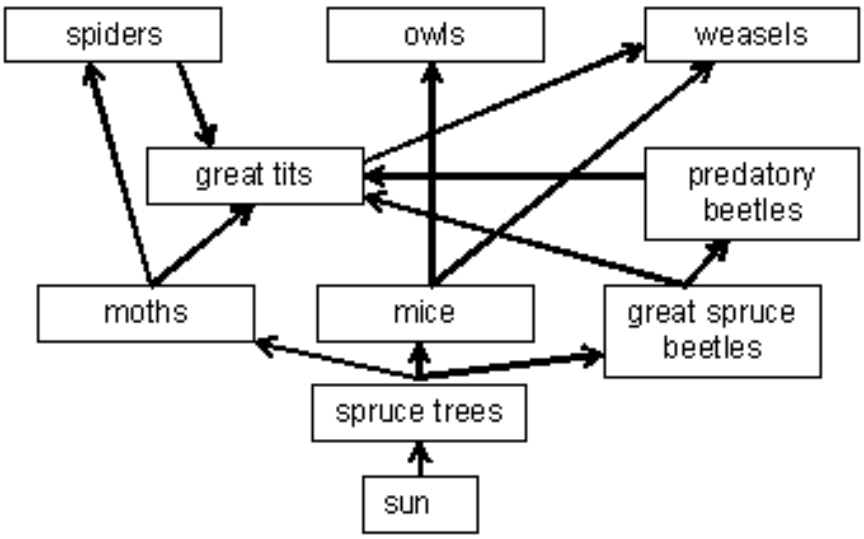
5. In the 1980s most of Wales' forestry plantations were made up of spruce trees, (*Picea abies*). In 1982, an insect pest - the great spruce beetle, (*Dendroctonus micans*) was accidentally introduced and quickly spread through the spruce forests. Biologists began a method of control by releasing 500 pairs of predatory beetles from Russia, (*Rhizophagus grandis)*, in the spruce forests. This beetle had proved to have been very successful at controlling the great spruce beetle in Russia.

(a) Give **one** reason why this method of control is more environmentally friendly than using pesticides. [1]

.....

(b) The following is a simplified food web for a spruce plantation after the release of the predatory beetle.



Use the food web shown to help you state, with a reason, what you would expect to be the effects of releasing the predatory beetles on:

(i) mice ..... [2]

reason

.....

(ii) great tits ..... [2]

reason

.....

(iii) the owls ..... [2]

reason

.....

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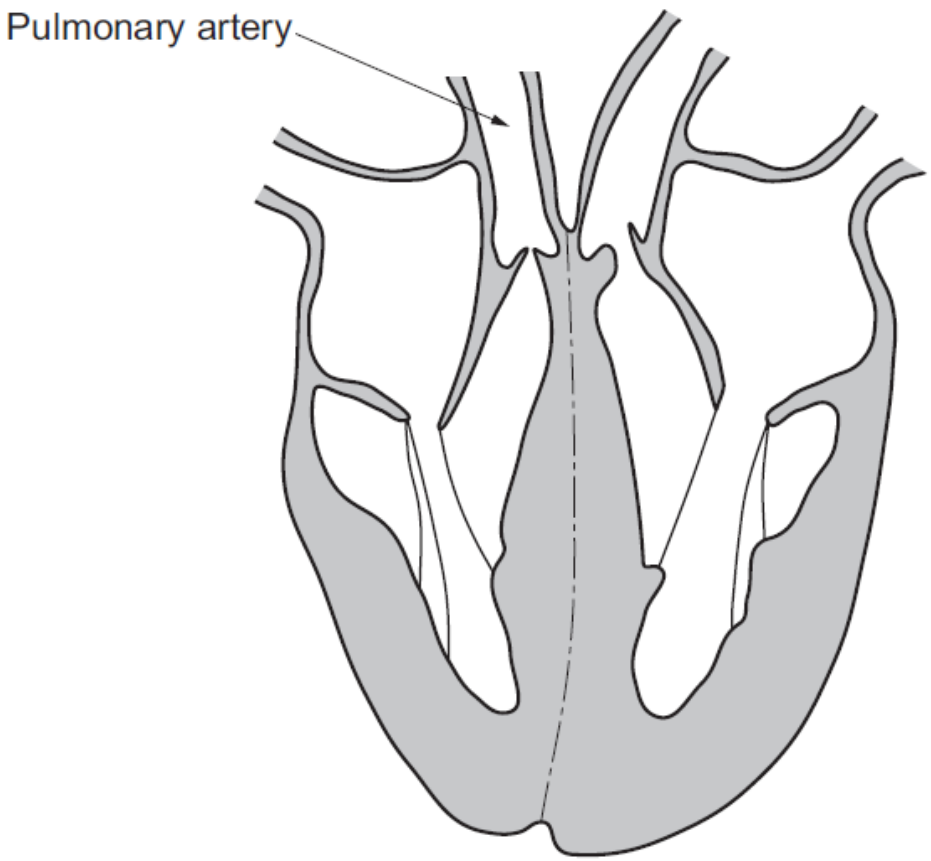
6. The diagram shows a section through a human heart.



(a) (i) **Label** the following structures **on the diagram above:** [2]

I left atrium;
II aorta;
III vena cava;
IV right ventricle.

(ii) State **one** way in which the blood carried in the pulmonary artery is different to that carried in all other arteries in the body. [1]

.....

(iii) Why is the wall of the left ventricle more muscular than the right? [1]

.....

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(b) The following table shows the pulse rate (rate of heart beat) of a group of year 11 students, which had been measured over different periods of time. Heart rate has been calculated for some of them.

Name of student	**Gender**	**Pulse rate**	**Heart rate (beats per minute)**
Gareth	male	41 beats in 30 seconds	82
Colin	male	178 beats in 2 minutes	……
Mary	female	80 beats in 1 minute	80
Alan	male	16 beats in 10 seconds	96
Tracy	female	36 beats in 30 seconds	……..
Cathy	female	228 beats in 3 minutes	76
Tom	male	85 beats per minute	85

(i) Calculate the heart rate for Colin and Tracy. **Write** your answers in the table. [2]

(ii) What conclusion could be reached regarding the effect of gender on the pulse rate of the students? [1]

.....

.....

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(c) The table below shows the rate of blood flow to the heart muscle and to the leg muscles at rest and during running.

	Rate of blood flow (cm^3/ minute)	
Organ	**At rest**	**During exercise**
heart muscle	250	350
leg muscles	1200	4500

Explain why the changes in blood flow are important during exercise. [4]

.....

.....

.....

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.....

.....

11

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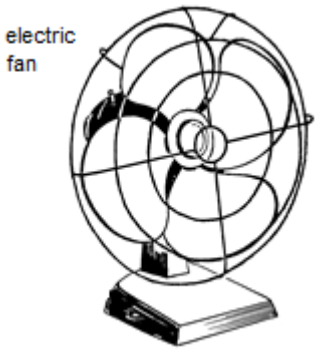
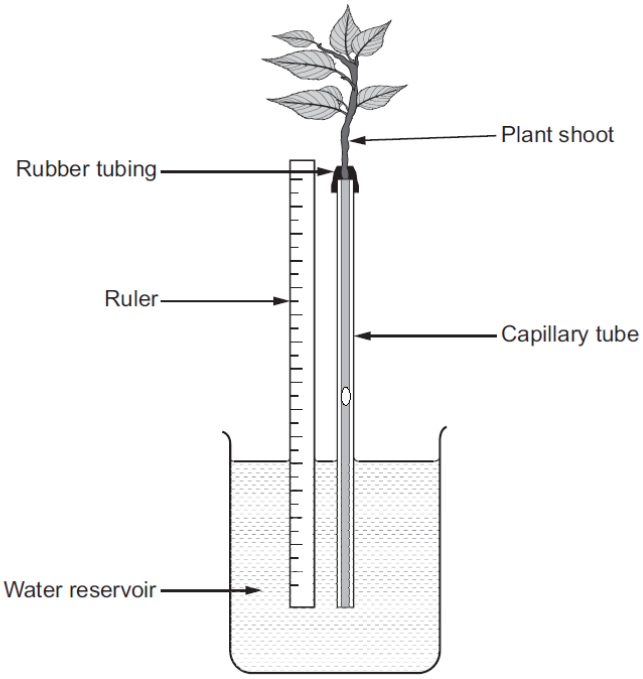
7. Using the apparatus shown in the diagram, describe how you would measure the rate of transpiration in the plant shoot in still and moving air. [6 QER]





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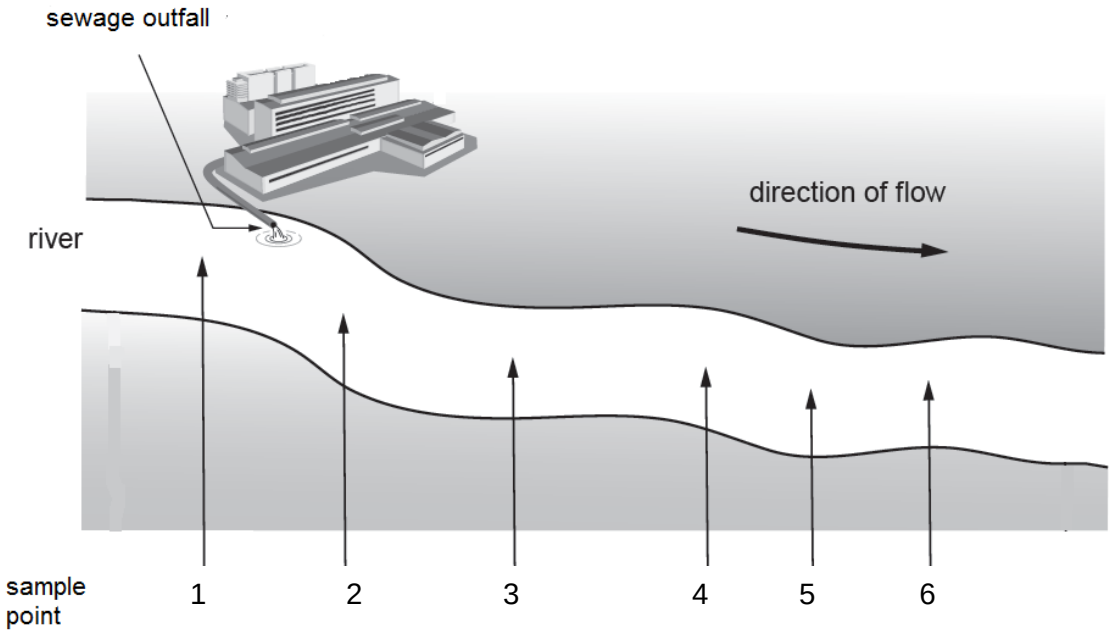
8. Samples of water were taken from a river at a sewage outfall and at a number of points downstream from the outfall as shown in the diagram below.



The table shows the oxygen concentration of the water at each of the sample points.

Sample point	Oxygen concentration (arbitrary units)
1	0.10
2	0.04
3	0.20
4	0.40
5	1.00
6	1.28

(a) The oxygen concentration is twice as great at sample point **4** compared with sample point **3**. Calculate how many times greater is the oxygen content at sample point **3** compared with sample point **2**? [1]

answer = ……times greater

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(b) Explain what happens to the oxygen content of the water as the distance from the outfall increases. [2]

.....

.....

.....

(c) Identify the sample point at which you would expect there to be the least variety of species. Give a reason for your answer. [2]

Sample point .....

Reason .....

.....

.....

(d) What term is used to describe a species whose presence or absence may be used to show the level of pollution in a river? [1]

.....

6

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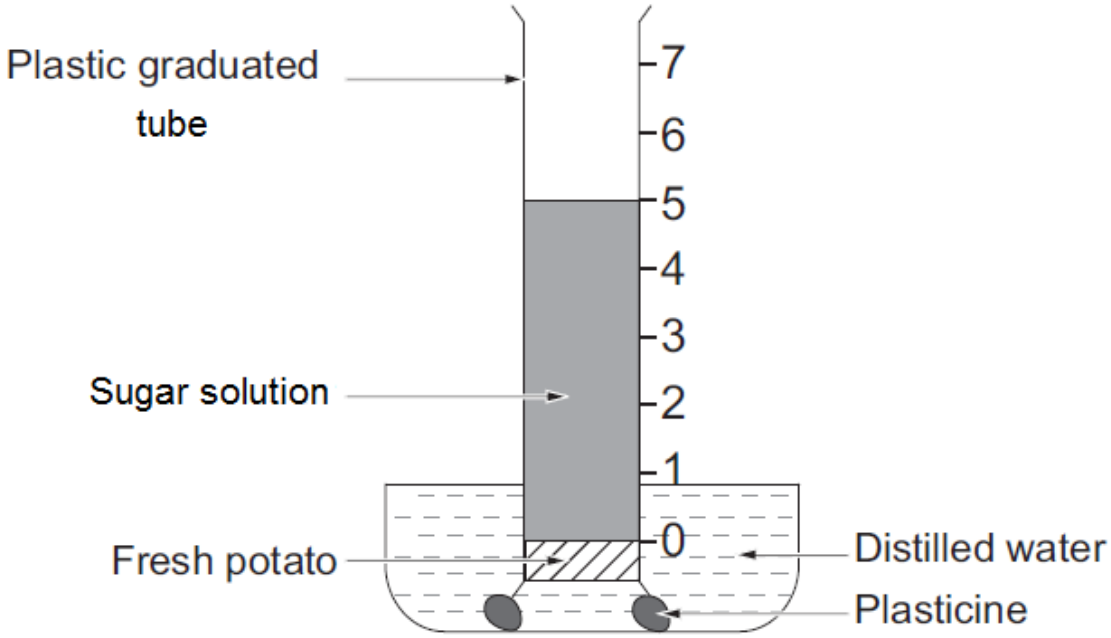
9. The apparatus below was used to investigate the movement of water through a cell membrane. 5 cm^3 of 1 M sugar solution was added to the graduated tube at the start of the investigation.



After 30 minutes, the volume of the sugar solution was measured. The procedure was repeated with 0.2 M sugar solution.

The results are shown in the table below.

Concentration of sugar solution (M)	**Volume of sugar solution at the start (cm^3)**	**Volume of sugar solution after 30 min (cm^3)**
1.0	5	7
0.2	5	5

(a) (i) Name the type of diffusion occurring in this experiment. [1]

.....

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(ii) Explain the results for:

I 1.0 M sugar solution; [4]

.....

.....

.....

II 0.2 M sugar solution.

.....

.....

.....

(b) A similar piece of apparatus was set up using **boiled** potato and 1.0 M sucrose solution. It was left for 30 minutes. Explain why all the sugar solution passed into the distilled water. [2]

.....

.....

.....

.....

7

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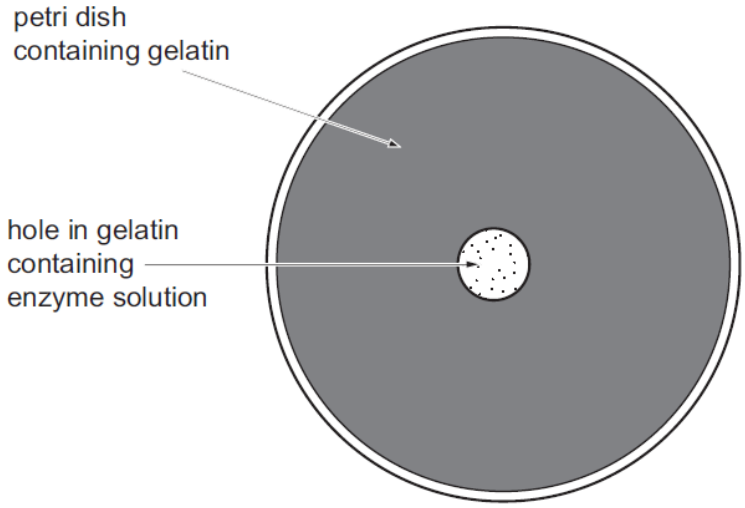
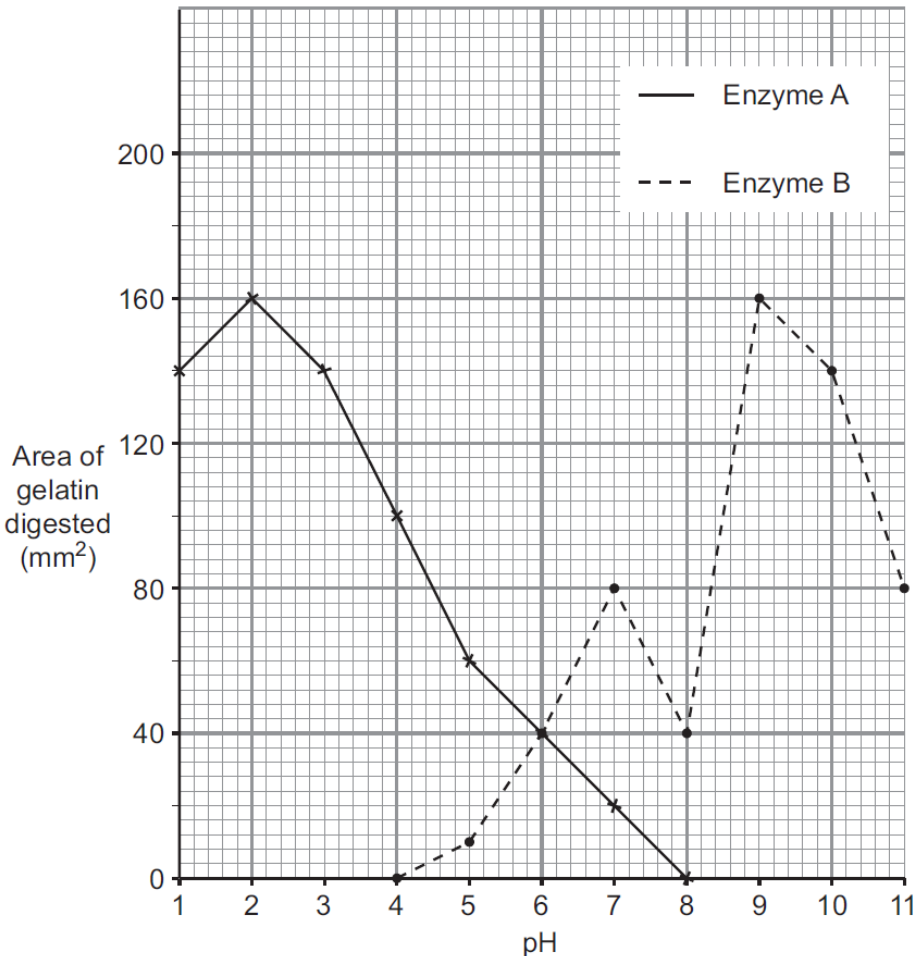
10. The effect of pH on the activity of two protein-digesting enzymes, **A** and **B**, was investigated. The enzymes, at the required pH, were placed in holes made in the middle of a layer of gelatin in separate Petri dishes as shown in the diagram. The procedure was carried out for enzymes **A** and **B** for a range of pH from 1 to 11.



Gelatin is a jelly made of protein.

After one hour, the activity of each enzyme was estimated by measuring the area of gelatin digested by the enzyme.

The results are shown in the following graph.



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(a) (i) At which pH were both enzymes equally active? ..... [1]

(ii) It was suspected that one of the results may have been due to experimental error. Identify this result. [1]

Enzyme .....

pH .....

(b) Name **three** parts of the human digestive system which produce protein-digesting enzymes. [3]

(I) .....

(II) .....

(III) .....

(c) Which part of the human digestive system produces enzyme **A**? Give a reason for your answer. [2]

.....

.....

.....

7

END OF PAPER

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UNIT 1: CELLS, ORGAN SYSTEMS AND ECOSYSTEMS
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

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Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			For each cell the correct organelles should be drawn in the correct location in the cell **Root cell:** nucleus (1) mitochondria (1) If chloroplast drawn and labelled (– 1). **Palisade cell:** Nucleus (1) Mitochondria (1) Chloroplasts (1) **Animal cell**: Nucleus (1) Mitochondria (1) If chloroplast drawn (-1)	7			7		
	(b)			**A** Cell wall (1) **B** Cell membrane (1)	2			2		
				Question 1 total	**9**	**0**	**0**	**9**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		60 ^{o}C		1		1	1	
		(ii)		0.5 g		1		1	1	
	(b)			20.0 x *60* x 4.2 (1) 1000 x *0.5* 10.1 kJ/g (1)	1	1		2	2	
	(c)			Insulate the apparatus/ use a calorimeter/ make sure all the food burns			1	1		1
	(d)	(i)		Black coffee		1		1		
		(ii)		No fat in skimmed milk		1		1		
		(iii)		Chocolate mocha with whole milk (1) has most fat (1) has most sugar (1)			3	3		
				Question 2 total	**1**	**5**	**4**	**10**	**4**	**1**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		Arrow pointing towards alveoli	1			1		
		(ii)		**A** Bronchiole (1) **B** Alveolus (1)	2			2		
		(iii)		**Any 2 x (1) from:** large surface area moist surface rich blood supply thin	2			2		
	(b)	(i)		Rubber sheet		1		1		
		(ii)		Trachea		1		1		
		(iii)		Lungs		1		1		
	(c)	(i)		2 [dm^3]		1		1	1	
		(ii)		2 x 20/100 (1) e.c.f from (i) 0.4 [dm^3] (1)		2		2	2	
				Question 3 total	**5**	**6**	**0**	**11**	**3**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		To keep it air-tight/ maintain sealed unit		1		1		1
		(ii)		Allow light in/ for photosynthesis		1		1		
	(b)			Provide oxygen (1) Provide food (1)		2		2		
	(c)	(i)		D		1		1		
		(ii)		B		1		1		
				Question 4 total	**0**	**6**	**0**	**6**	**0**	**1**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
5	(a)			No bioaccumulation/ build up of concentration/ more host specific/ does not kill useful insects		1		1		
	(b)	(i)		Increase (1) More spruce to eat (1)			2	2		
		(ii)		Decrease (1) No great spruce beetle to eat (1) **OR** Increase (1) More moths and more spruce trees to eat (1) Effect should link to the explanation, only award 'increase' or 'decrease' if explanation correct			2	2		
		(iii)		Increase (1) More mice to eat (1)			2	2		
				Question 5 total	**0**	**1**	**6**	**7**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		All labels correct (2) two labels correct (1)	2			2		
		(ii)		Carries deoxygenated blood/ less oxygen/ more carbon dioxide	1			1		
		(iii)		Needs to pump/force blood around the body	1			1		
	(b)	(i)		Colin 89 (1) Tracy 72 (1)		2		2	2	
		(ii)		Boys have higher rates than girls		1		1		
	(c)			Heart muscle needs more oxygen (1) to pump blood faster (1) Leg muscles need more oxygen (1) to release more energy (1) (to do more work)		4		4		
				Question 6 total	**4**	**7**	**0**	**11**	**2**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7				**Indicative content:** Note level of bubble to start. Leave for stated time. Note final level of bubble. Calculate rate. Use new air bubble (Squeeze plastic tubing to push air bubble out). Note level. Switch on fan. Leave for same time as before. Note level of bubble. Calculate rate. **5 – 6 marks** Detailed account including all steps in method and repeats. A clear explanation of how to calculate rate. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks** Account testing both still and moving air but without clear detail of how to calculate rate or mention of repeats *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** Basic account without reference to fan, repeats or calculation of rate. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. *The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	6			6		6
				Question 7 total	**6**	**0**	**0**	**6**	**0**	**6**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			5		1		1	1	
	(b)			Increases (1) because fewer microbes use it for respiration (1)			2	2		
	(c)			Point 2 (1) Least oxygen present (1)			2	2		
	(d)			Indicator (1)	1			1		
				Question 8 total	**1**	**1**	**4**	**6**	**1**	**0**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
9	(a)	(i)		osmosis	1			1		
		(ii)	I	For 1.0M water passed into sugar solution (1) from high water conc to lower water conc/down gradient (1).		2		2		2
			II	For 0.2M water passed in and out of potato at same rate (1) because inside and out is same (1)		2		2		2
	(b)			Boiling destroys SPM (1) so osmosis does not take place/solution can pass through (1)	2			2		2
				Question 9 total	**3**	**4**	**0**	**7**	**0**	**6**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		6		1		1	1	1
		(ii)		B at pH8		1		1	1	1
	(b)			Stomach (1) Pancreas (1) Small intestine (1)	3			3		
	(c)			Stomach (1) Digests most protein in acid pH (1)			2	2		
				Question 10 total	**3**	**2**	**2**	**7**	**2**	**2**

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FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	**9**	**0**	**0**	**9**	**0**	**0**
2	**1**	**5**	**4**	**10**	**4**	**1**
3	**5**	**6**	**0**	**11**	**3**	**0**
4	**0**	**6**	**0**	**6**	**0**	**1**
5	**0**	**1**	**6**	**7**	**0**	**0**
6	**4**	**7**	**0**	**11**	**2**	**0**
7	**6**	**0**	**0**	**6**	**0**	**6**
8	**1**	**1**	**4**	**6**	**1**	**0**
9	**3**	**4**	**0**	**7**	**0**	**6**
10	**3**	**2**	**2**	**7**	**2**	**2**
TOTAL	**32**	**32**	**16**	**80**	**12**	**16**

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Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

BIOLOGY

UNIT 1: CELLS, ORGAN SYSTEMS AND ECOSYSTEMS
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**7**	
3.	**7**	
4.	**5**	
5.	**16**	
6.	**9**	
7.	**7**	
8.	**5**	
9.	**7**	
10.	**5**	
11.	**6**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **11** is a quality of extended response (QER) question where your writing skills will be assessed.

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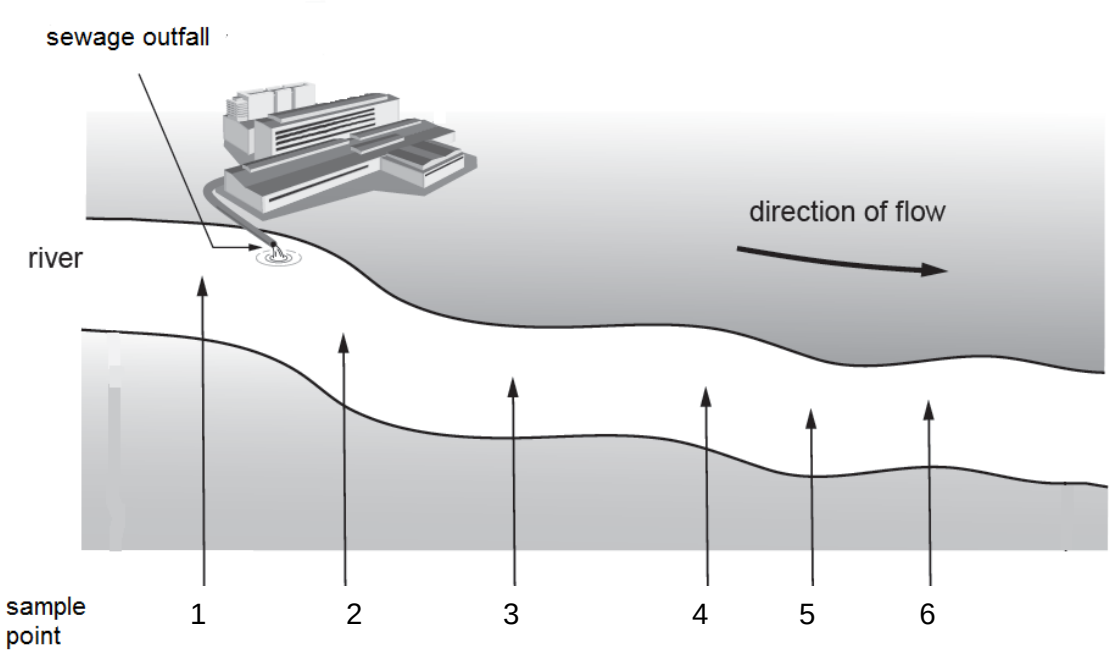
*Answer **all** questions*

1. Samples of water were taken from a river at a sewage outfall and at a number of points downstream from the outfall as shown in the diagram below.



The table shows the oxygen concentration of the water at each of the sample points.

Sample point	Oxygen concentration (arbitrary units)
1	0.10
2	0.04
3	0.20
4	0.40
5	1.00
6	1.28

(a) The oxygen concentration is twice as great at sample point **4** compared with sample point **3**. Calculate how many times greater is the oxygen content at sample point **3** compared with sample point **2**? [1]

answer = ……times greater

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(b) Explain what happens to the oxygen content of the water as the distance from the outfall increases. [2]

.....

.....

.....

(c) Identify the sample point at which you would expect there to be the least variety of species. Give a reason for your answer. [2]

Sample point .....

Reason .....

.....

.....

(d) What term is used to describe a species whose presence or absence may be used to show the level of pollution in a river? [1]

.....

6

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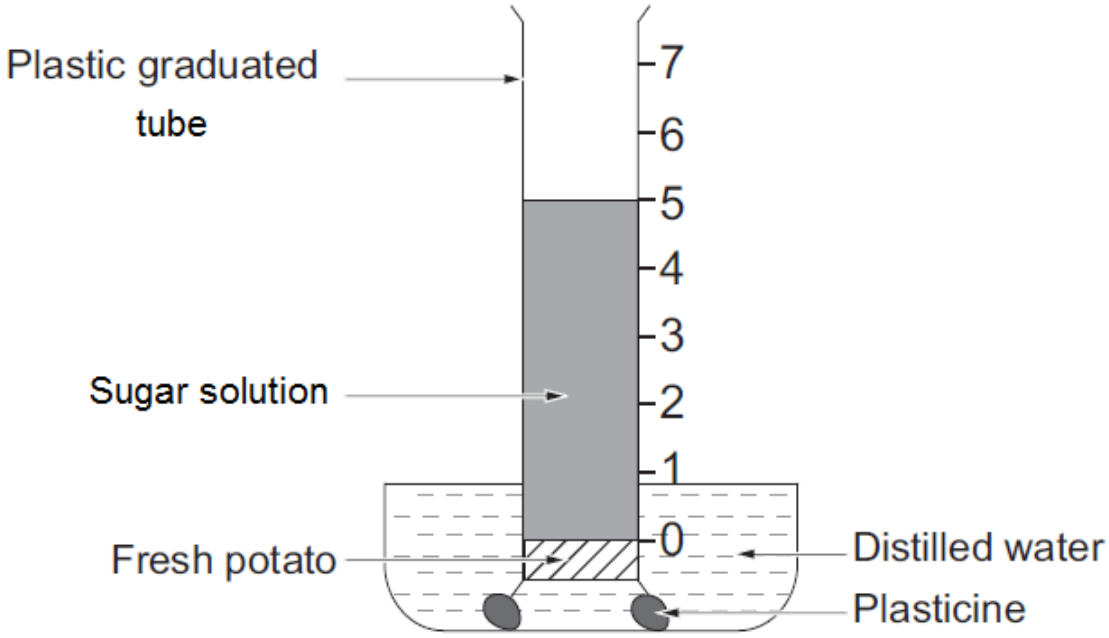
2. The apparatus below was used to investigate the movement of water through a cell membrane. 5 cm^3 of 1 M sugar solution was added to the graduated tube at the start of the investigation.



After 30 minutes, the volume of the sugar solution was measured. The procedure was repeated with 0.2 M sugar solution.

The results are shown in the table below.

Concentration of sugar solution (M)	**Volume of sugar solution at the start (cm^3)**	**Volume of sugar solution after 30 min (cm^3)**
1.0	5	7
0.2	5	5

(a) (i) Name the type of diffusion occurring in this experiment. [1]

.....

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(ii) Explain the results for:

I 1.0 M sugar solution; [4]

.....

.....

.....

II 0.2 M sugar solution.

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.....

(b) A similar piece of apparatus was set up using **boiled** potato and 1.0 M sucrose solution. It was left for 30 minutes. Explain why all the sugar solution passed into the distilled water. [2]

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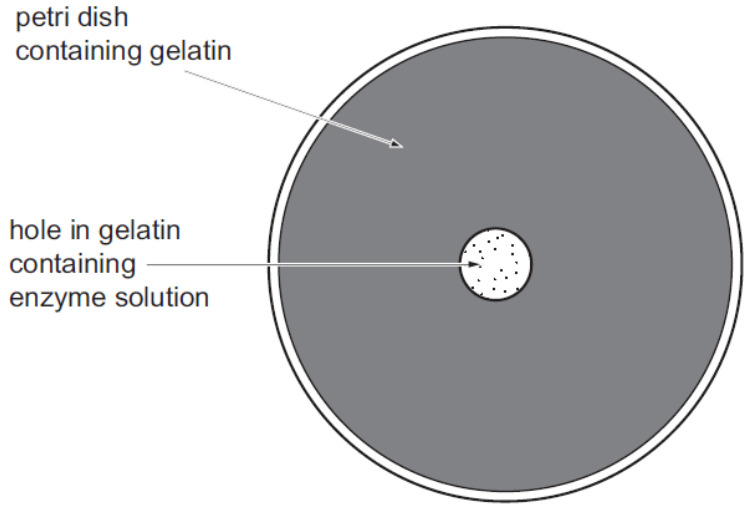
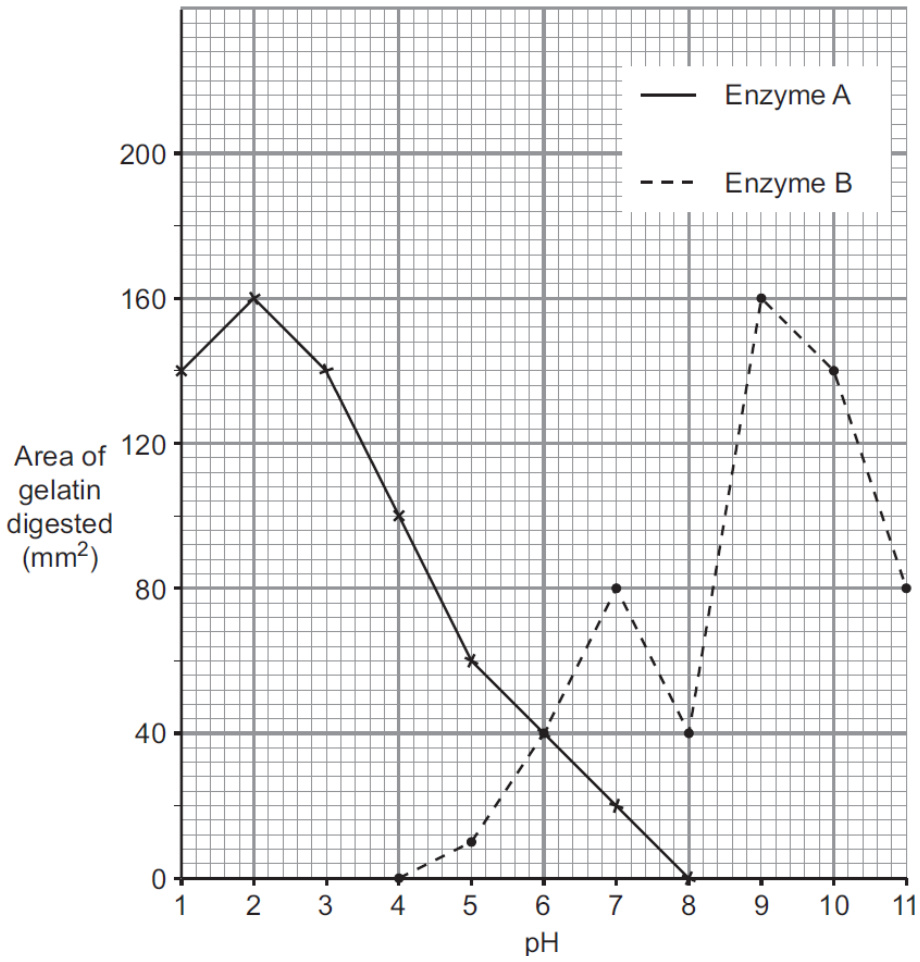
3. The effect of pH on the activity of two protein-digesting enzymes, **A** and **B**, was investigated. The enzymes, at the required pH, were placed in holes made in the middle of a layer of gelatin in separate Petri dishes as shown in the diagram. The procedure was carried out for enzymes **A** and **B** for a range of pH from 1 to 11.



Gelatin is a jelly made of protein.

After one hour, the activity of each enzyme was estimated by measuring the area of gelatin digested by the enzyme.

The results are shown in the following graph.



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(a) (i) At which pH were both enzymes equally active? ..... [1]

(ii) It was suspected that one of the results may have been due to experimental error. Identify this result. [1]

Enzyme .....

pH .....

(b) Name **three** parts of the human digestive system which produce protein-digesting enzymes. [3]

(I) .....

(II) .....

(III) .....

(c) Which part of the human digestive system produces enzyme **A**? Give a reason for your answer. [2]

.....

.....

.....

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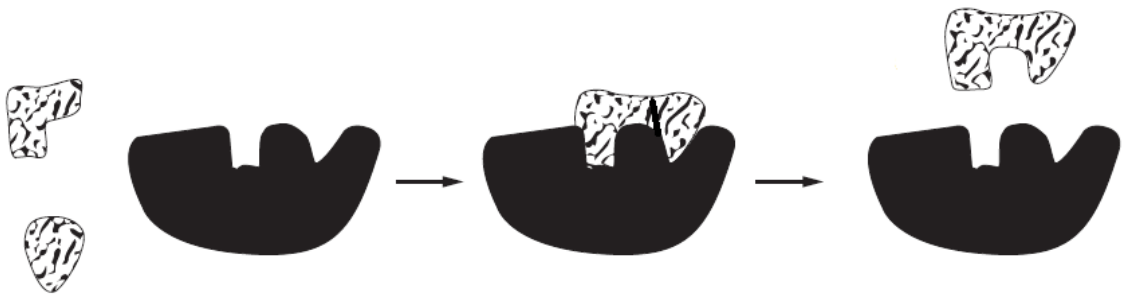
4. The following diagrams represent the molecules involved in the lock and key theory of an enzyme-controlled reaction.



(a) **On the diagrams** above **label** the: [4]

(i) active site;

(ii) product;

(iii) substrates;

(iv) enzyme-substrate complex.

(b) Underline the correct answer from the choices below. [1]

The enzyme-controlled process shown above represents the:

break down of starch into glucose

break down of fat into glycerol and fatty acid

build up of protein from amino acids

break down of protein into amino acids

5

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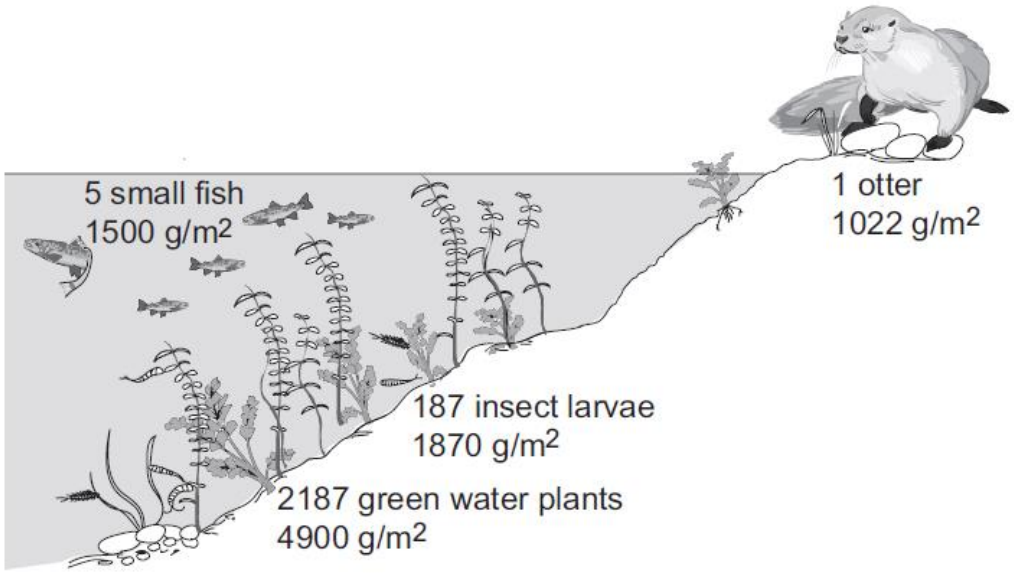
5. The diagram below shows all the organisms involved in a food chain in an aquatic environment.



(a) Use the information in the diagram to answer the following. [2]

(i) Calculate the ratio of the numbers of producers to the number of consumers to the nearest whole number.

Producers:Consumers = ... : .....

(ii) Draw a labelled pyramid of biomass in the space below for all the organisms labelled in the diagram. Your diagram should include each feeding level and the quantity of biomass it contains. [3]

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(b) Some people who kept American crayfish illegally released them into the lake. The crayfish are second stage consumers.

Describe and explain the expected effect this will have on **two** of the other living organisms shown in the diagram. [4]

.....

.....

.....

.....

.....

(c) A farmer sprayed pesticides on his crops growing near the lake. [2]

A few months later, dead fish were found in the lake. Explain what happened to cause the death of the fish.

.....

.....

.....

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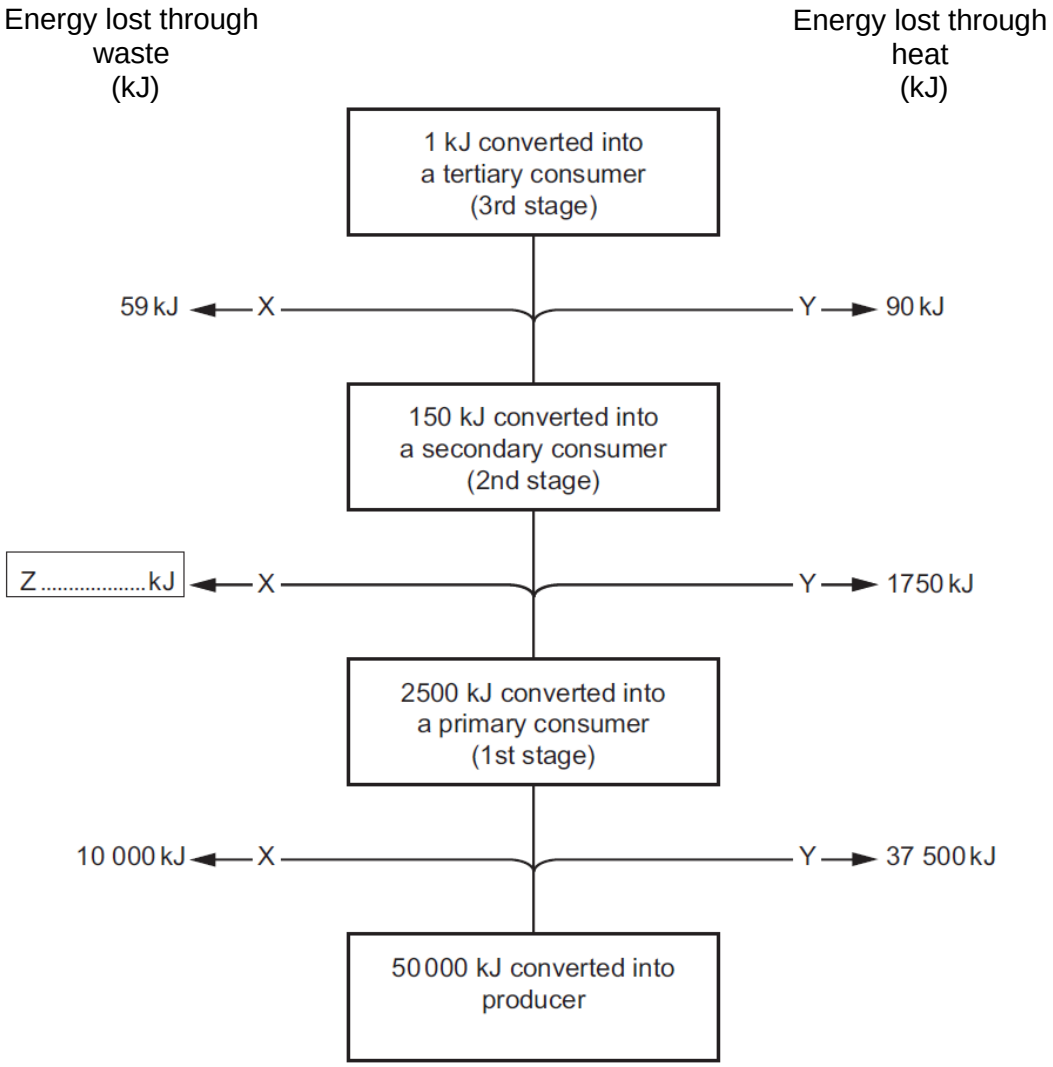
(d) The diagram shows the energy flow through the food chain in the lake.



(i) Calculate the value of **Z** to **complete the box** on the diagram. [1]

(ii) Calculate the percentage of the energy in the first stage consumer is transferred to the second stage consumer. [2]

Percentage of energy transferred = ...%

(iii) What processes in the consumers account for the energy flow represented by the letters **X** and **Y**? [2]

X ..... **Y** .....

16

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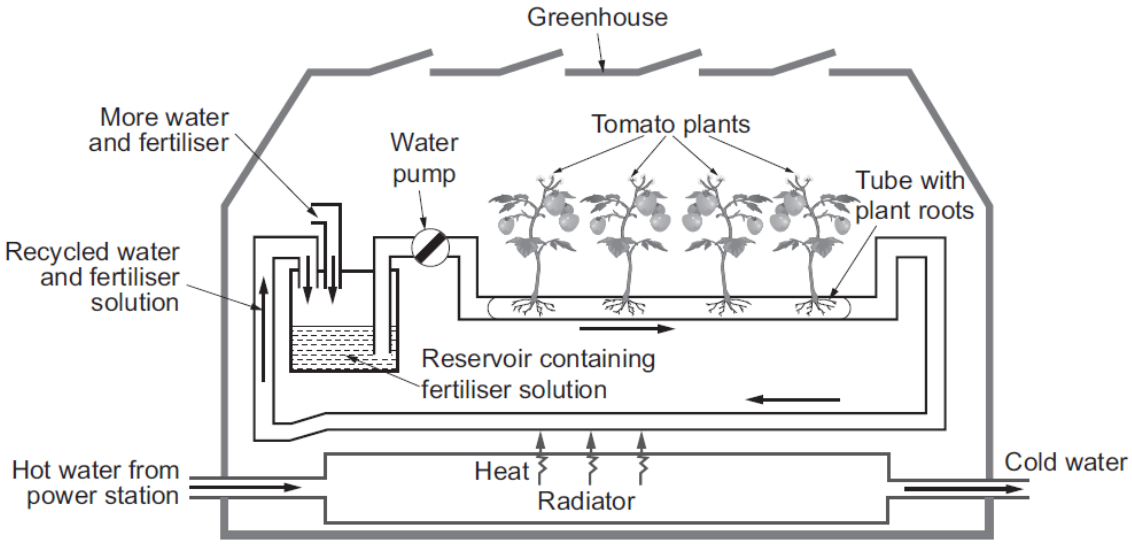
6. The diagram shows the production of tomatoes in large commercial greenhouses.



Domestic garden greenhouses are often heated using electricity. Water and fertiliser are given to the plants by people using watering cans.

(a) Suggest **two** reasons why the greenhouse shown in the diagram is more economical and efficient than the domestic garden greenhouse as described. [2]

(I) .....

.....

(II) .....

.....

(b) Why would more water have to be added to the recycled water? [1]

.....

.....

(c) What nutrients should be present in the fertiliser to prevent: [2]

(i) yellowing of the leaves;.....

(ii) poor root growth? .....

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(d) Explain why, when a petrol driven pump is used in a greenhouse, as shown in the diagram, even higher crop yields are possible. [2]

.....

.....

.....

(e) State **two** *other* ways to improve tomato production in the greenhouse shown. [2]

(I) .....

(II) .....

9

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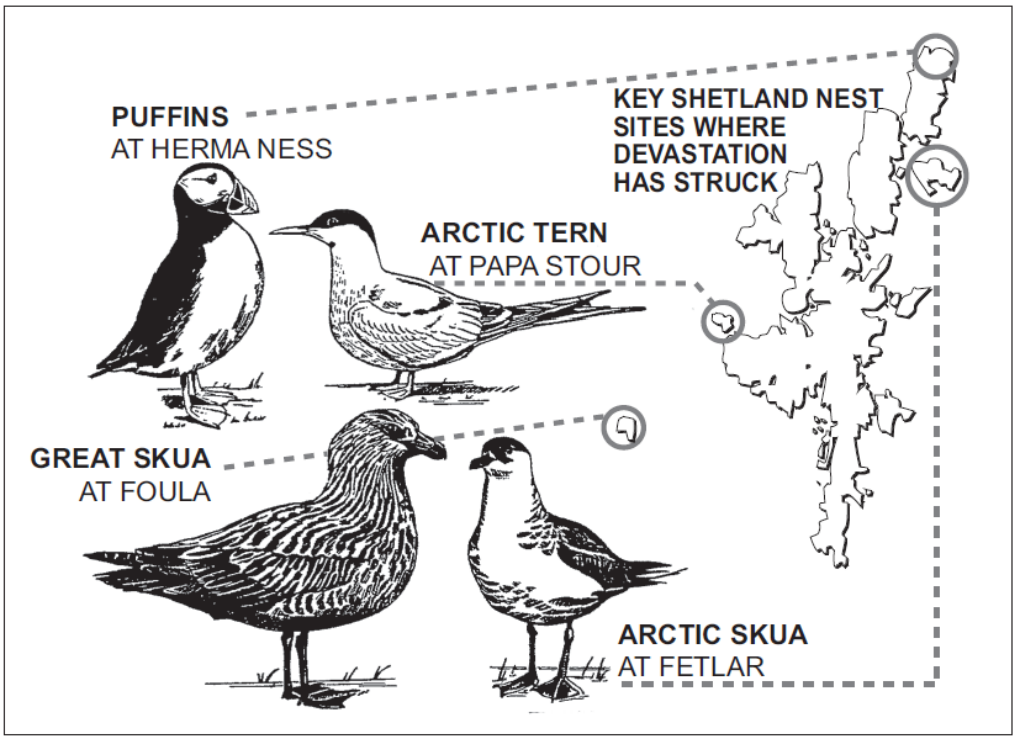
7. In 1974 sand eel fishing on a large scale began in the Shetland Isles. Sand eels are small fish which live in the sea. Sea birds feed on sand eels. In 1988, The Royal Society for the Protection of Birds published the following information.

Alert over Shetland's vanishing seabirds



On the Shetland Isles, the number of sea birds has been greatly reduced. Sand eels are caught in large numbers for use as food in dairy and fish farms on Shetland. The sand eel population has decreased rapidly.

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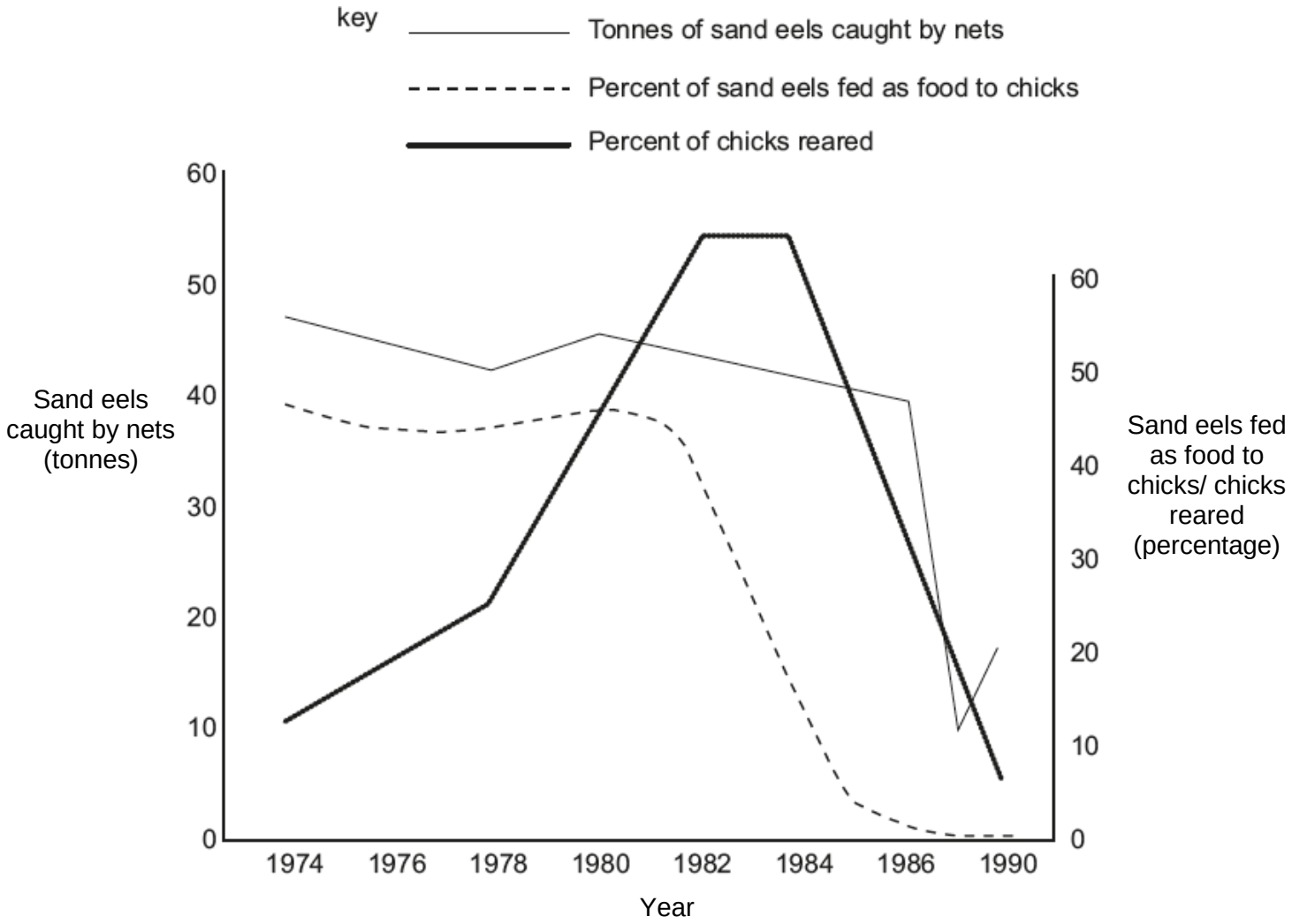
The following graphs show

- the tonnes of sand eels caught by net
- the percentage of sand eels fed to sea bird chicks
- the percentage of chicks successfully reared.



(a) Explain the effects that sand eel fishing might have had on the seabirds. [2]

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(b) In 1986 sand eel fishing near the Shetland Isles was banned, but still took place around nearby islands. Explain what would you expect to happen to the number of seabirds during the next 5 years. [1]

near the Shetland Isles;

.....

.....

around the nearby islands?

.....

.....

(c) What measure, other than banning sand eel fishing altogether, could be taken to ensure there is enough food to feed the chicks? [1]

.....

(d) The dairy farmers and fish farmers on Shetland claimed that there was no evidence to prove that sand eel fishing was to blame for the decrease in bird population. As a government scientist, describe how you would set up a long term experiment to obtain evidence? [3]

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8. An enzyme implant has successfully reduced the level of the fatty substance, cholesterol, in the blood of rabbits by 40% within 70 minutes. Scientists have developed a way of implanting the enzyme called PLA2 into humans. The enzyme breaks down the cholesterol and the products are taken out of the blood stream into the liver. Several drugs already on the market can be used to lower cholesterol levels but some of these have unwanted side effects.

(a) Name a group of drugs that are widely used to lower cholesterol in humans. [1]

.....

(b) Explain the effects of cholesterol on blood pressure in humans. [2]

.....

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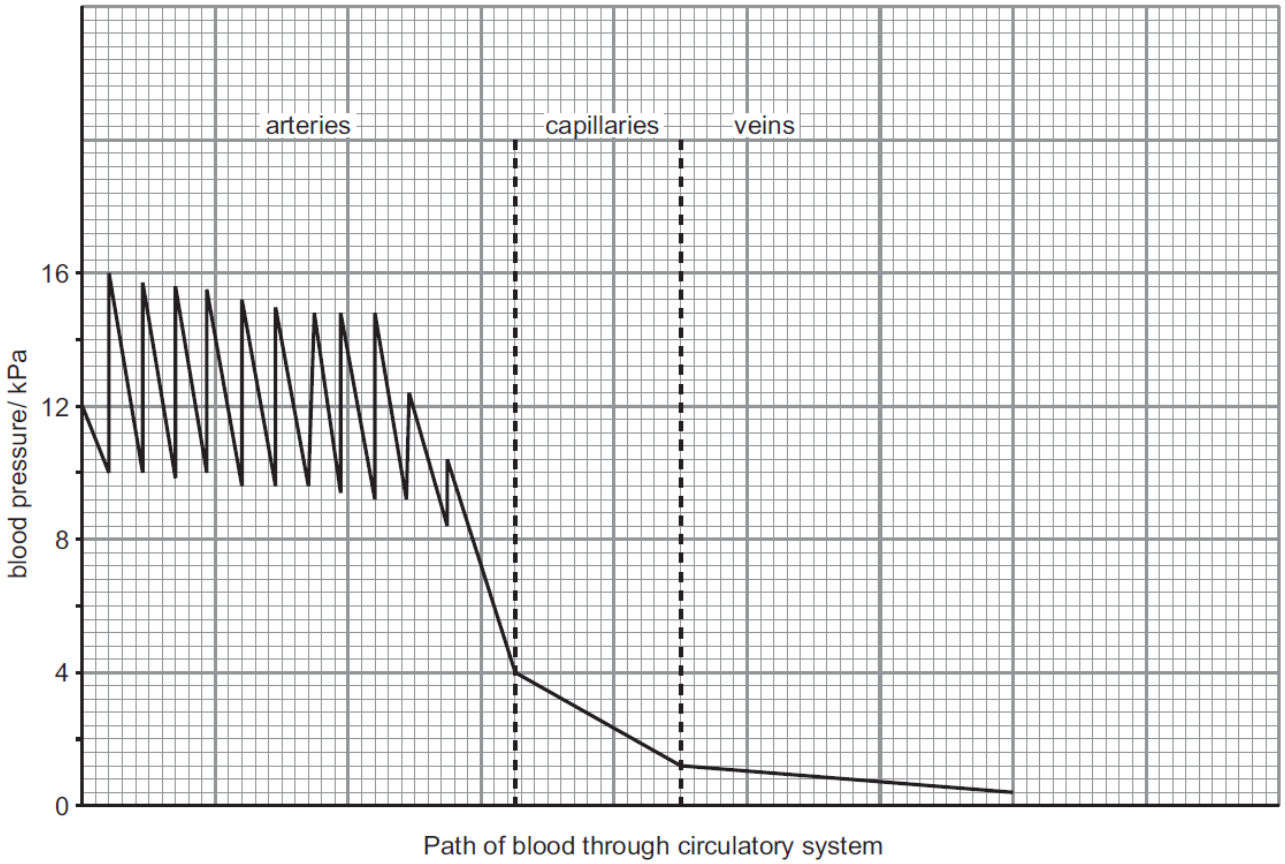
(c) The graph shows changes in blood pressure as blood flows through the circulatory system.



Explain the rise and fall of the blood pressure in the arteries shown in the graph. [2]

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.....

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9. When muscles contract, they change chemical energy into kinetic energy.

Strands of fresh muscle fibres (cells), measuring 20 mm x 2 mm were placed in ATP solution. After five minutes they were re-measured and the mean length calculated. The results are shown in the table:

Treatment	Mean original length (mm)	Mean final length (mm)
ATP Solution	20.0	16.0

(a) Calculate the mean percentage change in length of the muscle fibres when placed in ATP solution. [2]

mean percentage change in length = ...%

(b) Explain the results shown in the table. [2]

.....

.....

(c) The rate at which dissolved substances move across a cell membrane is directly proportional to the difference in concentration of the dissolved substance inside and outside the cell.

The difference in concentration is calculated using the following expression:

$$\frac{\text{concentration inside cell - concentration outside cell}}{\text{concentration outside cell}}$$

During exercise, the concentration of carbon dioxide inside the cell is 18 arbitrary units and the concentration outside is 3 arbitrary units.

(i) Calculate the difference in concentration of the carbon dioxide during exercise. [1]

difference in concentration = ... arbitrary units

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(ii) What effects will increasing the intensity of exercise have on [2]

I the difference in concentration of carbon dioxide inside and outside the muscle cell;

.....

II the rate of diffusion of carbon dioxide out of the muscle cell?

.....

7

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10. Scientists investigated the rates of absorption of different sugars by the small intestine as follows:

In one experiment they used a piece of intestine poisoned by cyanide. Cyanide is poisonous because it stops respiration in cells.

The results are shown in the table.

	Rates of absorption (arbitrary units)	
Type of Sugar	**Intestine without cyanide**	**Intestine with cyanide**
glucose	1.00	0.33
galactose	1.10	0.53
xylose	0.30	0.30
arabinose	0.29	0.29

(a) (i) Name **two** sugars from the table which can be absorbed by active transport. [1]

..... and .....

(ii) Use the evidence from the table to explain why you chose these sugars. [2]

.....

.....

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(b) All of the sugars named in the table can be absorbed by diffusion.

Explain how information from the table provides evidence for this. [2]

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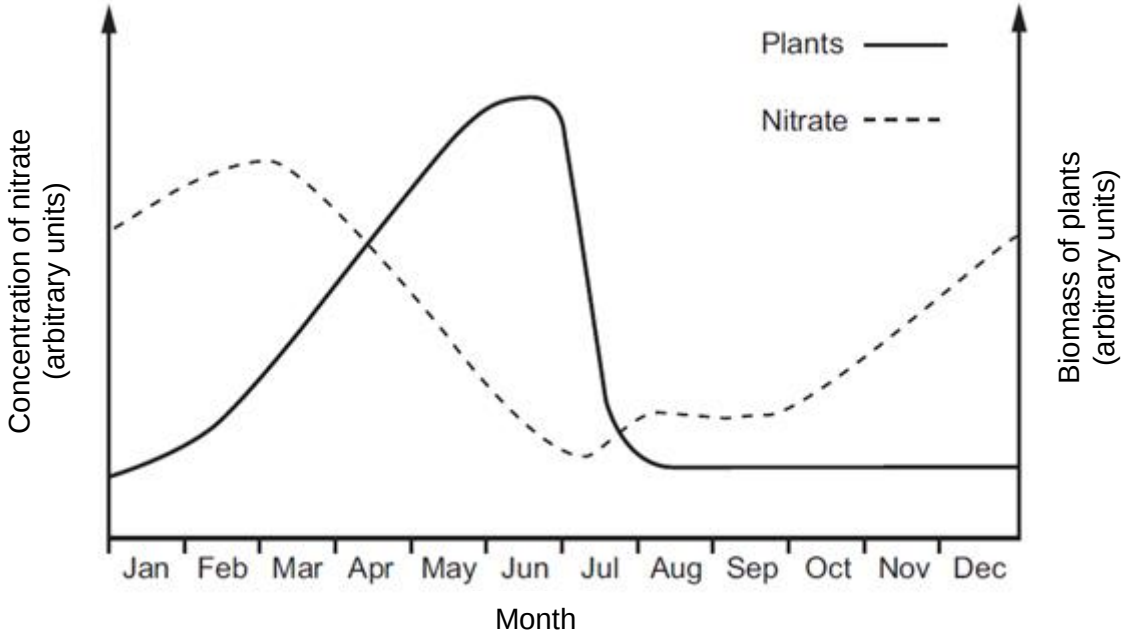
11. The graph shows how the biomass of plants in a **pollution-free** lake varies during one year, along with the concentration of nitrates in the water.



Explain fully the results shown in the graph between March and July. Account for the change in nitrate concentration after October. [6 QER]

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6

END OF PAPER

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UNIT 1: CELLS, ORGAN SYSTEMS AND ECOSYSTEMS
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

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Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			5		1		1	1	
	(b)			Increases (1) because fewer microbes use it for respiration (1)			2	2		
	(c)			Point 2 (1) Least oxygen present (1)			2	2		
	(d)			Indicator (1)	1			1		
				Question 1 total	**1**	**1**	**4**	**6**	**1**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		osmosis	1			1		
		(ii)	I	For 1.0M water passed into sugar solution (1) from high water conc to lower water conc/down gradient (1).		2		2		2
			II	For 0.2M water passed in and out of potato at same rate (1) because inside and out is same (1)		2		2		2
	(b)			Boiling destroys SPM (1) so osmosis does not take place/solution can pass through (1)	2			2		2
				Question 2 total	**3**	**4**	**0**	**7**	**0**	**6**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
3	(a)	(i)		6		1		1	1	1
		(ii)		B at pH8		1		1	1	1
	(b)			Stomach (1) Pancreas (1) Small intestine (1)	3			3		
	(c)			Stomach (1) Digests most protein in acid pH (1)			2	2		
				Question 3 total	**3**	**2**	**2**	**7**	**2**	**2**

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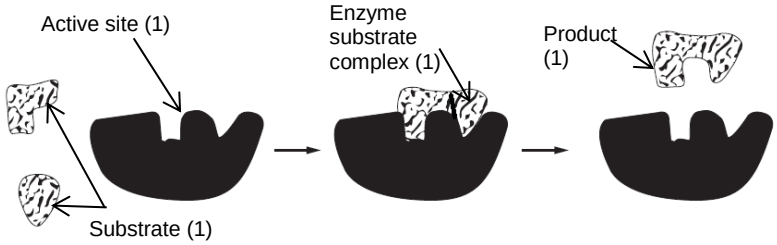
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)				4			4		
	(b)			Build-up of protein from amino acids	1			1		
				Question 4 total	**5**	**0**	**0**	**5**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		2187/193 (1) 11: 1 (1)		2		2	2	
		(ii)		Triangle or blocks showing correct sequence of masses (1) correct labels (1) correct unit (1)	3			3		
	(b)			**Any two (x 2) from:** Increase in plants (1) As less 1st stage consumers (1) **Or** Decrease in insect larvae (1) Being eaten by crayfish (1) **Or** Decrease in fish (1) Less food available (1) **Or** Decrease in otters (1) Less fish available (1)			4	4		
	(c)			Pesticide leached into lake/washed in by rain (1) Bioaccumulation/build up (1)	2			2		
	(d)	(i)		2500 – 1750 = 600 kJ (correct units)		1		1	1	
		(ii)		150 / 2500 x 100 (1) 6% (1)		2		2	2	
		(iii)		**X** Excretion (1) **Y** Respiration (1)	2			2		
				Question 5 total	**7**	**5**	**4**	**16**	**5**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Any 2 (x1) from:** Electricity is more expensive (1) Hand watering is labour intensive (or description) (1) Recycled water is more economical (1)	2			2		
	(b)			Water is lost by the plants through transpiration	1			1		
	(c)	(i)		Potassium	1			1		
		(ii)		Phosphate	1			1		
	(d)			Fossil fuel produces carbon dioxide (1) used in photosynthesis (1)		2		2		
	(e)			**Any 2 (x1) from:** Pest control (1) Permanent lighting (1) GM crops (1) Selective breeding (1)	2			2		
				Question 6 total	**7**	**2**	**0**	**9**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
7	(a)			Fewer sand eels to feed young (1) Fewer chicks reared (1)		2		2		
	(b)			*Near the Shetland Islands*: More chicks reared because more sand eels available **and** *Around the nearby islands*: Less chicks reared because number of sand eels would decrease			1	1		
	(c)			Limit catch/impose quotas/close season/restrict size of fish taken	1			1		
	(d)			Count numbers of breeding birds now (1) Ban sand eel fishing for a period of time (1- 2 years) (1) Count chicks successfully reared at end of ban (1)			3	3		3
				Question 7 total	**1**	**2**	**4**	**7**	**0**	**3**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			Statins	1			1		
	(b)			Cholesterol narrows the arteries by building up in them (1) This raises the blood pressure (1)		2		2		
	(c)			Contractions and relaxation of ventricle (1) Causes wave / pulse of blood passing through arteries/ cause muscles in walls of arteries to contact and relax (1)	2			2		
				Question 8 total	**3**	**2**	**0**	**5**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
9	(a)			$\frac{4}{20}$ x 100 (1) 20 (1)		2		2	2	2
	(b)			ATP provides energy (1) for contraction (1)	2			2		
	(c)	(i)		$\frac{18-3}{3} = 5$		1		1		
		(ii)	I	Increase		1		1		
			II	Increase		1		1		
				Question 9 total	**2**	**5**	**0**	**7**	**2**	**2**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		Glucose **and** galactose		1		1		1
		(ii)		Rate is reduced by poison (1) because active transport relies on respiration to release energy (1)			2	2		2
	(b)			Even when poison is added there is some absorption by **all** sugars (1) Diffusion does not require energy/respiration (1)		2		2		
				Question 10 total	**0**	**3**	**2**	**5**	**0**	**3**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
11				**Indicative content:** The concentration of nitrate decreases and the mass of plants increases because the plants absorb the nitrates to make protein and grow from March to June. More light, higher temperature, therefore more photosynthesis and plant growth from March to June. Drop of biomass in July because less nitrate available/most nitrate has been used. After October nitrate increases because plants die and decay. Bacteria convert protein into nitrate. **5 – 6 marks** Detailed description and explanation for all parts of graph correct. There *is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks** No mention of increase in photosynthesis from March to June no mention of protein being made from nitrates. Most of the other points should be mentioned. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** Some idea of changes related to months correct. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*		6		6		
				Question 11 total	**0**	**6**	**0**	**6**	**0**	**0**

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HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	**1**	**1**	**4**	**6**	**1**	**0**
2	**3**	**4**	**0**	**7**	**0**	**6**
3	**3**	**2**	**2**	**7**	**2**	**2**
4	**5**	**0**	**0**	**5**	**0**	**0**
5	**7**	**5**	**4**	**16**	**5**	**0**
6	**7**	**2**	**0**	**9**	**0**	**0**
7	**1**	**2**	**4**	**7**	**0**	**3**
8	**3**	**2**	**0**	**5**	**0**	**0**
9	**2**	**5**	**0**	**7**	**2**	**2**
10	**0**	**3**	**2**	**5**	**0**	**3**
11	**0**	**6**	**0**	**6**	**0**	**0**
TOTAL	**32**	**32**	**16**	**80**	**11**	**16**

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Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

BIOLOGY

UNIT 2: VARIATION, HOMEOSTASIS AND MICRO-ORGANISMS
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**7**	
3.	**8**	
4.	**7**	
5.	**6**	
6.	**5**	
7.	**4**	
8.	**6**	
9.	**6**	
10.	**6**	
11.	**5**	
12.	**5**	
13.	**3**	
14.	**7**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **10** is a quality of extended response (QER) question where your writing skills will be assessed.

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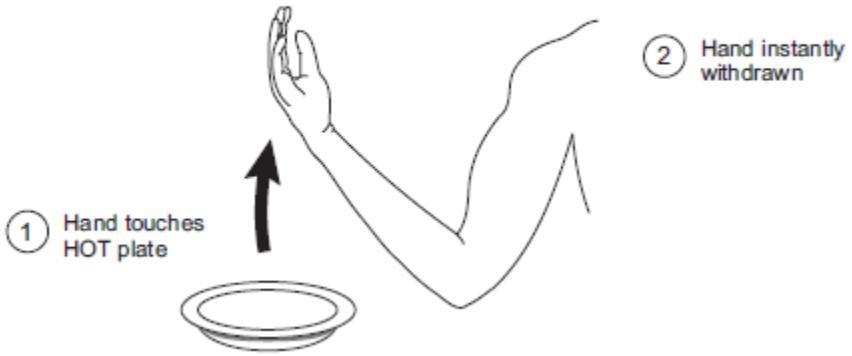
*Answer **all** questions*

1. The diagram shows an example of a nervous response.



(a) Name this type of nervous response. [1]

.....

(b) What is the purpose of the type of response shown in the diagram? [1]

.....

(c) Complete the sentences below using some of the words in the list. [3]

fast automatically nervous deliberately

These responses of the ..... system are very .....…

They happen ..... without thought.

5

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2. The photograph shows a species of leaf-eating beetle.

(a) The actual length of the beetle from the tip of the snout to the tip of the abdomen is 5 mm.

(i) Measure the length of the beetle in the photograph from the tip of the snout to the tip of the abdomen. [1]

length = ... mm

(ii) Calculate the magnification of the photograph. [1]

magnification = x .....

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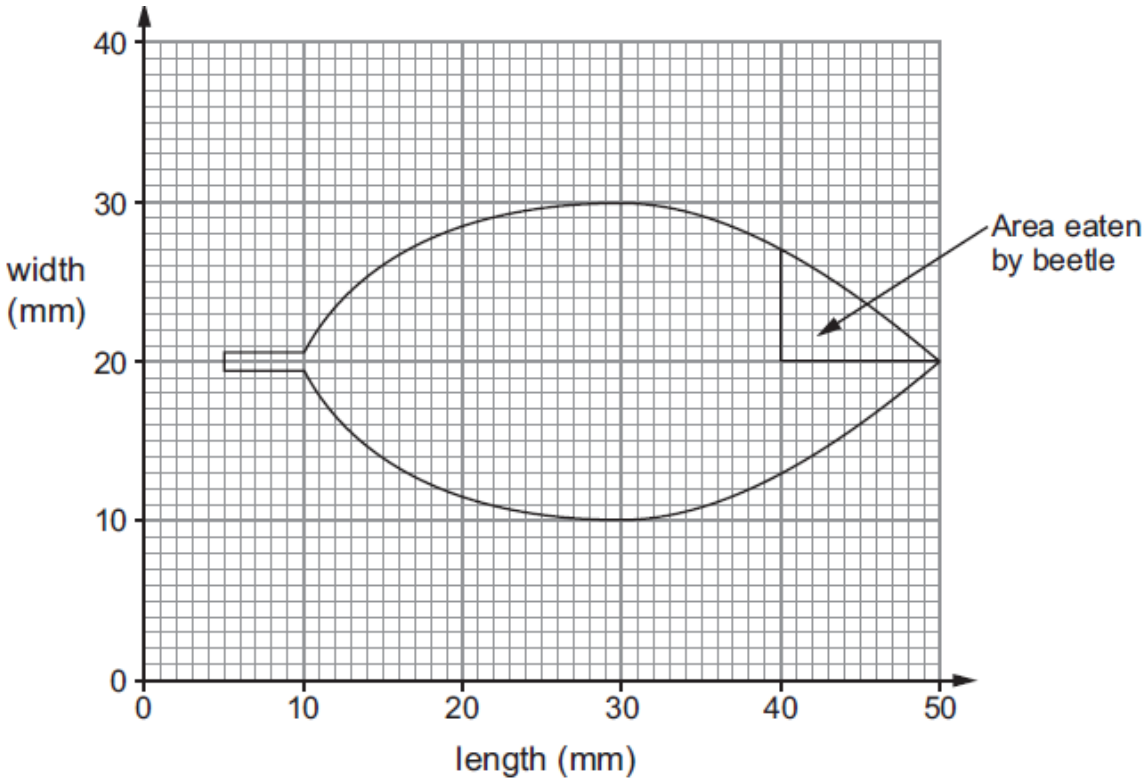
(b) This species of beetle was accidentally introduced to Fiji in the Pacific. The beetles ate the leaves of a rare plant. It was estimated that one of these beetles could eat the area of the leaf shown on the graph paper in five minutes.



Use the drawing of the leaf to estimate the area eaten. [2]

area = ...

units = ……..

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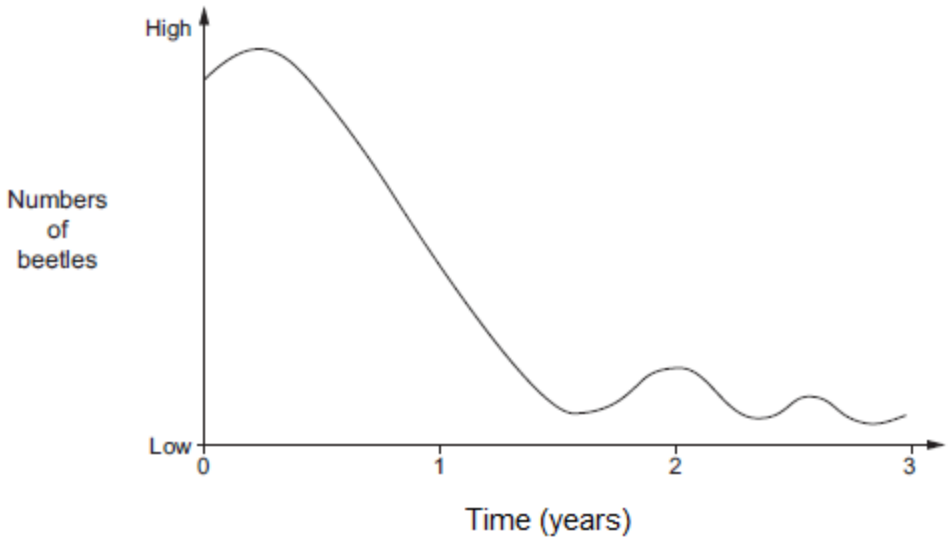
(c) A wasp was discovered which laid its eggs in the beetle eggs and killed the developing beetles.

A large number of these wasps were released in Fiji. The graph shows the effect of releasing the wasps on the number of beetles over a three year period.



Use the graph to select the most suitable statement from the list below. Underline your answer. [1]

After two years:

the beetles died out;

the wasps did not survive in Fiji;

the wasps were reducing the population of beetles;

the beetle did not have enough to eat.

(d) Name the method of control demonstrated by the use of the wasp. [1]

.....

(e) Suggest a problem that could arise by the introduction of the wasp to Fiji. [1]

.....

.....

7

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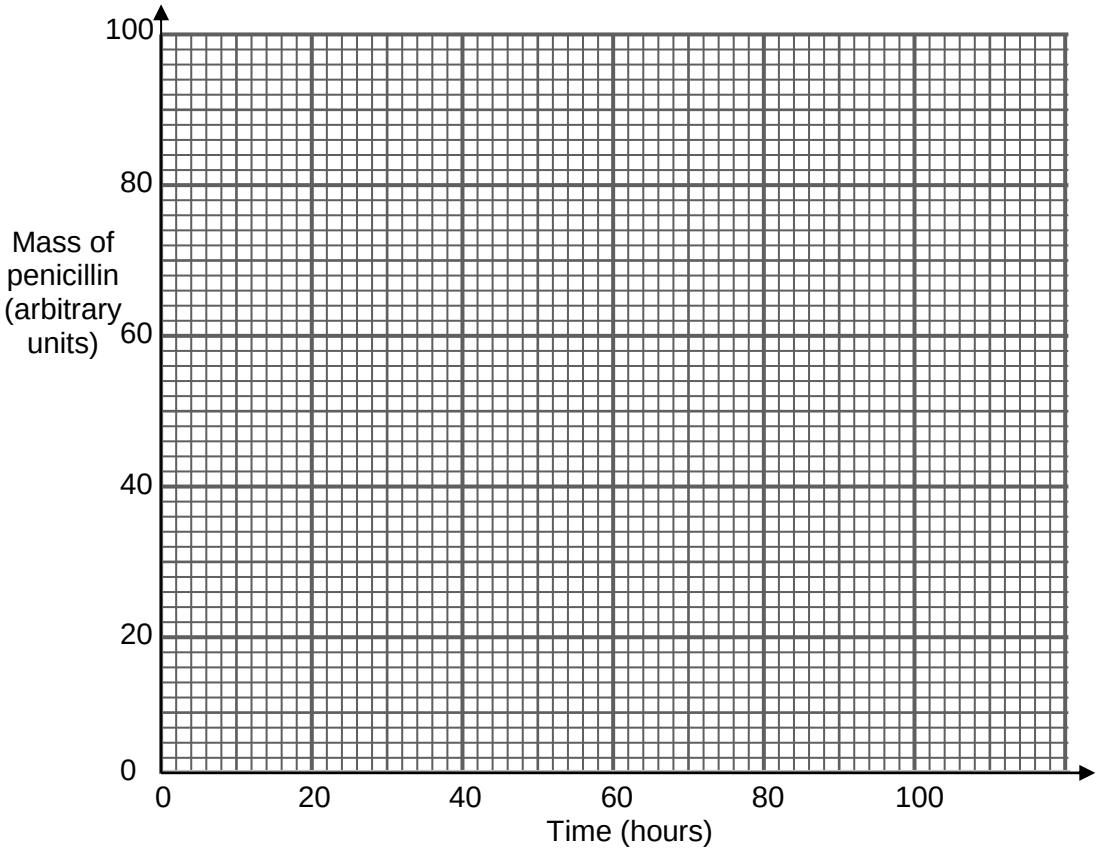
3. The antibiotic, penicillin, is produced by a fungus, *Penicillium*. Using *Penicillium* grown as a culture on a type of sugar, scientists measured the mass of penicillin produced over a period of seventy hours.

The results are shown in the table below:

Time (hours)	Mass of penicillin (arbitrary units)
20	0
30	4
40	12
50	43
60	67
70	67

(a) Plot the results on the grid below. Join the plots with a ruler. [3]



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(b) From the graph:

(i) State the mass of penicillin at 44 hours. [1]

mass = ... arbitrary units

(ii) What mass of penicillin was produced between 44 and 54 hours? [1]

mass = ... arbitrary units

(iii) After how many hours did the production of penicillin stop rising? [1]

……

(c) (i) How do antibiotics help in curing some diseases? [1]

.....

(ii) What problem can occur if antibiotics are over-used? [1]

.....

8

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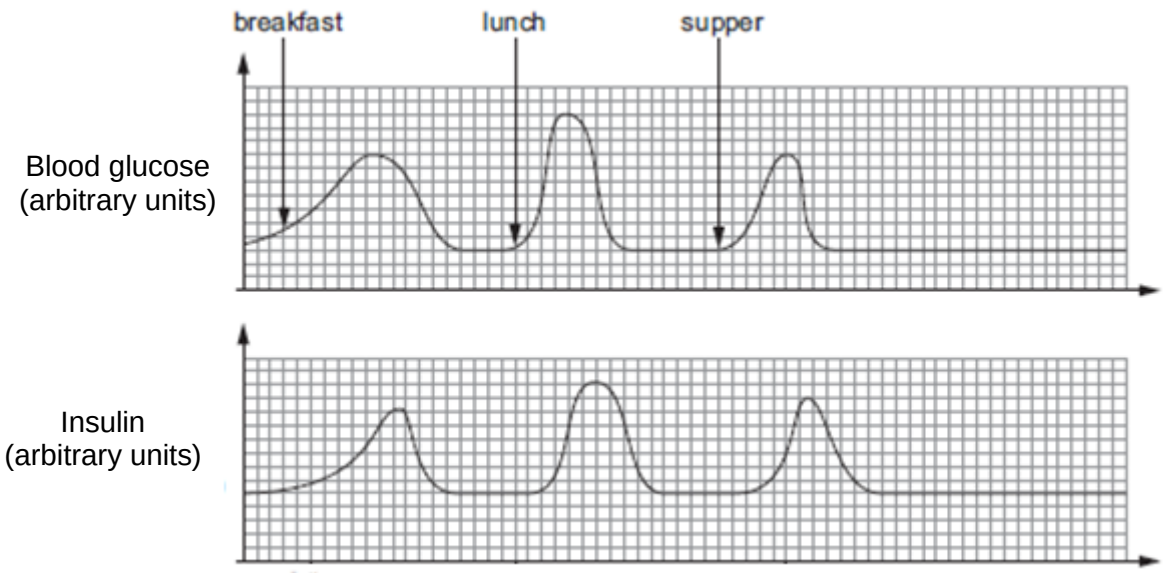
4. The graphs show the variation in the blood glucose and insulin concentrations in a person a day.



(a) State the effect of eating a meal on the concentration of: [2]

(i) blood glucose;

.....

(ii) insulin.

.....

(b) Explain how the pancreas helps to reduce blood glucose levels. [3]

.....

.....

.....

.....

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(c) Some people with diabetes have to inject insulin into their bodies. [2]

(i) What would be the effect of injecting too much insulin on the blood glucose concentration?

.....

(ii) How could the effect of injecting too much insulin be corrected?

.....

7

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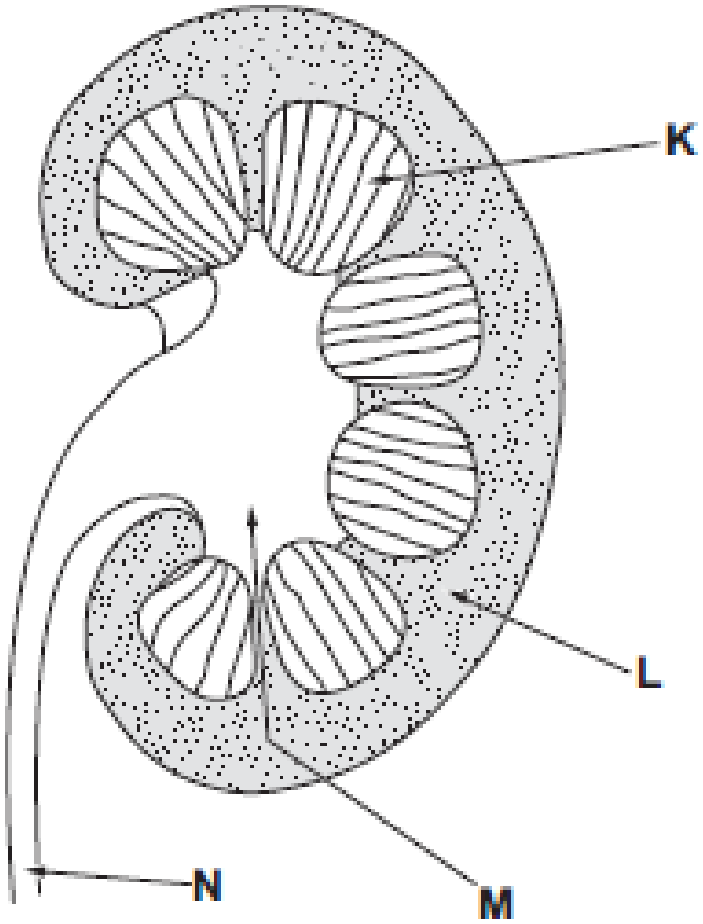
5. The diagram shows a section through a human kidney.



(a) Which letters (**K** – **N**) show the: [3]

(i) cortex .....

(ii) medulla .....

(iii) pelvis .....

(b) Complete the following statements, naming the structures in the excretory system. [3]

(i) Urine leaves the kidney through the .....

(ii) Urine is stored in the .....

(iii) Urine leaves the body through the .....

6

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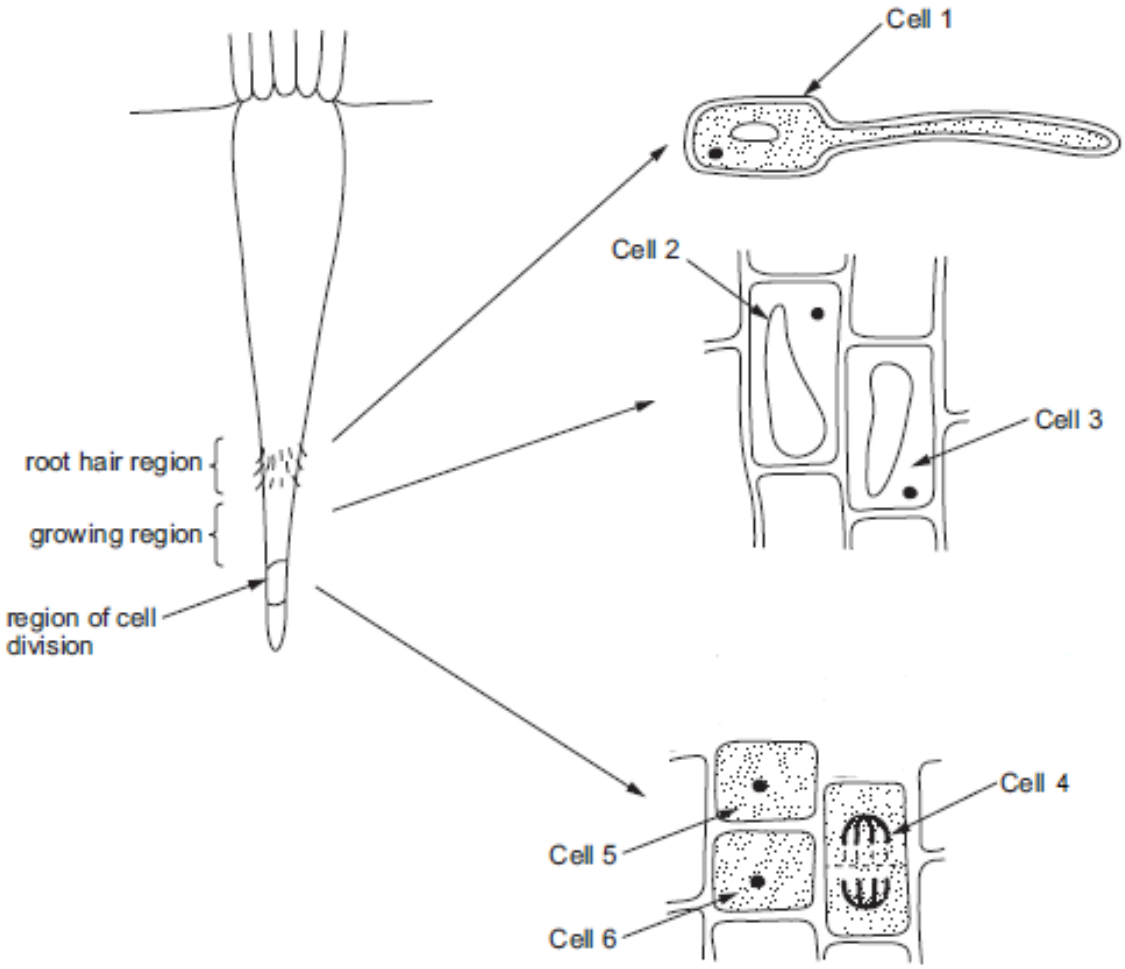
6. The diagrams shows some of the cells found in a root of a plant.



Use the numbers in the diagrams (**1** – **6**) to identify the following cells: [5]

(Any number can be used once, more than once, or not at all).

number(s)

(a) a cell which is dividing; .....

(b) the pair of cells which have just been formed by mitosis; .....

(c) the cell with the largest surface area; .....

(d) the oldest cell; .....

(e) the cell where chromosomes are visible. .....

5

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7. In fruit flies, the normal wing allele (**N**) is dominant to the small wing allele (**n**).

Normal wing

Small wing

(a) (i) Complete the Punnett Square below to show the results of a cross between a fly with normal wings and a fly with small wings. [1]

	N	**n**
n		
n		

(ii) What is the percentage of small winged flies in the offspring of this cross? [1]

.....

(b) Use the same letters as in part (a) and fill in the blanks to show two crosses which would **only** produce normal winged flies. [2]

(I) ..... x .....

(II) ..... x .....

4

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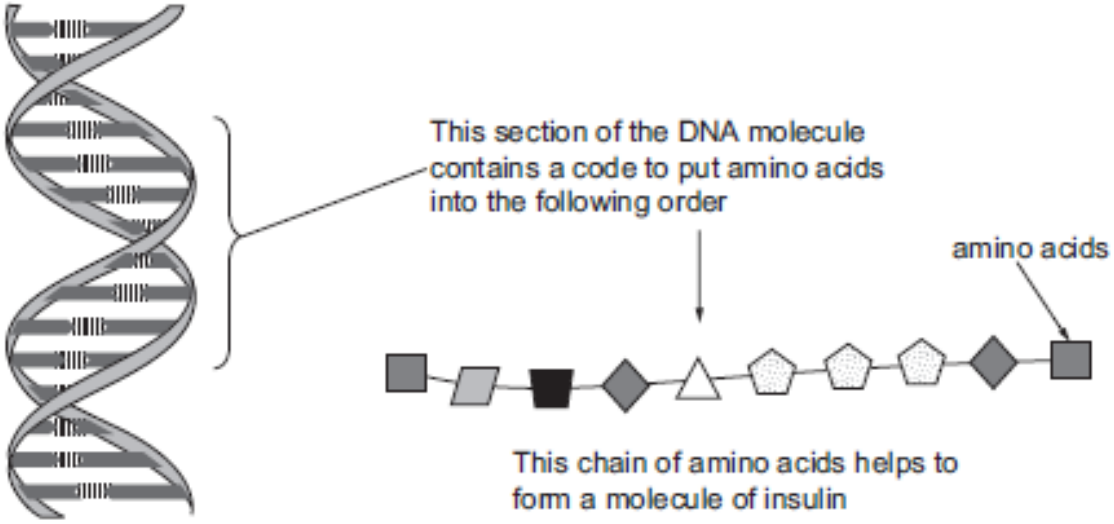
8. The diagram shows a part of a molecule of DNA.



(a) How many different types of bases are found in a DNA molecule? [1]

.....

(b) A person had a change in his DNA which resulted in him not being able to produce insulin. Instead of producing the chain of amino acids shown in the diagram above, he produced the following chain of amino acids.

(i) **Draw a circle** around the part of the chain of amino acids that shows the fault. [1]

(ii) What name is given to this change in the DNA? [1]

.....

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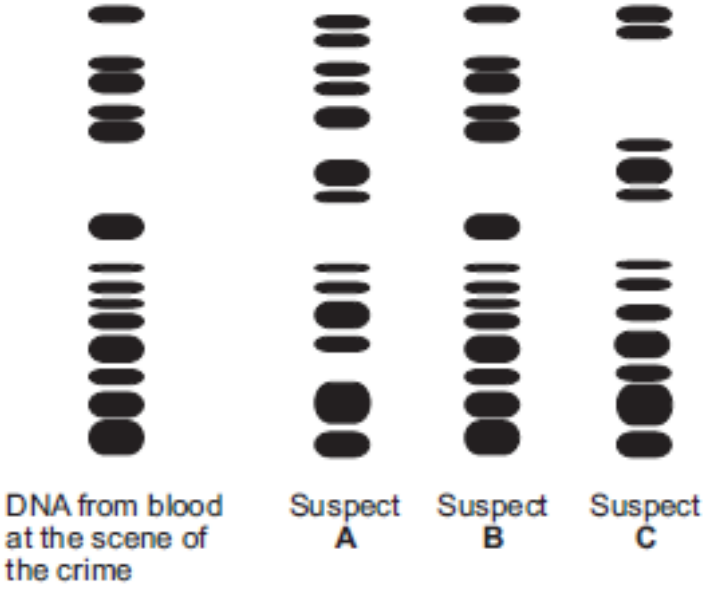
(c) In the 1980s, Professor Alec Jeffreys showed how genetic profiles could be used to identify crime suspects. He showed that genetic profiles can be used to compare the DNA of different people.

In 1988, DNA was taken from blood found at the scene of a crime. DNA samples were also taken from three suspects, A, B and C. The genetic profiles are shown below.



(i) Which suspect is most likely to have committed the crime? [1]

.....

(ii) Give a reason for your answer. [1]

.....

.....

.....

(d) In which of the following would the genetic profiles be exactly the same? Underline your answer: [1]

Two brothers;

Mother and daughter;

Identical twins;

Non-identical twins.

6

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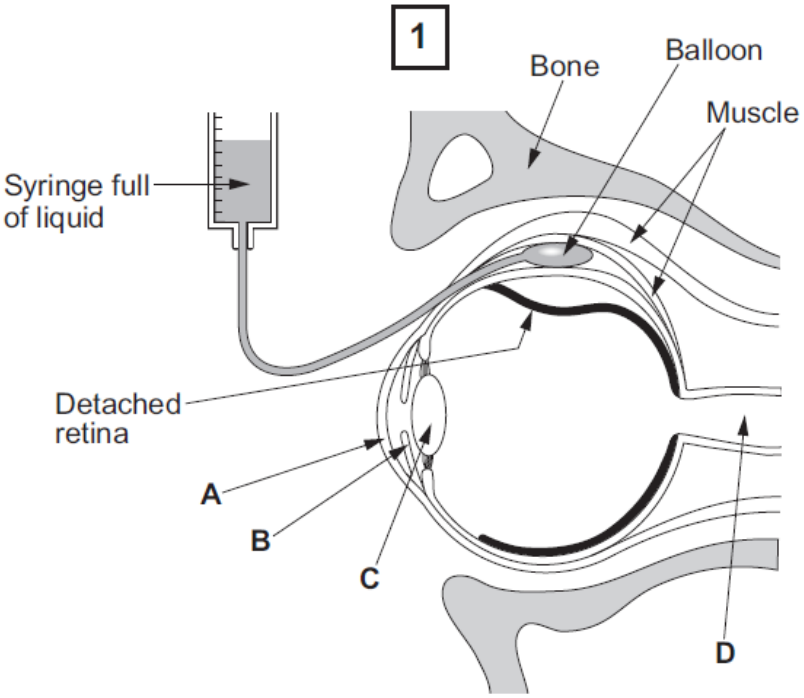
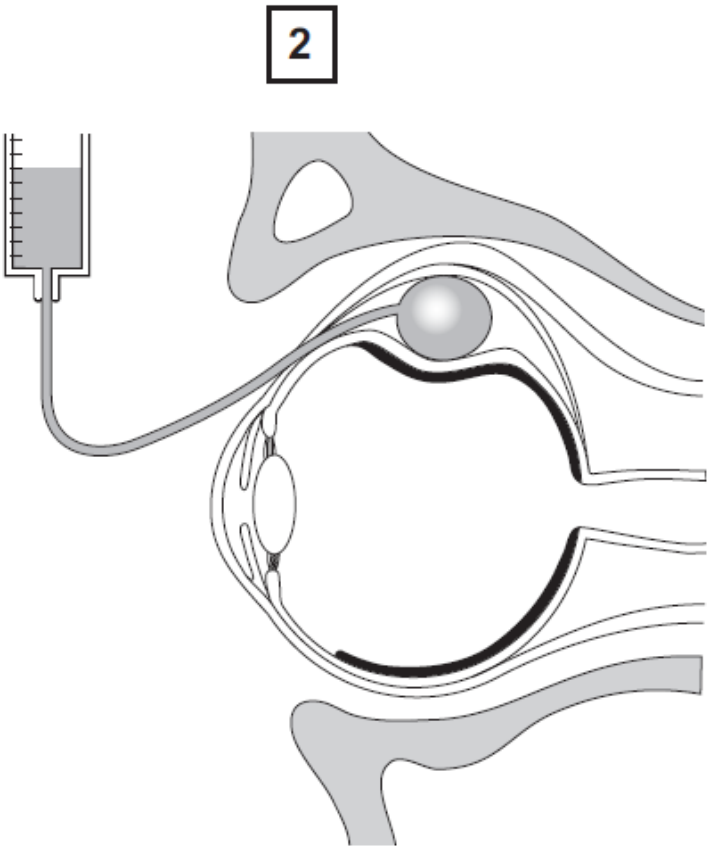
9. A serious sports injury can result when a cricket player is hit in the eye by a cricket ball. This often causes the retina of the eye to become detached as shown in diagram 1 below.

In 1980, scientists began to use lasers and small balloons to help them repair detached retinas. A laser beam is a perfectly straight beam of light energy and is directed onto the detached retina. The energy in the laser beam fuses the retina back in its normal position.





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(a) Which letters (**A** – **D)** on diagram **1** show: [4]

		letter
(i)	An effector in a reflex action.	…….
(ii)	The structure which finely adjusts the focussing of light onto the retina.	…….
(iii)	A connection to the central nervous system.	…….
(iv)	A part which allows light through.	…….

(b) On diagram **2**, **draw a single, straight line** with a ruler to show the path taken by a laser beam when it is passed through the pupil onto the detached retina. [1]

(c) Suggest the function of the balloon in this operation. [1]

.....

.....

6

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10. Write an account of the safe use of the aseptic techniques involved in inoculating and incubating bacteria on an agar plate in a laboratory. [6 QER]

……

……

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6

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11. An investigation was carried out into the effect of caffeine on the reaction time of eight people. Each person was given 2 g of instant coffee dissolved in 200 cm^3 boiling water. A computer program was used to measure the reaction times before and after drinking the coffee.

In order to measure the reaction times, each person had to press a button as soon as a signal was heard.

The results are shown in the table:

			Reaction time (s)	
Person	**Age**	**Gender**	**Before Coffee**	**After Coffee**
1	15	Male	0.17	0.16
2	17	Female	0.15	0.14
3	19	Female	0.18	0.15
4	16	Male	0.19	0.17
5	17	Male	0.14	0.12
6	20	Male	0.17	0.14
7	18	Male	0.21	0.15
8	16	Female	0.17	0.16

(a) What is the effect of caffeine on the reaction time of the people tested? [1]

.....

.....

(b) State **one** factor that has been kept constant. ..... [1]

(c) State **three** *other* factors which should have been controlled to make this a fair test. [3]

(I) .....

(II) .....

(III) .....

5

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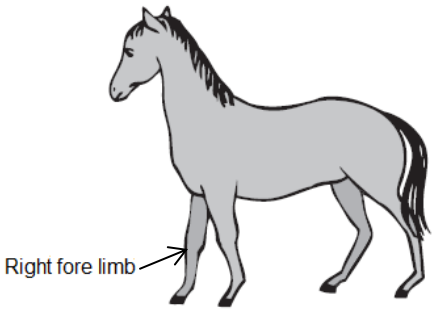
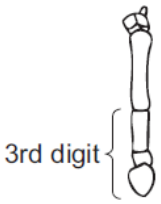
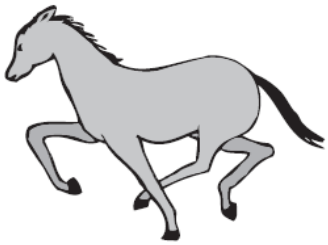
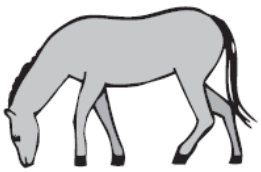
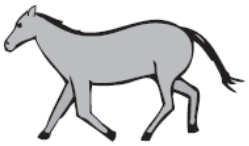
12. The diagrams show stages in the evolution of the horse.

Age of oldest fossils in millions of years	Name	Body form and size	Bones of right fore limb
1	*Equus*	 up to 1.6 m	
7	*Pilohippus*	 1.0 m	
26	*Merychippus*	 up to 1.0 m	
38	*Mesohippus*	 up to 0.6 m	
54	*Hyracotherium*	about 0.4 m	

All the examples shown are extinct except for the modern horse, *Equus.* *Hyracotherium* is the earliest ancestor. It lived in swampy, marshy areas with dense vegetation.

Gradually, during evolution, the modern horse and its ancestors became adapted to living in drier areas such as firmer, open grassland.

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(a) Suggest why the increase in size shown in the evolutionary stages was an advantage to the modern horse. [2]

.....

.....

.....

.....

(b) (i) Describe **two** changes that have taken place in the bones of the forelimb during evolution. [2]

.....

.....

.....

(ii) Suggest an advantage to *Hyracotherium* of having several digits touching the ground. [1]

.....

.....

5

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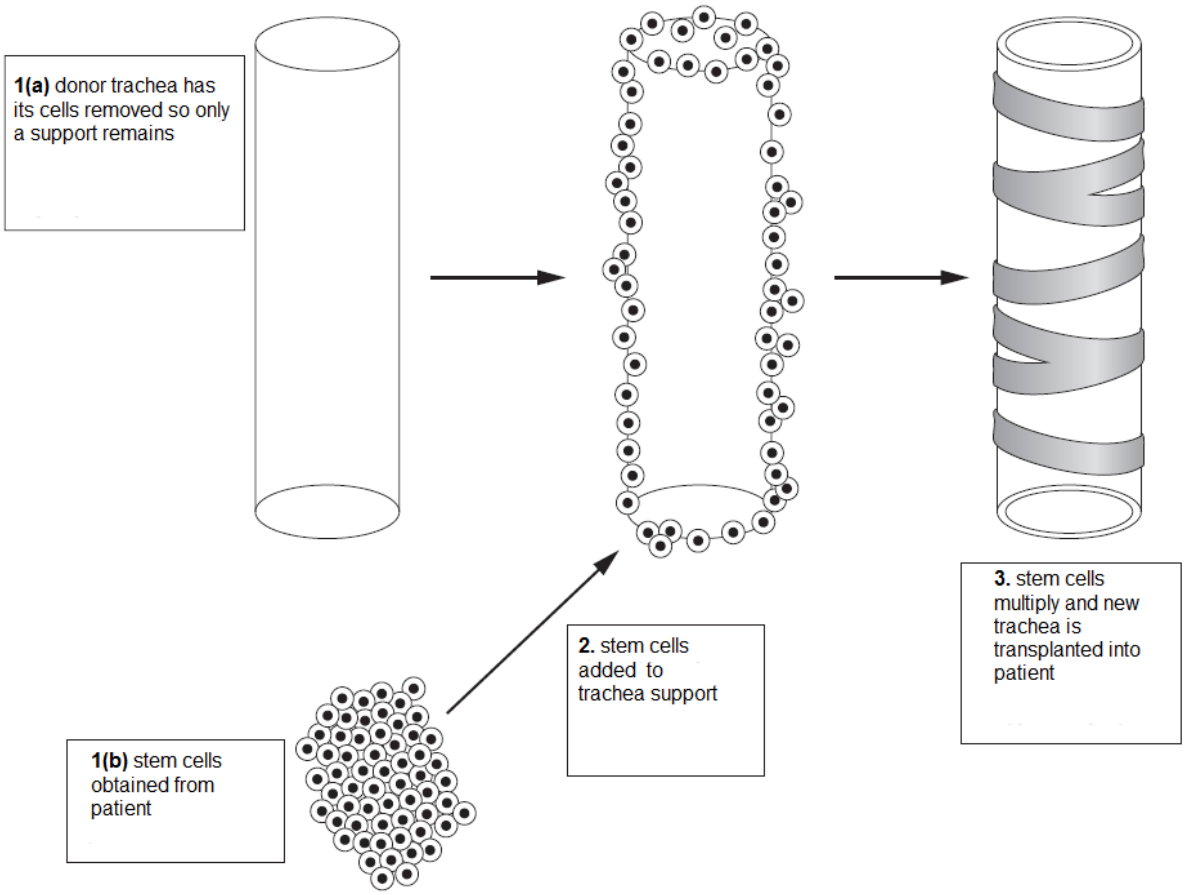
13. (a) Why are stem cells different to most cells in mature tissues of the body? [1]

.....

.....

The trachea supplies the lungs with air. If the trachea becomes damaged it can now be replaced by one that is made using the person's own stem cells. The process is summarised in the following diagram.



(b) State **two** advantages to the patient of using their own stem cells rather than using embryonic stem cells from another source. [2]

.....

.....

3

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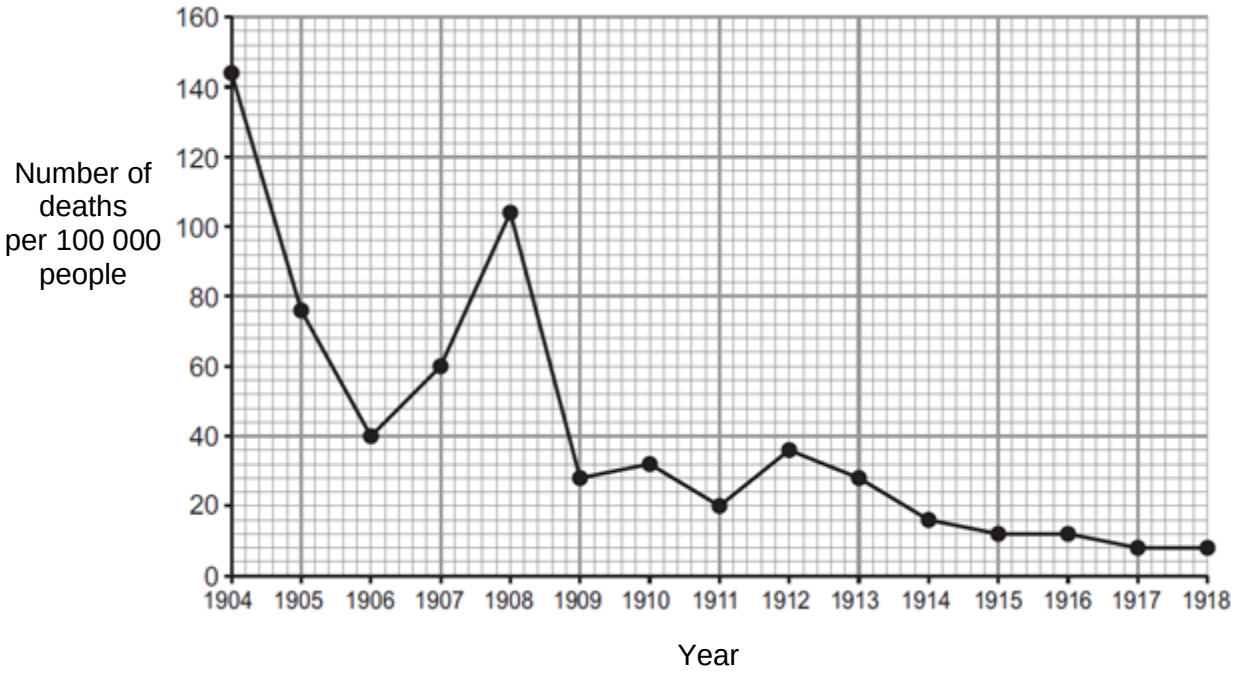
14. The graph shows the death rate from the disease, typhoid, over a period of fourteen years in Mexico. The disease is caused by the bacterium *Salmonella typhi*. In 1908, chlorine was added to Mexico's drinking water for the first time.



(a) Use the data given to answer the following:

(i) What can be concluded about how *Salmonella typhi* can enter the body? [1]

.....

(ii) Suggest a reason why the death rate in 1910 was lower than in 1905. [1]

.....

(b) Antibiotics were not used to treat typhoid until the 1950s. Suggest a way by which deaths could have been reduced before 1908. [1]

.....

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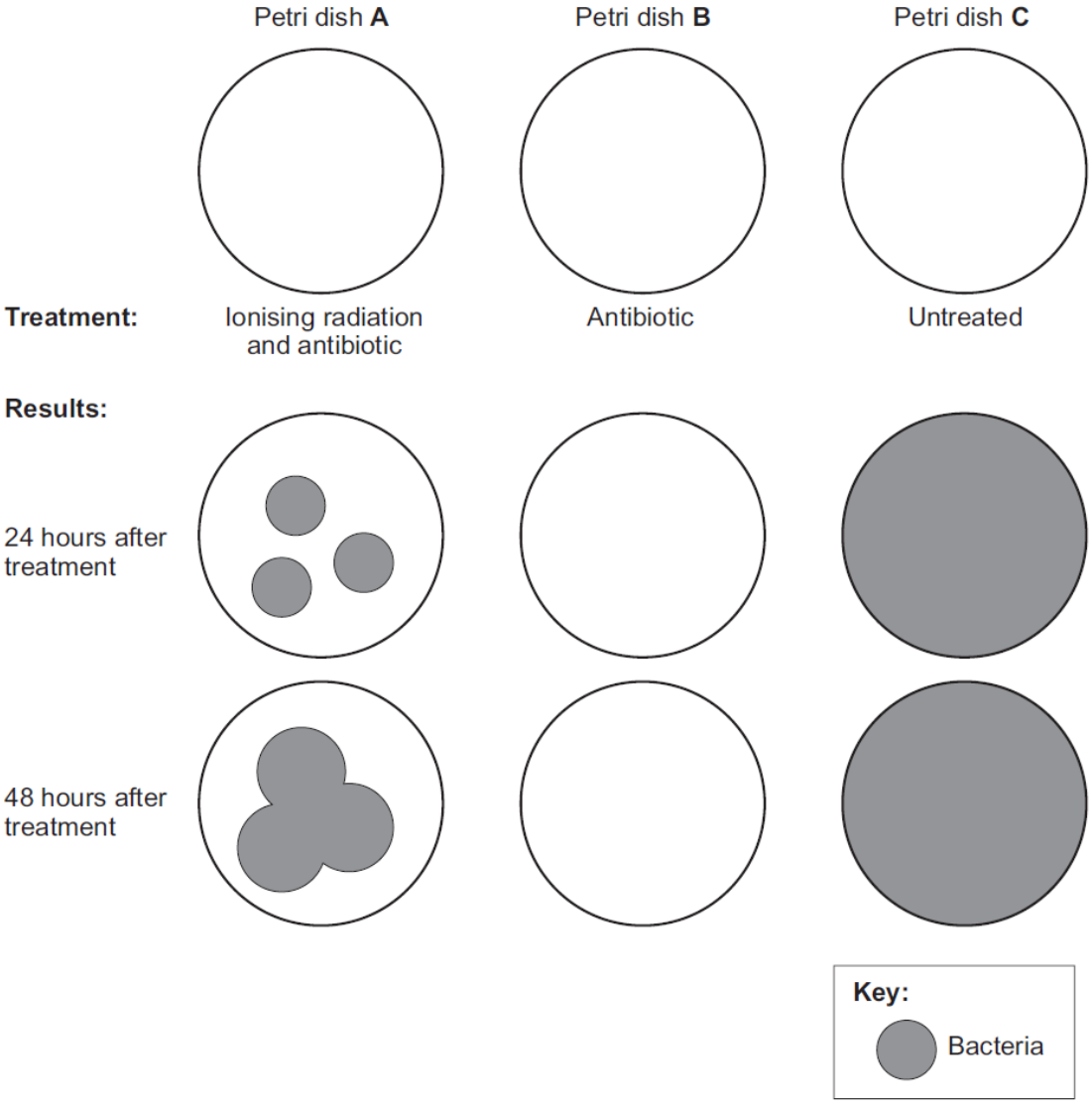
(c) In 1979, fourteen thousand people in Mexico died during an outbreak of typhoid. The antibiotic, chloramphenicol, proved to be ineffective during the outbreak. In order to find out why chloramphenicol failed to cure patients, scientists cultured *Salmonella typhi* in Petri dishes and treated them as follows:

Petri dish **A**: this was subjected to ionising radiation followed immediately with a dose of chloramphenicol.

Petri dish **B**: a dose of chloramphenicol, equal to the dose given in Petri dish **A**, was added.

Petri dish **C**: this was given neither ionising radiation, nor chloramphenicol.



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(i) What was the purpose of Petri dish **C**? [1]

.....

(ii) Explain the effect of ionising radiation on *Salmonella typhi* and why scientists must continue to discover new antibiotics. [3]

.....

.....

.....

.....

7

END OF PAPER

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UNIT 2: VARIATION, HOMEOSTASIS AND MICRO-ORGANISMS
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

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Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Reflex	1					
	(b)			Protection / to stop fingers being burned	1					
	(c)			Nervous (1) Fast (1) Automatically (1)	3					
				Question 1 total	**5**	**0**	**0**	**5**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		55[mm]		1		1	1	
		(ii)		$\frac{55}{5} = x\,11$ [e.c.f. from a (i)]		1		1	1	
	(b)			34-38 (1) mm^2 (1)		2		2	2	
	(c)			<u>the wasps were reducing the population of beetles</u>			1	1		
	(d)			Biological (control) / biocontrol	1			1		
	(e)			Wasp may kill useful species		1		1		
				Question 2 total	**1**	**5**	**1**	**7**	**4**	**0**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
3	(a)			All 6 plots correct (2) 5 plots correct (1) Plots joined with a ruler (1)		2 1		3	3	
	(b)	(i)		24/25/ correct from candidates graph		1		1	1	
		(ii)		{53/52} – {25/24} = 29/28/27/ correct from candidates graph		1		1	1	
		(iii)		60		1		1	1	
	(c)	(i)		They kill bacteria	1			1		
		(ii)		Bacteria become resistant	1			1		
				Question 3 total	**2**	**6**	**0**	**8**	**6**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Increase in concentration		1		1		
		(ii)		Increase in concentration		1		1		
	(b)			Produces insulin (1) Which changes glucose to glycogen (1) Which is stored in liver (1)	3			3		
	(c)	(i)		Concentration would decrease below a safe limit / to a dangerous level		1		1		
		(ii)		Eat glucose / sugar/ sugary food		1		1		
				Question 4 total	**3**	**4**	**0**	**7**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		L	1					
		(ii)		K	1					
		(iii)		M	1					
	(b)	(i)		Ureter	1					
		(ii)		Bladder	1					
		(iii)		Urethra	1					
				Question 5 total	**6**	**0**	**0**	**6**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			4		1		1		
	(b)			5 and 6		1		1		
	(c)			1		1		1		
	(d)			1		1		1		
	(e)			4		1		1		
				Question 6 total	**0**	**5**	**0**	**5**	**0**	**0**

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<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)</td><td></td><td><table><tr><td></td><td>N</td><td>n</td></tr><tr><td>n</td><td>Nn</td><td>nn</td></tr><tr><td>n</td><td>Nn</td><td>nn</td></tr></table>All correct for 1 mark</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>50%</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>NN x NN (1)
Nn x NN (1)</td><td></td><td></td><td>2</td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 7 total</td><td>0</td><td>2</td><td>2</td><td>4</td><td>1</td><td>0</td></tr>
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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			4	1			1		
	(b)	(i)		Circle around first diamond from left			1	1		
		(ii)		Mutation	1			1		
	(c)	(i)		B			1	1		
		(ii)		Profile / bands match DNA from blood			1	1		
	(d)			Identical twins		1		1		
				Question 8 total	**2**	**1**	**3**	**6**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		B	1					
		(ii)		C	1					
		(iii)		D	1					
		(iv)		A	1					
	(b)			Line passing through pupil and hitting the detached retina		1				
	(c)			Pushes {choroid/ sclera} onto retina/ supports retina / holds retina in correct place		1				
				Question 9 total	**4**	**2**	**0**	**6**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10				**Indicative content:** Use of sterile Petri dish. Flaming the inoculating loop before collecting a sample of harmless bacteria (from yogurt). Using nutrient agar, spread / plate bacteria. Seal Petri dish with tape. Invert Petri dish. Incubate at a stated temperature ($25^{q}C$) for a stated time (12-24 hours). **5 – 6 marks** All steps should be present including stated incubation temperature and detailed aseptic technique. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks** Most steps present, including use of sterile Petri dish/ flaming loop and incubation. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** Any correct statement regarding aseptic technique *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. *The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	6					6
				Question 10 total	**6**	**0**	**0**	**6**	**0**	**6**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			It makes the reaction faster / speeds up reaction		1		1		
	(b)			Concentration of coffee / mass of coffee / volume of water		1		1		1
	(c)			**Any 3 (x 1) from:** Gender / sex Age Fasting before test Time interval between drinking and testing.			3	3		3
				Question 11 total	**0**	**2**	**3**	**5**	**0**	**4**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			Increases chances of survival (1) Because increase in size means it will have fewer predators/ can run faster (1)			2	2		
	(b)	(i)		Reduction of number/ bones reduce from four to one (1) Bones become thicker(1)		2		2		
		(ii)		Greater surface area prevents sinking in marsh land		1		1		
				Question 12 total	**0**	**3**	**2**	**5**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)			They can differentiate into many types of cells	1			1		
	(b)			Cells will not be rejected (1) No ethical objections (1)	2			2		
				Question 13 total	**3**	**0**	**0**	**3**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
14	(a)	(i)		The bacteria enter via drinking water			1	1		
		(ii)		The bacteria were being killed by chlorine		1		1		
	(b)			Drinking water could have been boiled		1		1		
	(c)	(i)		To act as a control			1	1		1
		(ii)		Ionising radiation speeds up mutation in bacteria (1) so they become resistant to antibiotics (1) New antibiotics are needed to replace resistant ones (1)			3	3		
				Question 14 total	**0**	**2**	**5**	**7**	**0**	**1**

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FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	**5**	**0**	**0**	**5**	**0**	**0**
2	**1**	**5**	**1**	**7**	**4**	**0**
3	**2**	**6**	**0**	**8**	**6**	**0**
4	**3**	**4**	**0**	**7**	**0**	**0**
5	**6**	**0**	**0**	**6**	**0**	**0**
6	**0**	**5**	**0**	**5**	**0**	**0**
7	**0**	**2**	**2**	**4**	**1**	**0**
8	**2**	**1**	**3**	**6**	**0**	**0**
9	**4**	**2**	**0**	**6**	**0**	**0**
10	**6**	**0**	**0**	**6**	**0**	**6**
11	**0**	**2**	**3**	**5**	**0**	**4**
12	**0**	**3**	**2**	**5**	**0**	**0**
13	**3**	**0**	**0**	**3**	**0**	**0**
14	**0**	**2**	**5**	**7**	**0**	**1**
TOTAL	**32**	**32**	**16**	**80**	**11**	**11**

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Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

BIOLOGY

UNIT 2: VARIATION, HOMEOSTASIS AND MICRO-ORGANISMS
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**3**	
4.	**6**	
5.	**7**	
6.	**7**	
7.	**7**	
8.	**11**	
9.	**9**	
10.	**6**	
11.	**8**	
12.	**6**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **12** is a quality of extended response (QER) question where your writing skills will be assessed.

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*Answer **all** questions*

1. An investigation was carried out into the effect of caffeine on the reaction time of eight people. Each person was given 2 g of instant coffee dissolved in 200 cm^3 boiling water. A computer program was used to measure the reaction times before and after drinking the coffee.

In order to measure the reaction times, each person had to press a button as soon as a signal was heard.

The results are shown in the table:

			Reaction time (s)	
Person	**Age**	**Gender**	**Before Coffee**	**After Coffee**
1	15	Male	0.17	0.16
2	17	Female	0.15	0.14
3	19	Female	0.18	0.15
4	16	Male	0.19	0.17
5	17	Male	0.14	0.12
6	20	Male	0.17	0.14
7	18	Male	0.21	0.15
8	16	Female	0.17	0.16

(a) What is the effect of caffeine on the reaction time of the people tested? [1]

.....

.....

(b) State **one** factor that has been kept constant. ..... [1]

(c) State **three** other factors which should have been controlled to make this a fair test. [3]

(I) .....

(II) .....

(III) .....

5

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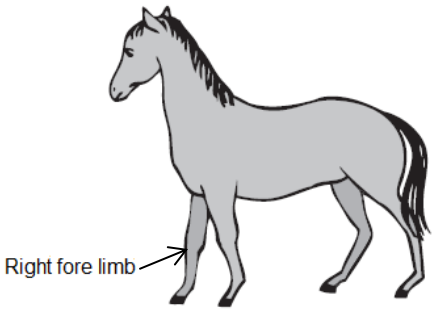
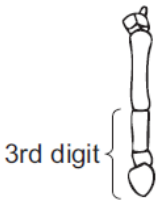
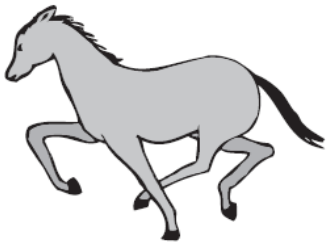
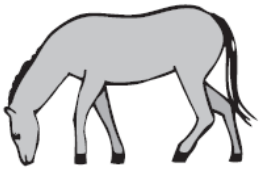
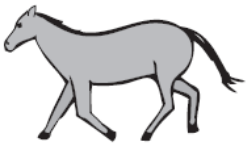
2. The diagrams show stages in the evolution of the horse.

Age of oldest fossils in millions of years	Name	Body form and size	Bones of right fore limb
1	*Equus*	 up to 1.6 m	
7	*Pilohippus*	 1.0 m	
26	*Merychippus*	 up to 1.0 m	
38	*Mesohippus*	 up to 0.6 m	
54	*Hyracotherium*	about 0.4 m	

All the examples shown are extinct except for the modern horse. *Equus. Hyracotherium* is the earliest ancestor, it lived in swampy, marshy areas with dense vegetation.

Gradually, during evolution, the modern horse and its ancestors became adapted to living in drier areas such as firmer, open grassland.

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(a) Suggest why the increase in size shown in the evolutionary stages was an advantage to the modern horse. [2]

.....

.....

.....

.....

(b) (i) Describe **two** changes that have taken place in the bones of the forelimb during evolution. [2]

.....

.....

.....

(ii) Suggest an advantage to *Hyracotherium* of having several digits touching the ground. [1]

.....

.....

5

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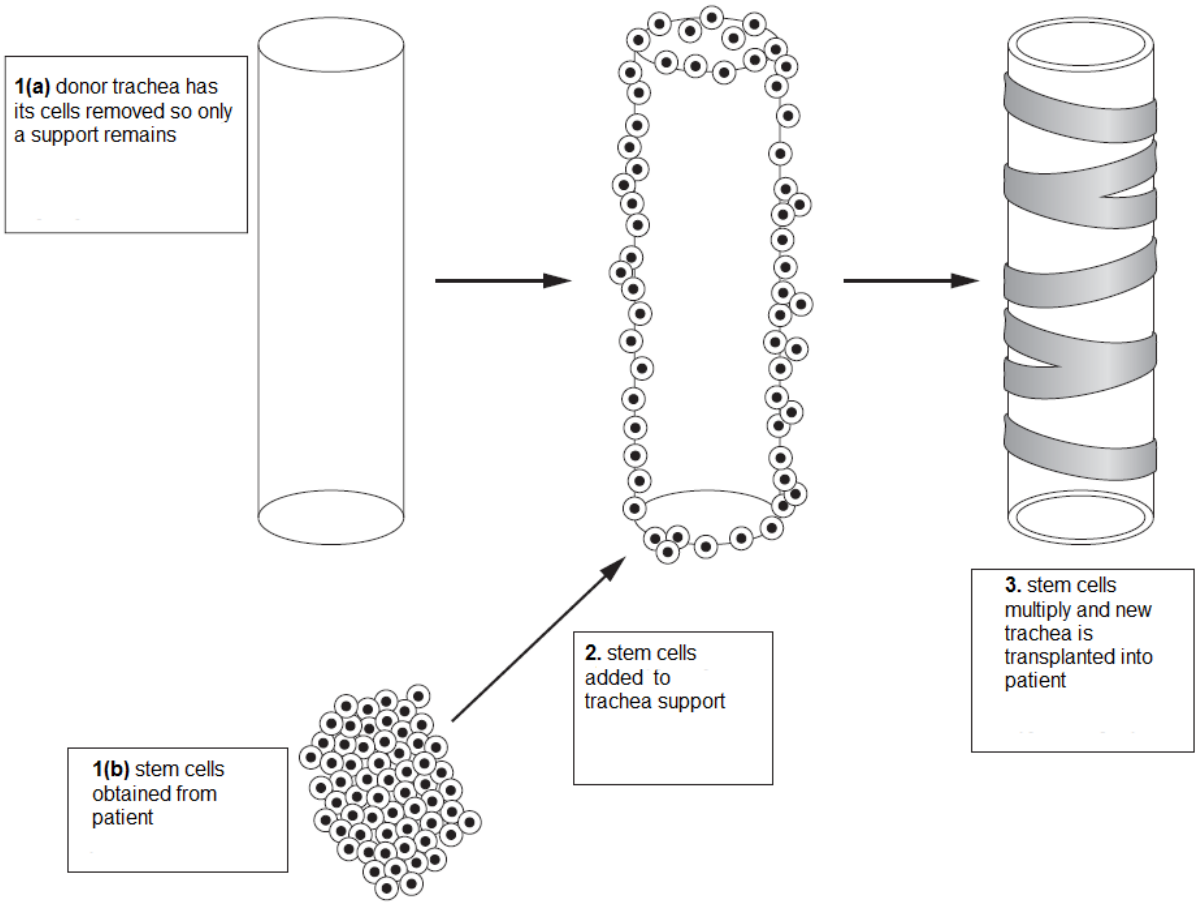
3. (a) Why are stem cells different to most cells in mature tissues of the body? [1]

.....

.....

The trachea supplies the lungs with air. If the trachea becomes damaged it can now be replaced by one that is made using the person's own stem cells. The process is summarised in the following diagram.



(b) State **two** advantages to the patient of using their own stem cells rather than using embryonic stem cells from another source. [2]

.....

.....

3

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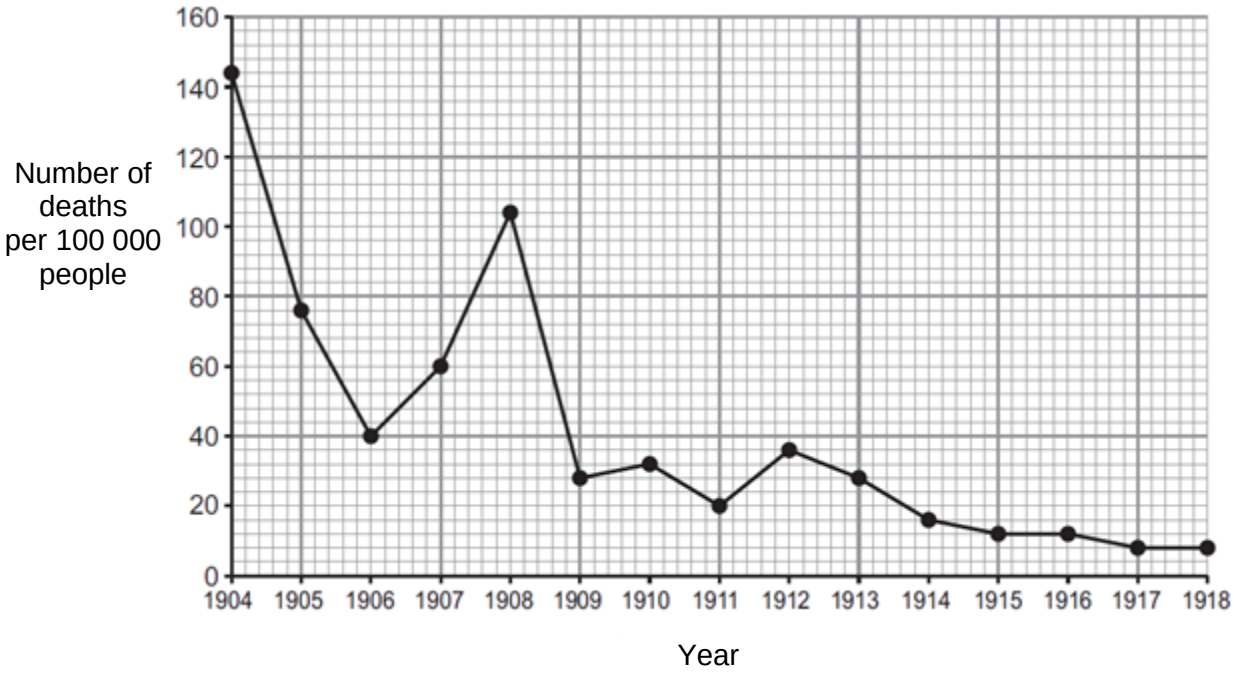
4. The graph shows the death rate from the disease, typhoid, over a period of fourteen years in Mexico. The disease is caused by the bacterium *Salmonella typhi*. In 1908, chlorine was added to Mexico's drinking water for the first time.



(a) Use the data given to answer the following:

(i) What can be concluded about how *Salmonella typhi* can enter the body? [1]

.....

(ii) Suggest a reason why the death rate in 1910 was lower than in 1905. [1]

.....

(b) In 1979, fourteen thousand people in Mexico died during an outbreak of typhoid. The antibiotic, chloramphenicol, proved to be ineffective during the outbreak. In order to find out why chloramphenicol failed to cure patients, scientists cultured *Salmonella typhi* in Petri dishes and treated them as follows:

Petri dish **A**: this was subjected to ionising radiation followed immediately with a dose of chloramphenicol.

Petri dish **B**: a dose of chloramphenicol, equal to the dose given in Petri dish **A**, was added.

Petri dish **C**: this was given neither ionising radiation, nor chloramphenicol.

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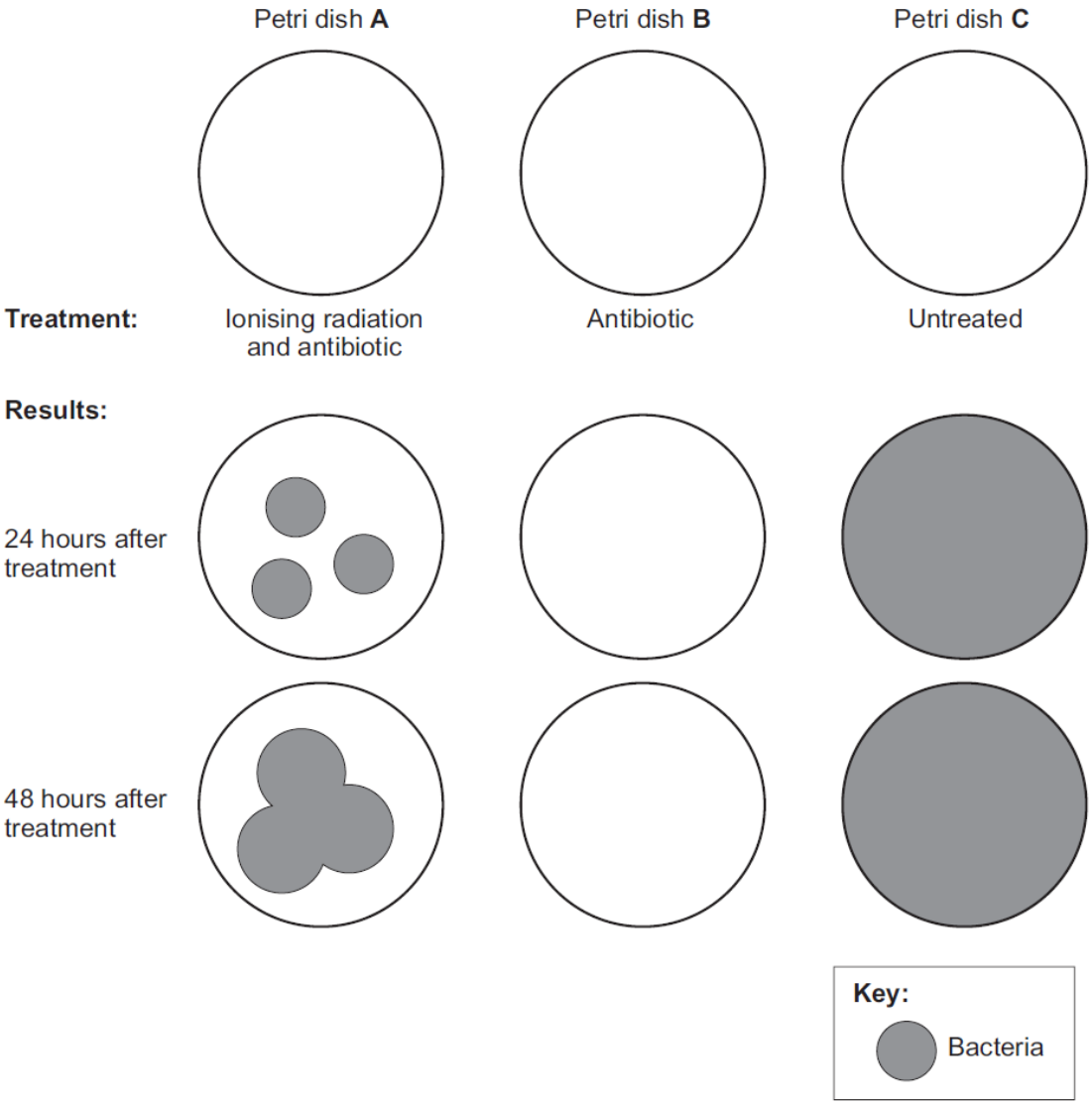

(i) What was the purpose of Petri dish **C**? [1]

.....

(ii) Explain the effect of ionising radiation on *Salmonella typhi* and why scientists must continue to discover new antibiotics. [3]

.....

.....

.....

.....

6

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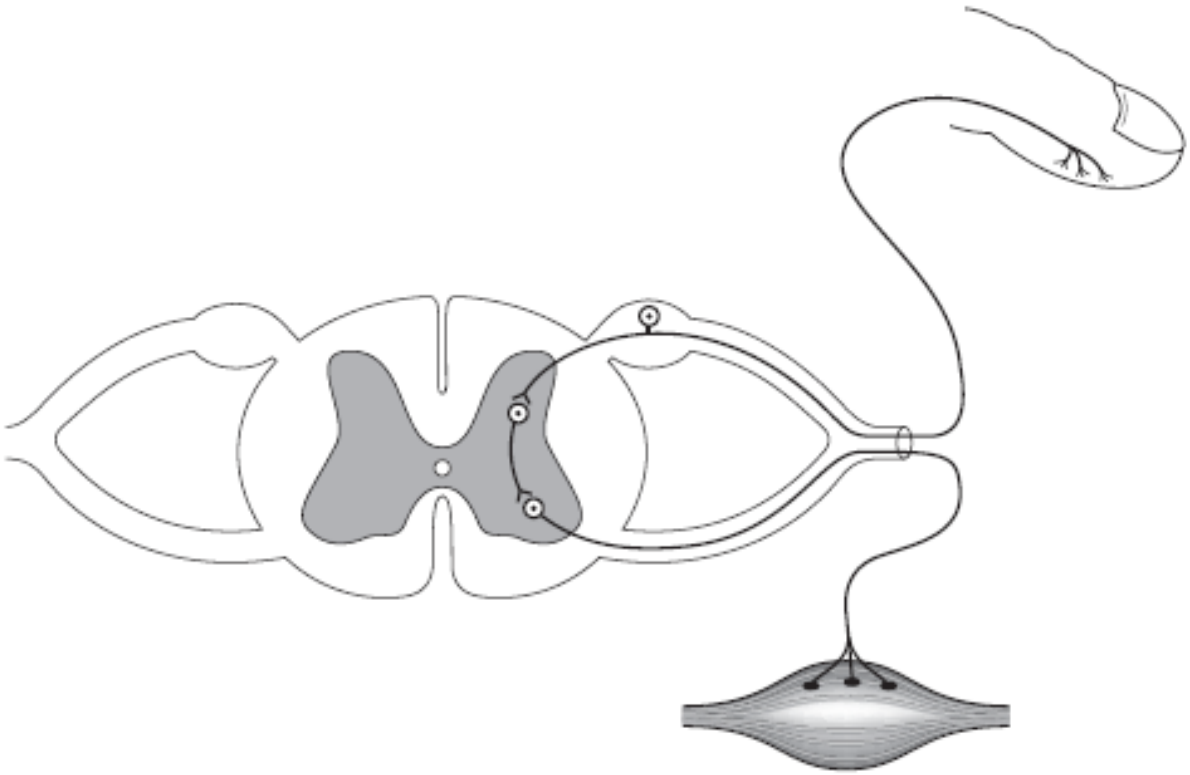
5. The diagram shows part of the nervous system involved in a withdrawal reflex action.



(a) **On the diagram** above, **label**: [4]

(i) the motor neurone;

(ii) the co-ordinator;

(iii) the synapse;

(iv) the sensory neurone.

(b) (i) Name the path taken by a nerve impulse in the reflex action shown in the diagram. [1]

.....

(ii) **Draw an arrow** on **each** neurone to show the direction of the nerve impulse. [1]

(iii) What stimulus affects receptors in your skin when your finger touches a flame? [1]

.....

7

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6. In 1905, the French scientist, Lucien Cuenot, discovered that a combination of certain dominant alleles in mice resulted in their death at birth. This principle is also shown in Manx cats.

Manx cats have short tails. Their **genotype** is **Nn**, where **N** represents the allele for short tail and **n** represents the allele for long tail. Manx cats with the genotype **NN** die shortly after birth.

(a) (i) Complete the following Punnet square to show the possible genotypes of the kittens produced from a cross between two short tailed cats. Use the letters **N** and **n**. [2]

short tail x

short tail

(ii) What fraction of a total litter of 8 would be expected to survive? [1]

.....

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(b) (i) Complete the following Punnet square to show the possible genotypes of the kittens produced from a cross between a short tailed cat and a long tailed cat. Use the letters **N** and **n**. [2]

short tail x

long tail

(ii) What percentage of the litter would be expected to survive? [1]

.....

(c) Name the type of genetic variation shown in the tail length of cats. [1]

.....

7

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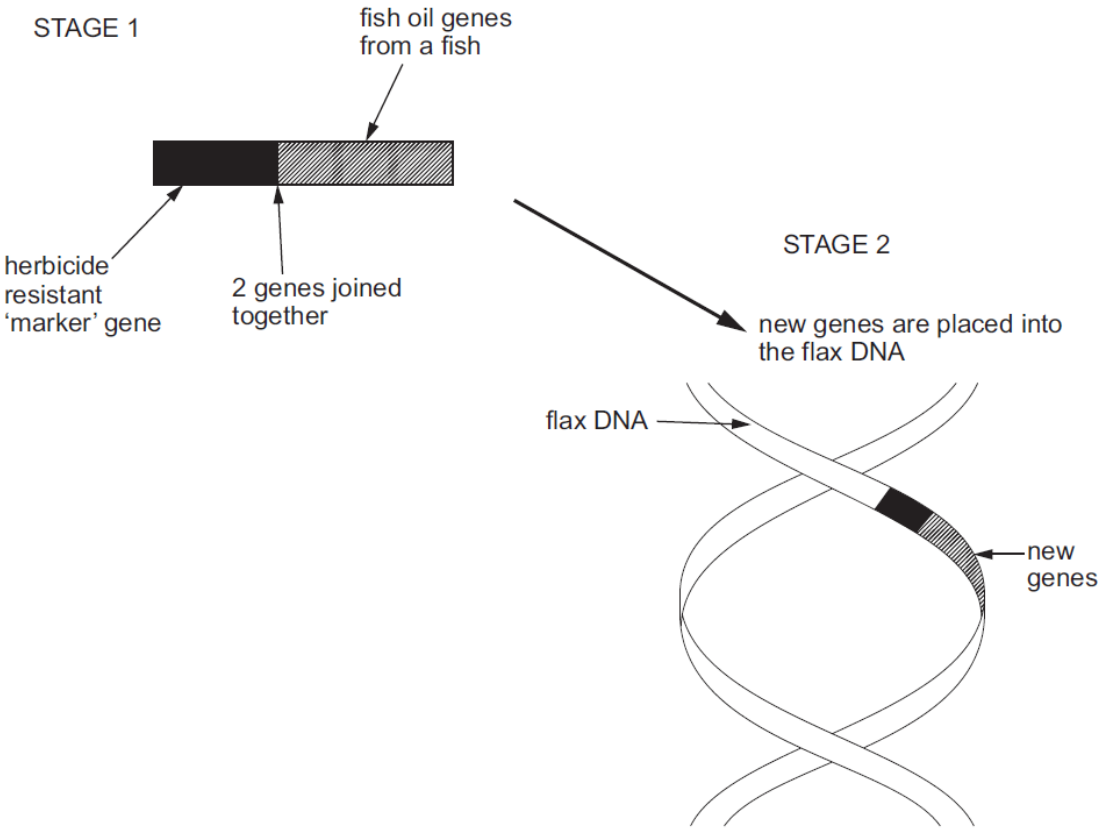
7. The following report appeared in a scientific journal in 2015:

FISH OIL FROM FLAX SEEDS

The production of fish oils is controlled by genes. Scientists have artificially transferred these genes to the DNA of flax plants. During this transfer, a herbicide-resistant 'marker' gene is joined to the fish oil genes and is also transferred to the DNA of the flax plant. The plant is now able to produce fish oil in its seeds.



(a) The scientists needed to know if the genes for fish oil production were successfully added to the DNA of the flax plant. Suggest how the 'marker' gene helps them to find out. [2]

.....

.....

.....

(b) Fish oils are recommended as part of a healthy diet to protect against heart disease. The world market for them is very large. Suggest **two** advantages of obtaining fish oils from GM flax seeds rather than from fish. [2]

(I) .....

(II) .....

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(c) The cultivation of the four main GM crops in 2002 and 2006 is shown in the table for the USA.

	Area of land for growing crops (Thousands of Hectares)			
	2002		**2006**	
Crop	**Non GM**	**GM**	**Non GM**	**GM**
soya bean	72	37	50	45
cotton	34	7	29	13
rapeseed	25	3	24	4
maize	140	12	116	36

(i) What does the data in the table suggest about a possible change of attitude of Americans to growing GM crops between 2002 and 2006? [1]

.....

.....

(ii) Calculate the percentage increase in GM maize production in 2006 compared to 2002. Show your working. [2]

percentage increase in GM maize production = ... %

7

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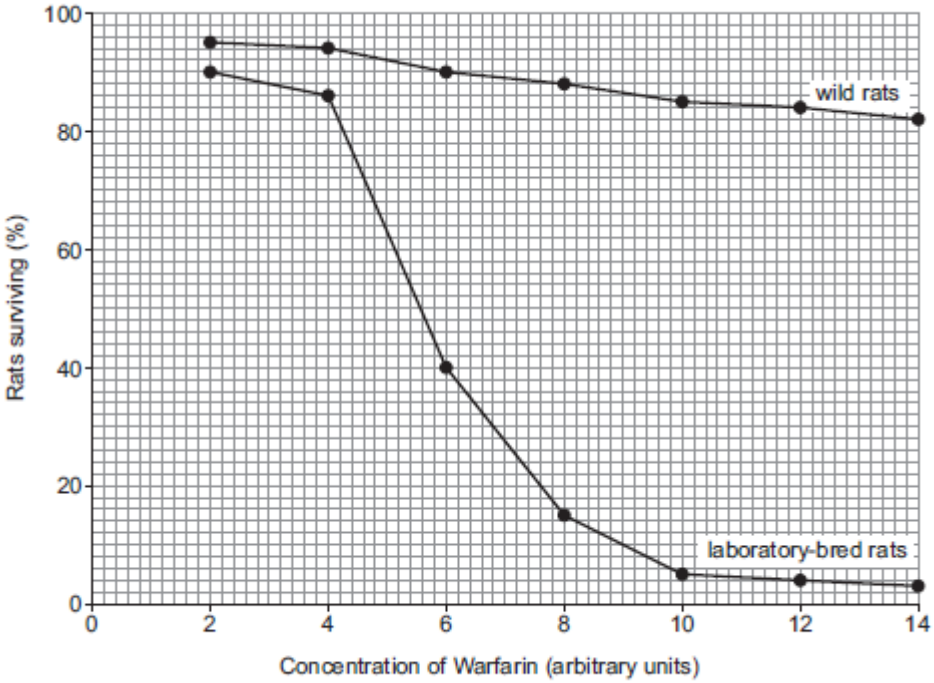
8. In the 1960s, some wild rats in Wales were found to be resistant to the concentrations of Warfarin that normally killed them. Scientists investigated the effect of Warfarin on resistant and non-resistant rats.

They used samples captured from the population in the wild together with non-resistant rats which had been bred in the laboratory. They noted the percentage that survived various concentrations of Warfarin. The results are shown in the graph below.



(a) What basic assumption is being made by the scientists regarding the wild rats used in this investigation? [1]

.....

.....

.....

(b) How would you modify the procedure in order to increase confidence in the conclusion? [2]

.....

.....

.....

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(c) Compare the effect of increasing the concentration of Warfarin on the wild rats and the laboratory-bred rats. [2]

.....

.....

.....

(d) Calculate the percentage difference in survival between the wild rats and the laboratory-bred rats at a Warfarin concentration of ten arbitrary units. [1]

percentage difference = ... %

(e) Today, most rats in Britain have developed resistance to Warfarin. Explain how resistance to Warfarin has evolved and spread throughout populations of rats since the 1960s. [4]

.....

.....

.....

.....

.....

.....

.....

(f) State **one** advantage of using laboratory-bred rats in this investigation. [1]

.....

.....

11

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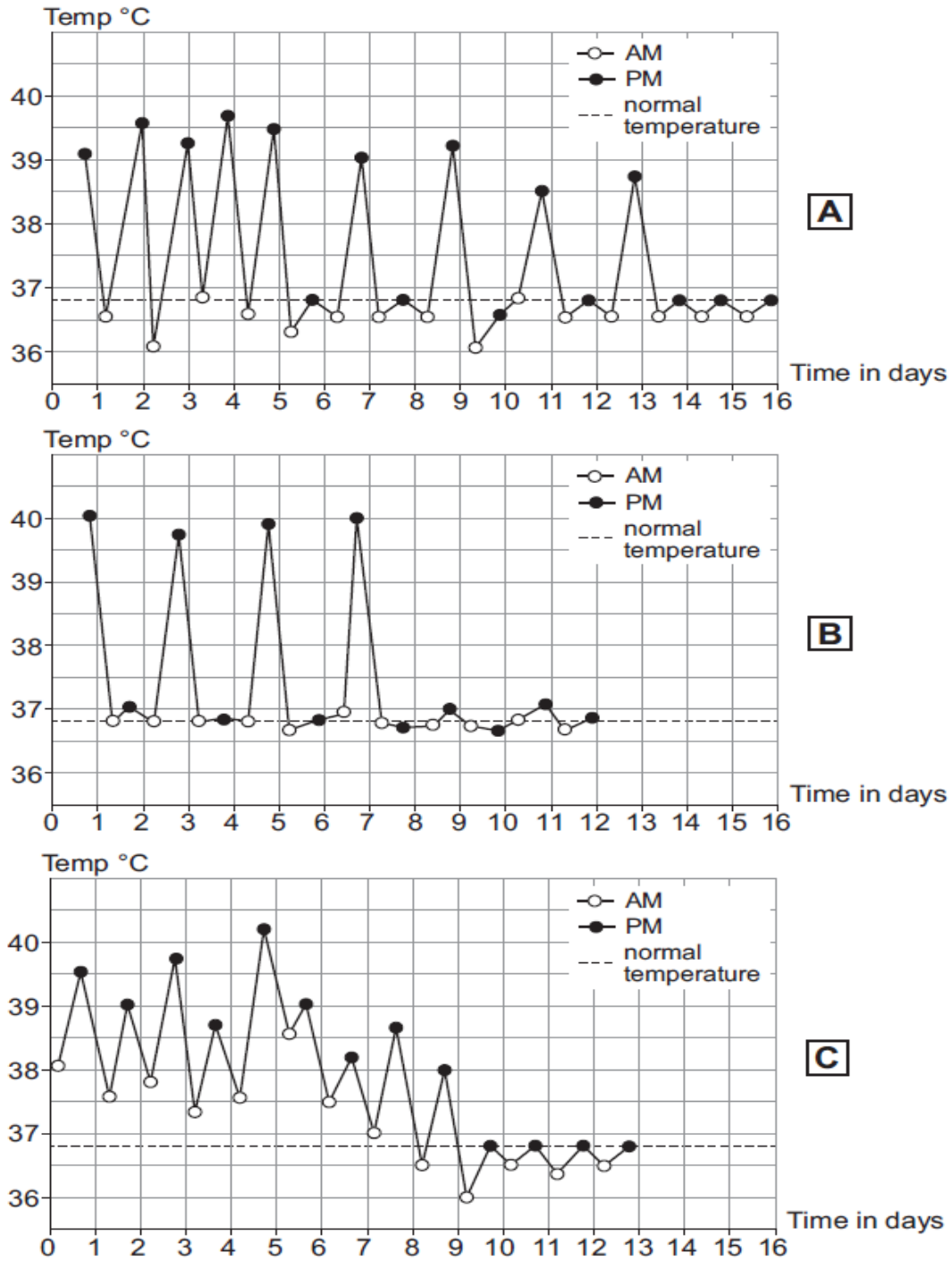
9. Malaria can occur in three forms, each caused by a different species of single-celled organism. The charts below show temperature charts of patients suffering from each of the three types of malaria, **A**, **B** and **C**. The charts record the changes in body temperature over sixteen days. A person suffers fever when the body temperature rises **above normal body temperature**.



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(a) Use the information given, to state which chart shows: [6]

(i) the most regular pattern of fever every three days;

.....

(ii) the most irregular pattern of fever;

.....

(iii) the highest body temperature;

.....

(iv) the most frequent temperatures below normal;

.....

(v) the patient recovering quickest from an attack of malaria;

.....

(vi) the greatest range of difference in temperature.

.....

(b) Fever occurs when the causative malarial organism bursts out of red blood cells. How many times does this occur in type **B**? [1]

.....

(c) Name:

(i) the causative agent of malaria; [1]

.....

(ii) the organism which spreads malaria from one human to another. [1]

.....

9

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10. The hepatitis B virus causes a life-threatening disease. Vaccines used against this virus are very expensive. Scientists have genetically engineered bananas to produce an antigen, found on the hepatitis B virus. The banana 'vaccine' produced in this way costs just a few pence per dose.

The hepatitis antigen has also been produced by genetically engineering potatoes. It has produced an immune response in rats which eat the genetically engineered raw potatoes.

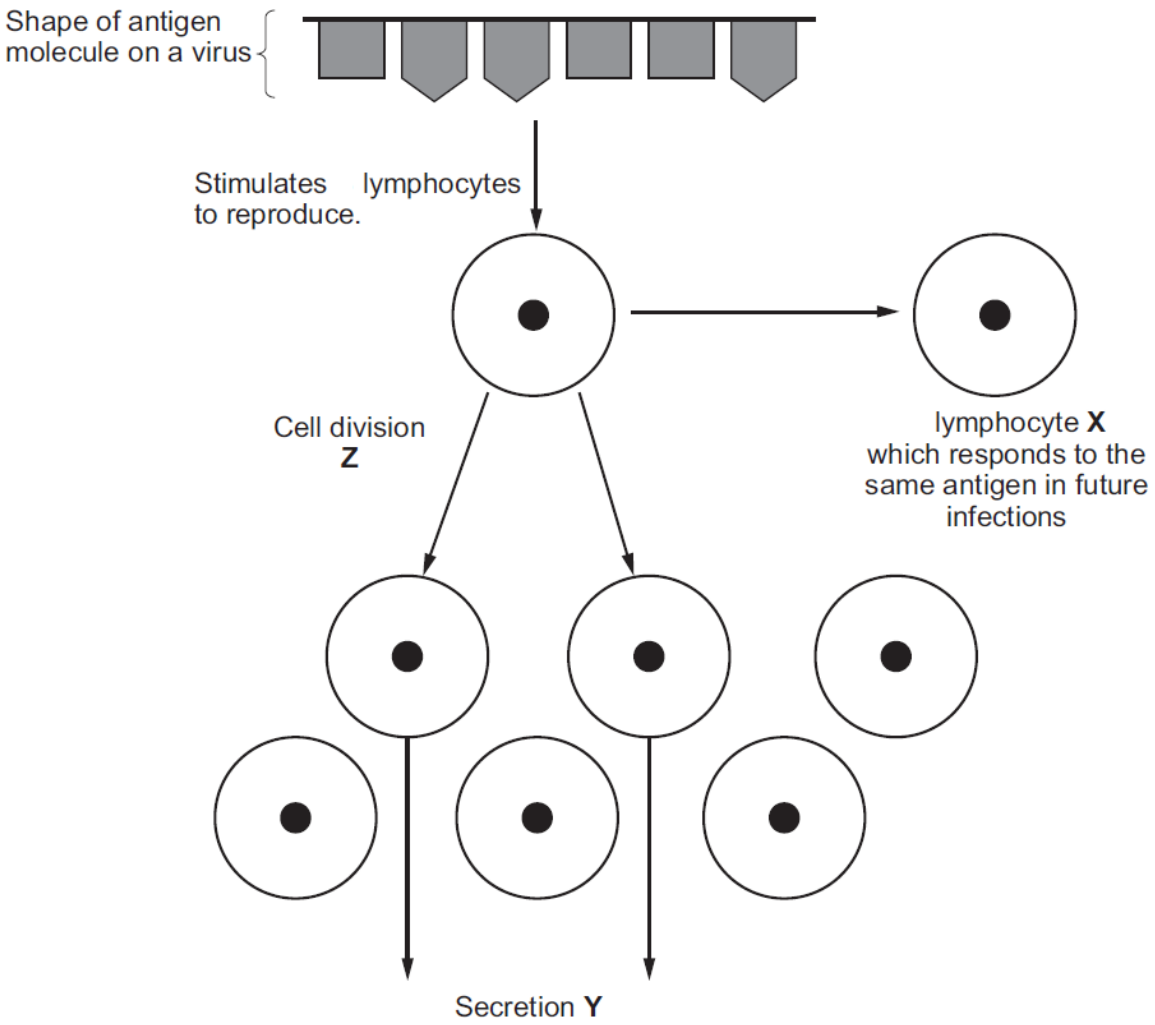
(a) Antigens are proteins. State why boiled genetically engineered potatoes would be of no use in giving immunity to humans. [1]

.....

(b) Suggest **one** advantage of using genetically engineered bananas rather than normal vaccines in developing countries. [1]

.....

(c) The following diagram shows how the immune response is stimulated by antigens.



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Name: [3]

(i) the type of lymphocyte **X** .....

(ii) the secretion **Y** .....

(iii) the type of cell division **Z** .....

(d) In some countries, vaccination is compulsory for all people. Suggest **one** reason why some people object to this legislation. [1]

.....

.....

6

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11. Chinese mitten crabs (*Eriocher sinensis)*, were accidently introduced to the river Thames in England in 1935. By 2014 they had spread as far as Scotland. Chinese mitten crabs eat invertebrates and decaying plants and animals. They compete with native species of crayfish. The result of the invasion has been a reduction in biodiversity.

(a) (i) Why is the Chinese mitten crab regarded as an alien species? [1]

.....

.....

(ii) What is meant by the term, *biodiversity*? [2]

.....

.....

(b) When the Chinese mitten crabs were recorded in a river near a crayfish farm, the owner of the farm wanted to know how many were there.

Scientists estimated the population size as follows:

- Cages were baited and placed in the river and left for two days.
- After two days, the scientists found 45 crabs in the cages, these were marked with water-proof paint and released back into the river.
- The cages were re-baited, placed in the river and visited two days later.
- At this time 47 crabs were counted and found to include 29 that had been marked two days before.

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If **Q** is the number of crabs in the first sample, **R** the number in the second sample and **S** the number of marked crabs in the second sample, the following equation could be used to estimate the population size:

$$\frac{\mathbf{Q} \times \mathbf{R}}{\mathbf{S}}$$

(i) Use the equation to estimate the population of crabs in the river. [2]

population size = ……

(ii) Give **three** sources of error in this method of estimating the population size. [3]

I .....

II .....

III .....

8

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12. Describe the function of Antidiuretic Hormone (ADH) in the maintenance of a constant volume of water in the body. [6 QER]

……

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END OF PAPER

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UNIT 2: VARIATION, HOMEOSTASIS AND MICRO-ORGANISMS
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

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Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			It makes the reaction faster / speeds up reaction		1		1		
	(b)			Concentration of coffee / mass of coffee / volume of water		1		1		1
	(c)			**Any 3 (x 1) from:** Gender / sex Age Fasting before test Time interval between drinking and testing.			3	3		3
				Question 1 total	**0**	**2**	**3**	**5**	**0**	**4**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
2	(a)			Increases chances of survival (1) Because increase in size means it will have fewer predators/ can run faster (1)			2	2		
	(b)	(i)		Reduction of number/ From four to one (1) Bones become thicker(1)		2		2		
		(ii)		Greater surface area prevents sinking in marsh land		1		1		
				Question 2 total	**0**	**3**	**2**	**5**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			They can differentiate into many types of cells	1			1		
	(b)			Cells will not be rejected (1) No ethical objections (1)	2			2		
				Question 3 total	**3**	**0**	**0**	**3**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		The bacteria enter via drinking water			1	1		
		(ii)		The bacteria were being killed by chlorine		1		1		
	(b)	(i)		To act as a control			1	1		1
		(ii)		Ionising radiation increases chance of mutation in bacteria (1) so they become resistant to antibiotics (1) New antibiotics are needed to replace resistant ones (1)			3	3		
				Question 4 total	**0**	**1**	**5**	**6**	**0**	**1**

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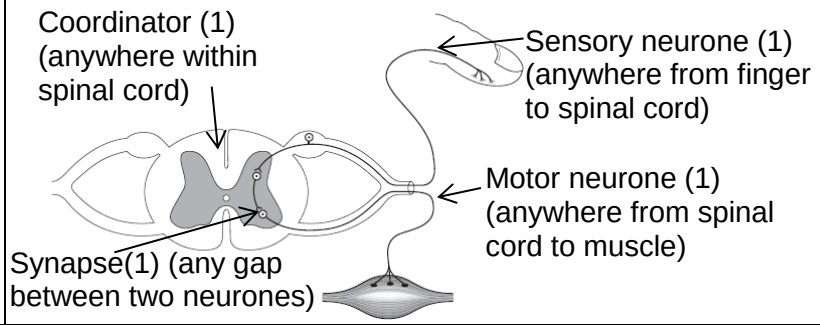
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			**Correct labels = 4x1**  	4					
	(b)	(i)		Reflex arc	1					
		(ii)		Three arrows correct (one on each neurone)	1					
		(iii)		Temperature / heat		1				
				Question 5 total	**6**	**1**	**0**	**7**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		<table><tr><td></td><td>N</td><td>n</td></tr><tr><td>N</td><td>NN</td><td>Nn</td></tr><tr><td>n</td><td>Nn</td><td>nn</td></tr></table> Gametes (1) Correct mechanics of square (1)		2		2		
		(ii)		3/4 / 6/8		1		1	1	
	(b)	(i)		<table><tr><td></td><td>N</td><td>n</td></tr><tr><td>n</td><td>Nn</td><td>nn</td></tr><tr><td>n</td><td>Nn</td><td>nn</td></tr></table> Gametes (1) Correct mechanics of square (1)		2		2		
		(ii)		50%		1		1	1	
	(c)			Discontinuous	1			1		
				Question 6 total	**1**	**6**	**0**	**7**	**2**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Grow crop of GM flax and add herbicide (1) If plants survive, they are resistant and also have fish oil genes (1)		2				2
	(b)			Cheaper than using fish (1) Conserves fish stocks (1)			2			
	(c)	(i)		Attitudes more positive / GM crops accepted by more people			1			
		(ii)		$\frac{(36 - 12)}{12}$ x 100 (1) 200 % (1)		2			2	
				Question 7 total	**0**	**4**	**3**	**7**	**2**	**2**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			All the wild rats are resistant		1		1		
	(b)			**Any 2 (x1) from:** Use rats of same age Increase size of sample Use rats of known resistance			2	2		2
	(c)			Very small decrease in survival with increase in concentration for wild rats/ very high decrease in laboratory-bred rats (1) Neither wild rats nor laboratory-bred rats are all killed by highest concentration of Warfarin (1).		1	1	2		
	(d)			85 – 5 = 80		1		1	1	
	(e)			**Any 4 (x1) from:** Mutation (1) in a gene caused resistance (1) Allowed them to survive/ Non-resistant died (1) Natural selection took place (1) They bred to pass on gene (1).	4			4		
	(f)			Scientists knew that they were all non-resistant to Warfarin / certain of the genotypes (1).		1		1		1
				Question 8 total	**4**	**4**	**3**	**11**	**1**	**3**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		B		1		1		
		(ii)		C		1		1		
		(iii)		C		1		1	1	
		(iv)		A		1		1	1	
		(v)		B		1		1		
		(vi)		C		1		1	1	
	(b)			8		1		1	1	
	(c)	(i)		Plasmodium	1			1		
		(ii)		mosquito	1			1		
				Question 9 total	**2**	**7**	**0**	**9**	**4**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Boiling denatures / destroys protein		1		1		
	(b)			Cheaper		1		1		
	(c)	(i)		Memory cell	1			1		
		(ii)		Antibodies	1			1		
		(iii)		Mitosis	1			1		
	(d)			Human rights / religious beliefs / fear of side effects	1			1		
				Question 10 total	**4**	**2**	**0**	**6**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
11	(a)	(i)		They have been introduced from another country		1		1		
		(ii)		The variety of species (1) number of each species (1)	2			2		
	(b)	(i)		$\frac{45 \times 47}{29}$ (1) 73 (1)	1	1		2	2	2
		(ii)		**Any 3 (x1) from:** Immigration Births Emigration Predation/ deaths not enough samples	3			3		3
				Question 11 total	**6**	**2**	**0**	**8**	**2**	**5**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
12				**Indicative content:** ADH production by brain / hypothalamus. Less ADH produced when water intake is high. This results in higher volume of less concentrated urine because less water is re-absorbed into the blood by the nephrons. More ADH produced when water intake is low. This results in lower volumes of more concentrated urine because more water is re-absorbed into the blood by the nephrons. **5 – 6 marks**: Detailed correct explanation of ADH production and effect in both high and low water intake. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks**: Less ADH produced when water intake is high. This results in large volumes of dilute urine because less water is re-absorbed. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks**: Some attempt to link the production of hormone with water intake and urine production. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks***: No attempt made or no response worthy of credit.*	6			6		
				Question 12 total	**6**	**0**	**0**	**6**	**0**	**0**

HIGHER TIER

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SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	0	2	3	5	0	4
2	0	3	2	5	0	0
3	3	0	0	3	0	0
4	0	1	5	6	0	1
5	6	1	0	7	0	0
6	1	6	0	7	2	0
7	0	4	3	7	2	2
8	4	4	3	11	1	3
9	2	7	0	9	4	0
10	4	2	0	6	0	0
11	6	2	0	8	2	5
12	6	0	0	6	0	0
TOTAL	32	32	16	80	11	15

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GCSE

BIOLOGY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INSTRUCTIONS TO TEACHERS / EXAMS OFFICERS

Confidential

To be opened on receipt for immediate use by

TEACHERS / EXAMS OFFICERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

A. General Instructions

1. Each candidate will have to submit the number of tasks indicated in the table below.

Qualification	Number of tasks to be submitted
Biology	1
Chemistry	1
Physics	1
Science (Double Award)	2
Applied Science (Double Award)	2
Applied Science (Single Award)	1

The assessment will need to be completed in the first half of the spring term (i.e. January-February). Each task will be completed in two sessions each of 60 minutes duration.

Each task will have a section A and a section B. Section A and section B will be two separate question papers.

Section A will be completed in session 1 and will involve obtaining results. This will be collected from the candidates at the end of session 1. Section B will be completed in session 2 and will involve the analysis and evaluation of the results. Candidates should be given access to their section A question paper in session 2. **Section B should not be given to candidates until the second session. Both sections should be collected in at the end of session 2.**

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2. The assessment should be supervised at all times by a member of staff responsible for teaching GCSE Science. Centres may use additional laboratories, provided that a subject teacher is available to supervise all groups at all times.

3. Teachers may open the **"Setting up Instructions"** document at the start of January. **This is for the purpose of ensuring that the apparatus functions well enough for the candidates to complete the task fully. Teachers are encouraged to try out the task, whilst preserving the confidentiality of the assessment.**

4. The question papers for all tasks will be made available to the examinations officer in each centre at the start of January.

5. **Section A**: It is permissible for candidates to work in small groups, of no more than three candidates. Teachers should ensure that each group has adequate working space and that the groups are set a reasonable distance apart. Each group requires uninterrupted access to the allocated apparatus – one set of apparatus per group. This is carried out under a limited level of control, i.e. learners may work with others to obtain results but they must provide their own responses to the questions set. Teacher assistance should not normally be required, but may be given if equipment failure occurs.

6. Once section A is completed, the question paper should be securely stored by the teacher until section B takes place.

7. **Section B**: This is carried out under a high level of control, i.e. learners must work individually. This section is to be completed with no teacher feedback or assistance allowed and under formal supervision. Candidates should have access to their section A question paper, as they need the results obtained in the first session to answer the questions in section B.

8. Candidates should write their answers in the spaces provided on the question paper. Should there be a need for additional space then a standard extension/answer booklet should be provided.

9. If candidates fail to obtain results for section A, it is acceptable for them to be given unformatted teacher results.

10. As soon as both section A and section B have taken place, the question papers for each candidate should be attached to each other and then securely stored by the exams officer before they are sent to the examiner by …… at the latest. Teachers should not be given access to the completed question papers after the actual assessments have taken place.

11. The assessment will be externally marked by a WJEC examiner. The name and address of the examiner will be issued to centres by the end of April.

12. Monitoring visits will take place on a random sample of centres to ensure the practical assessment is being administered correctly.

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B. Specific Instructions

Details of the apparatus and materials required for the tasks follow.

If any difficulty is experienced in providing the apparatus, WJEC should be informed as soon as possible.

Contacts:

Subject Officer Helen Francis, 029 2026 5081, helen.francis@wjec.co.uk

Support Officer Lowri Evans, 029 2026 5140, lowri.evans@wjec.co.uk

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

Apparatus Required

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 5 × different crushed biscuit types (2 × 2.0 g of each).
  A suggested range of biscuits could include ginger, nice, digestive, rich tea and crackers.
- 1 × stopwatch (± 0.01 s)
- 1 × 250 cm^3 beaker
- 2 × 10 cm^3 measuring cylinders/ syringes
- 5 × boiling tubes
- 10 × pieces of filter paper
- 50 cm^3 Benedict's reagent
- spatula
- CLEAPSS student safety sheet 4 – Food testing (1)
- labelling pen

The following is required for each class:

- Access to recently boiled water (kettle/ waterbath)
- Balance (± 0.1 g)

Please be aware of any candidates who may have nut allergies.

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GCSE

BIOLOGY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

SETTING UP INSTRUCTIONS

Confidential

To be opened on …… (date) by TEACHERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

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SECTION A

Introduction

Your task is to investigate the sugar content of different biscuits.

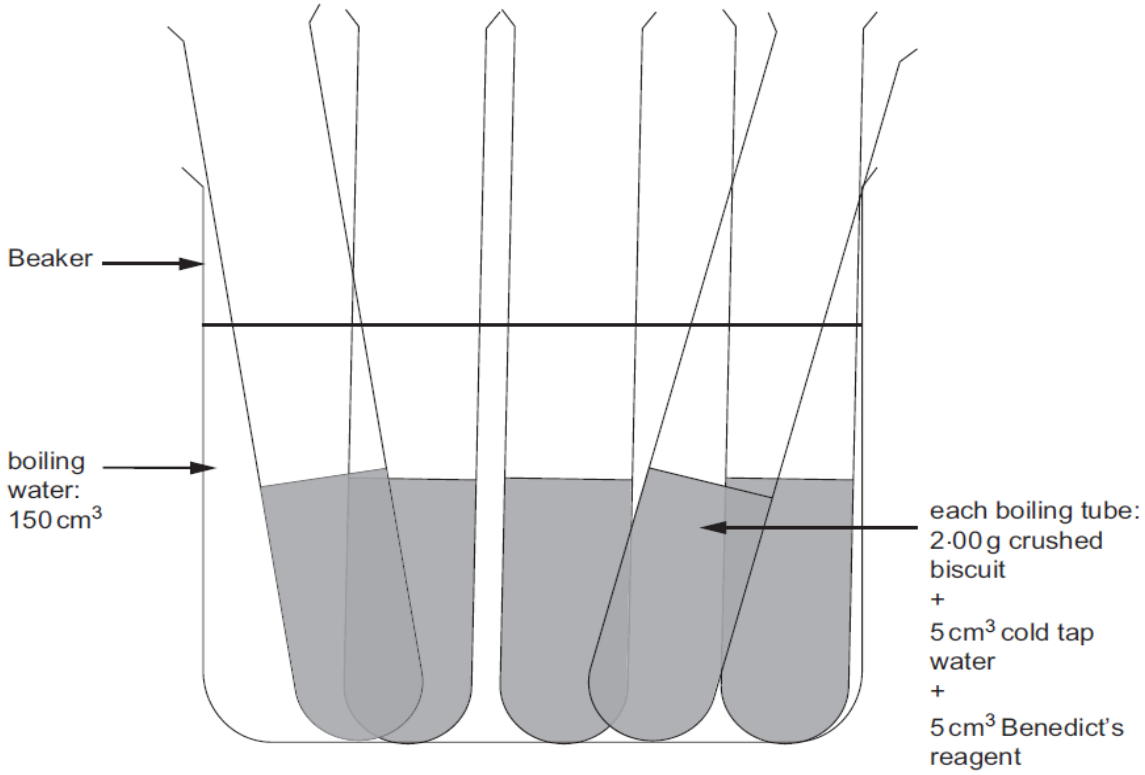
Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 5 × different crushed biscuit types (2 × 2.0 g of each)
  A suggested range of biscuits could include ginger, nice, digestive, rich tea and crackers.
- 1 × stopwatch (± 0.01 s)
- 1 × 250 cm^3 beaker
- 2 × 10 cm^3 measuring cylinders/ syringes
- 5 × boiling tubes
- 10 x pieces of filter paper
- 50 cm^3 Benedict's reagent
- spatula
- CLEAPSS student safety sheet 4 – Food testing (1)
- labelling pen

The following is required for each class:

- Access to recently boiled water (kettle/ waterbath)
- Balance (± 0.1 g)



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Method

1. Label the five boiling tubes for each type of biscuit.

2. Transfer 2.0 g of each biscuit type into the correct boiling tube.

3. Using a measuring cylinder/syringe, transfer 5 cm^3 of cold tap water into each boiling tube.

4. Using another measuring cylinder/syringe, transfer 5 cm^3 of Benedict's reagent into each boiling tube.

5. Shake each tube gently to ensure that the contents are thoroughly mixed.

6. Pour 150 cm^3 of boiling water into the 250 cm^3 beaker.

7. Place the five test tubes into the boiling water and immediately start the stopwatch.

8. Record, to the nearest second, the time it takes for the Benedict's reagent to change from blue to orange/brick red in colour.

9. Repeat steps 1 to 8 to gain two sets of results in total for each biscuit.

The remainder of the examination paper is not required for the purpose of checking the setting up of the task.

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Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

BIOLOGY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

SECTION A

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section A	**6**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 6.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will complete section **A** in one session and section **B** in the next session.

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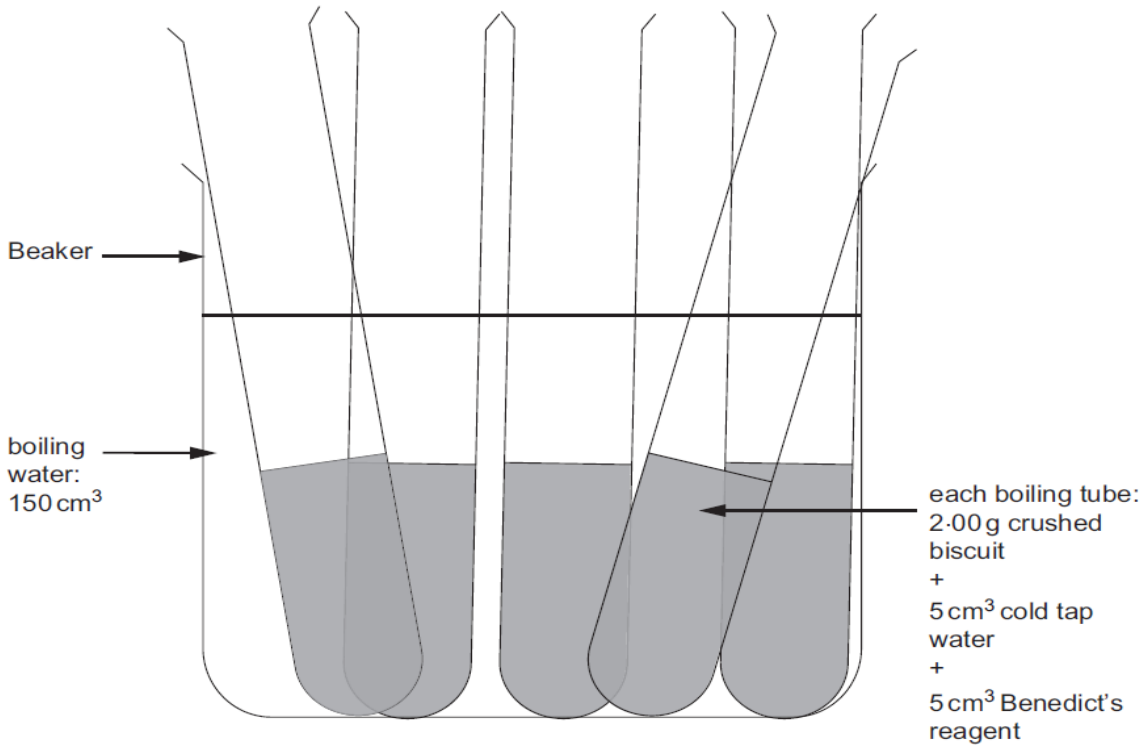
SECTION A

Your task is to investigate the sugar content of different biscuits.

The following apparatus available for each group:

- A range of five different crushed biscuit types (2 × 2.0 g of each)
- 1 × stopwatch (± 0.01 s)
- 1 × 250 cm^3 beaker
- 2 × 10 cm^3 measuring cylinders
- 5 × boiling tubes
- Filter paper
- Benedict's reagent
- Kettle
- Spatula
- Balance (± 0.1 g)
- CLEAPSS student safety sheet 4 – Food testing (1)



Read the method and answer question 1(a) before carrying out the experiment and recording your results.

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Method:

1. Label the five boiling tubes for each type of biscuit.

2. Transfer 2.0 g of each biscuit type into the correct boiling tube.

3. Using a measuring cylinder/syringe, transfer 5 cm^3 of cold tap water into each boiling tube.

4. Using another measuring cylinder/syringe, transfer 5 cm^3 of Benedict's reagent into each boiling tube.

5. Shake each tube gently to ensure that the contents are thoroughly mixed.

6. Pour 150 cm^3 of boiling water into the 250 cm^3 beaker.

7. Place the boiling test tubes into the boiling water and immediately start the stopwatch.

8. Record, to the nearest second, the time it takes for the Benedict's reagent to change from blue to orange/brick red in colour.

9. Repeat steps 1 to 8 to gain two sets of results in total for each biscuit.

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Answer **all** *questions*

1. (a) Carry out a risk assessment **for this experiment**.

Describe how each hazard may result in a risk of injury. Describe the control measures needed to minimise each risk. [2]

HAZARD	RISK	CONTROL MEASURE
Benedict's reagent: is an irritant		
Boiling water: can cause burns		

You may record raw results in the space below.

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(b) Present your results in a table; include all of your results and the mean time taken for the Benedict's solution to change from blue to orange/ brick red for each biscuit type. [4]

6

END OF PAPER

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Candidate Name	Centre Number					Candidate Number				
						0				

GCSE BIOLOGY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

SECTION B

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section B	**24**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator and your section **A** exam paper.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 24.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will have completed section **A** in a previous session.

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SECTION B

Answer **all** *questions*

2. (a) (i) State the independent variable in this experiment. [1]

……

(ii) State the dependent variable in this experiment. [1]

……

(iii) State **two** variables that needed to be controlled **for this experiment**. Explain why you controlled each of these. [4]

Control variable 1: ……

Explanation: ……..

Control variable 1: ……

Explanation: ……..

(b) Describe how you could set up a control tube for this experiment. [3]

……

……

……

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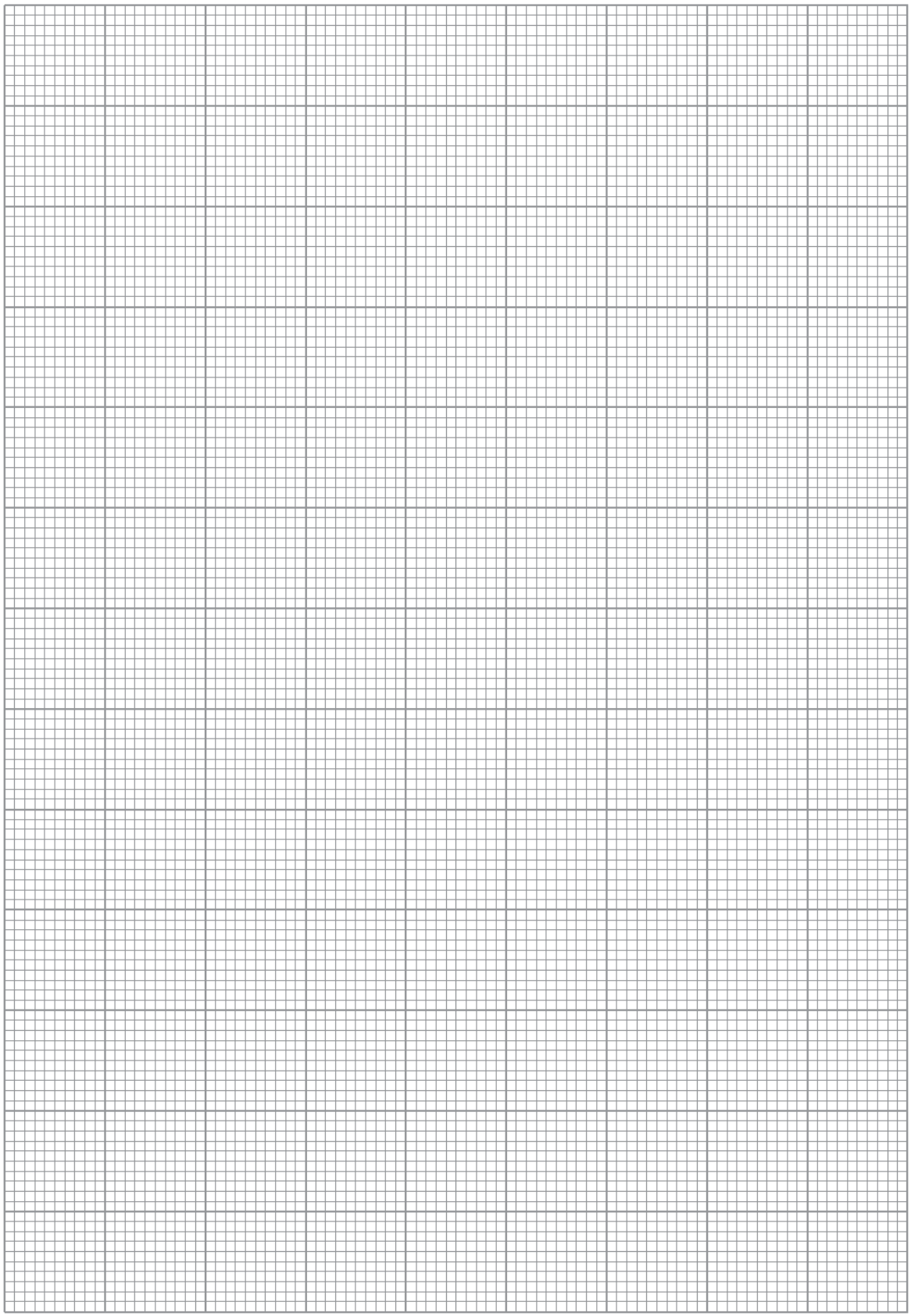
(c) Use your results from section A to draw a graph of your results on the grid below. [4]



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(d) What can you conclude about the sugar content of the biscuits tested? Explain your answer. [3]

……

……

……

……

(e) State the **main** source of uncertainty during this experiment. Describe how this uncertainty could be reduced. [2]

……

……

……

(f) Why does it make sense to record the time to the nearest second rather than tenths or hundredths of a second? [1]

……

……

(g) Angharad tests the sugar content of three types of biscuit (A, B and C). She times how long it takes for the Benedict's reagent to change colour. She repeats each biscuit three times.

Biscuit	Trial 1	Trial 2	Trial 3	Mean
A	361.8	355.3	347.2	354.8
B	315.4	329.3	333.5	326.1
C	303.9	312.0	398.6	338.2

(i) Circle the anomalous result in the table. State why this result is anomalous. [2]

……

……

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(ii) Angharad concluded that Biscuit **B** contained the most sugar. Another student disagreed with her. Suggest why the other student disagreed with her.

[1]

……

……

(iii) State what **further** data would be needed to produce a more valid conclusion. [2]

……

……

……

……

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END OF PAPER

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UNIT 3: PRACTICAL ASSESSMENT

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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SECTION A

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Benedict's risk: sensible risk e.g. chemical splashing into eyes, risk of spitting if heat tubes directly **and** Benedict's control measure: wear goggles, heat tubes indirectly/using a water bath (1) Boiling water risk: sensible risk e.g. can cause burns to skin/eyes when carrying the beaker/water bath **and** Boiling water control measure: wear goggles, avoid spillages, care when handling (1)	2			2		2
	(b)			Ordered layout into columns (1) Suitable column headings (1) Appropriate units (1) Correct calculation of mean scores from two repeat sets of results (1)	1 1	1 1		4	1	4
				Section A total	**4**	**2**	**0**	**6**	**1**	**6**

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SECTION B

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		The type of biscuit (1)	1			1		1
		(ii)		The time taken for the (Benedict's reagent) colour change (1)	1			1		1
		(iii)		**Any 2 (x1) from:** • Control variable - mass of biscuit • Explanation - used a balance to weigh to 2 • Control variable - volume of cold/tap water • Explanation - used a measuring cylinder/ syringe to measure to 5 cm^3 • Control variable - volume of Benedict's reagent • Explanation - used a measuring cylinder/ syringe to measure to 5 cm^3	2	2		4		4
	(b)			Use 2 g of a food that does not contain sugar (1) Same volume of Benedict's reagent (1) Other reference to same conditions e.g. same volume of water, use of boiling water in the beaker (1)		3		3		3
	(c)			Axes labelled correctly with units (1) Scales & use of at least ½ of graph paper (1) All plots correctly plotted with ± ½ small square tolerance (2) 1 error (1) >1 error (0)	1 1	2		4	4	4

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			Correct statement regarding which biscuit contained the most or the least sugar- check against candidates own results (1) All biscuits mean results considered (1) The faster/quicker/less time taken for the Benedict's reagent to change colour, the higher/greater/more sugar content of the biscuit (1)			3	3		3
	(e)			Random error stated as difficulty in judging when the Benedict's reagent had (fully) changed colour (1) Sensible suggestion of how to reduce the error e.g. sensor to detect colour change/ using the same person to make the judgement/ having agreement between two group members in making the judgement/ colour standard to compare (1)	2			2		2
	(f)			There is a delay of more than one tenth of a second between seeing the Benedict's colour change and stopping the stopwatch/difficulty in pinpointing the exact time of the colour change		1		1		1
	(g)	(i)		398.6 s is correctly circled (1) Anomalous results are not clustered to/do not fit the pattern/are not within the range of the other results (1)			2	2		2
		(ii)		Angharad included the anomalous result in her mean for C, otherwise that result would have been the lowest			1	1		1
		(iii)		Repeat trial 3 for C/ repeat all biscuits more times to assess repeatability (1) Compare with other groups for reproducibility (1)		2		2		2
				Section B total	**8**	**10**	**6**	**24**	**4**	**24**

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