
INTERNATIONAL GCSE CORE BIOLOGY

9221

Paper 1

Specimen paper

07:00 GMT

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- A ruler with millimetre measurements
- a scientific calculator.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this answer book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- The marks for each question are shown in brackets.
- You are expected to use a calculator where appropriate
- You are reminded of the need for good English and clear presentation in your answers.

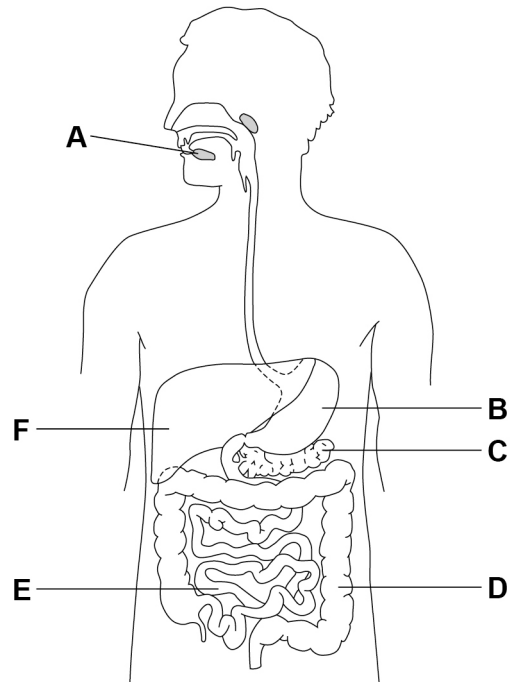
Advice

In all calculations, show clearly how you work out your answer.

0 1

Figure 1 shows the human digestive system.

Figure 1



0 1 . 1

Which organ in **Figure 1** is the large intestine?

Tick (✓) **one** box.

[1 mark]

A

☐

B

☐

C

☐

D

☐

0 1 . 2 Which organ in **Figure 1** is the salivary gland?

Tick (✓) **one** box.

[1 mark]

A

☐

B

☐

C

☐

D

☐

0 1 . 3 Food passes through some of the organs in **Figure 1**.

Which **one** of the following organs does food pass through?

Tick (✓) **one** box.

[1 mark]

B

☐

C

☐

F

☐

0 1 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

amylase

lipase

protease

Starch is broken down by the enzyme _____.

0 1 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

amino acids

fatty acids

sugars

Starch is broken down into _____.

A scientist compared the effect of three diets for athletes training for a marathon.

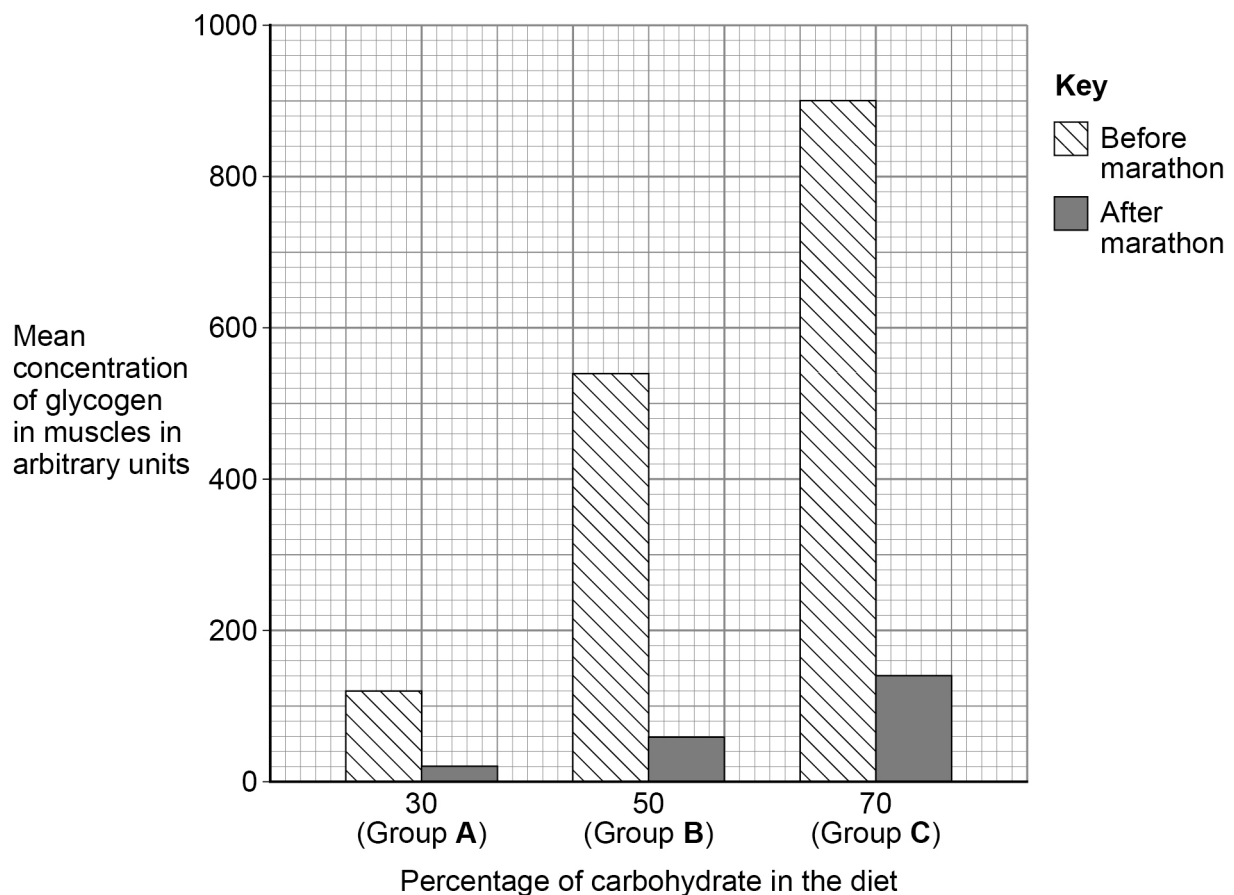
A marathon is a 26-mile run.

This is the method used.

1. Separate the athletes into 3 groups.
2. Each group of athletes eats a different diet for a month:
 - athletes in group **A** eat a diet containing 30% carbohydrate
 - athletes in group **B** eat a diet containing 50% carbohydrate
 - athletes in group **C** eat a diet containing 70% carbohydrate.
3. Measure the concentration of glycogen in the muscles of each athlete before and after running a marathon.

The results are shown in **Figure 2**.

Figure 2



0 1 . 6 Which **two** were control variables in the investigation?

Tick (✓) **two** boxes.

[2 marks]

Amount of food eaten per day

☐

Concentration of glycogen in the muscles

☐

Distance of the marathon

☐

Length of time the diet was eaten

☐

Percentage of carbohydrate in the diets

☐

0 1 . 7 The scientist recommended that athletes training for a marathon should eat a diet containing 70% carbohydrate.

Explain why eating this type of diet is an advantage to an athlete.

[4 marks]

0 2

The circulatory system in the human body consists of the heart and blood vessels.

The heart pumps blood around the body in the blood vessels.

0 2 . 1

Draw **one** line from each type of blood vessel to the description of the blood vessel.

[3 marks]

Blood vessel	Description
Artery	has thick walls of muscle and elastic fibres
Capillary	has valves to stop the back-flow of blood
Vein	is narrow with thin walls for fast diffusion
	is solid and not tube-shaped

0 2 . 2

Blood is made up of a fluid in which blood cells are suspended.

What is the name of the fluid?

Tick (✓) **one** box.

[1 mark]

Plasma	☐
Sweat	☐
Urine	☐
Water	☐

0 2 . 3

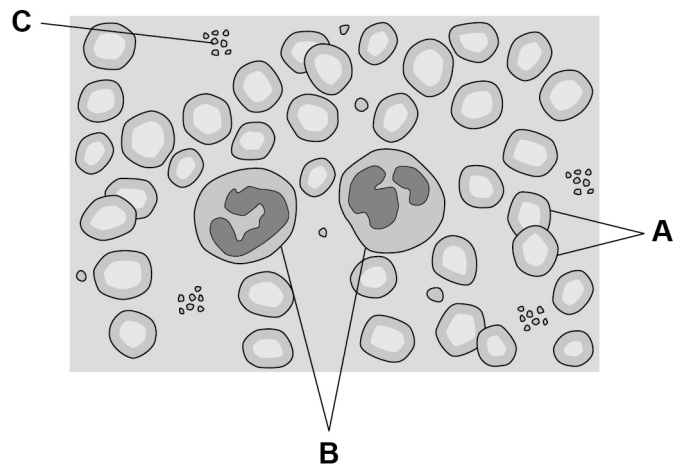
Deoxygenated blood travels to an organ to collect oxygen before being pumped to all the tissues in the body.

Name the organ where oxygen enters the blood.

[1 mark]

Figure 3 shows the components of the blood.

Figure 3



Describe the components of the blood, **A**, **B** and **C**.

You should:

- name each component
- describe the function of each component.

[6 marks]

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0 3

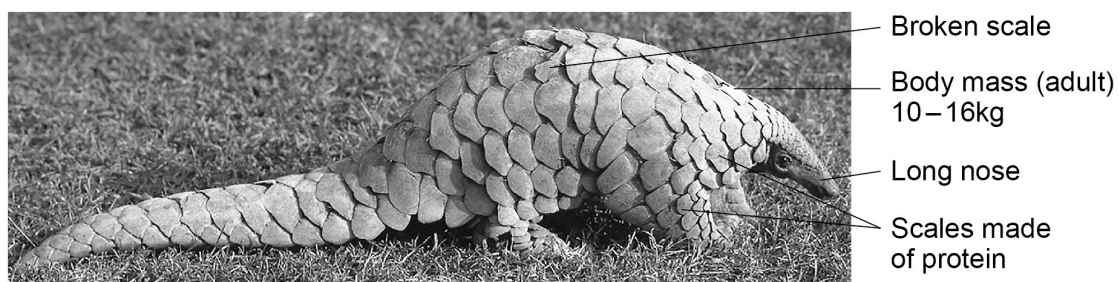
Pangolins are mammals. Pangolins have scales covering their body instead of hair.

Variation in pangolins may be caused by:

- genes
- the environment
- both genes and the environment.

Figure 4 shows a pangolin.

Figure 4



0 3

1

Complete **Table 1** to show the causes of variation in pangolins.

Tick (✓) **one** box in each row.

[3 marks]

Table 1

Characteristic	Variation caused by		
	genes	the environment	both genes and the environment
Body mass			
Broken scale			
Scales made of protein			

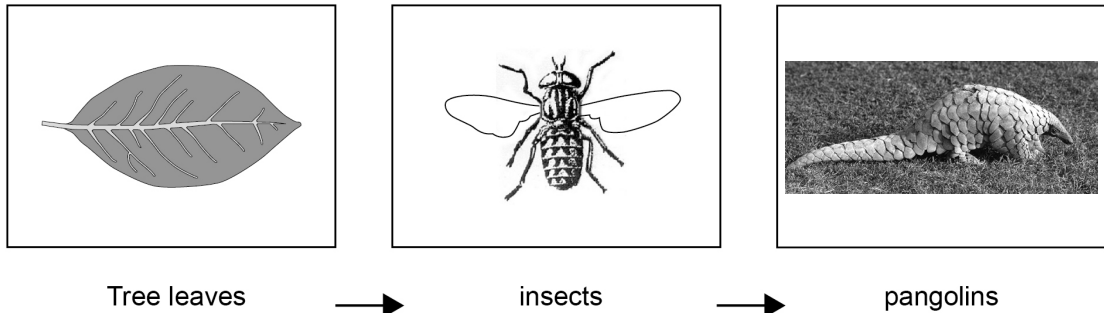
0 3 . 2

Pangolins live in trees.

Pangolins feed on insects.

Figure 5 shows a food chain for pangolins.

Figure 5



A pangolin ate 124 g of insects.

10% of the insect biomass was passed on to the pangolin. The rest of the biomass is waste.

Calculate the mass of insects that became biomass in the pangolin.

[2 marks]

Mass = _____ g

Question 3 continues on the next page

0 3 . 3 Pangolins are in danger of dying out.

Government officials seized an illegal package of 120 kg of pangolin scales.

The mean mass of scales on one pangolin was 600 g.

Calculate the number of pangolins needed to provide 120 kg of pangolin scales.

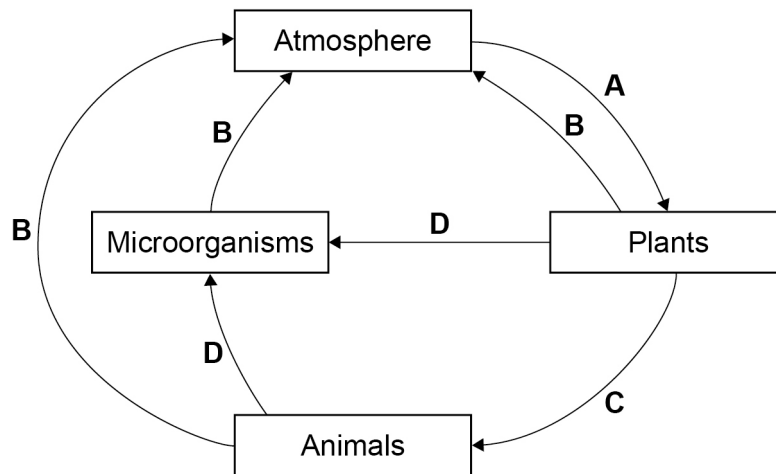
[3 marks]

Number of pangolins = _____

0 4

Figure 6 shows part of the carbon cycle.

Figure 6



0 4 . 1

Name process **C** in **Figure 6**.

[1 mark]

0 4 . 2

Write the word equation for process **A** shown on **Figure 6**.

[2 marks]

_____ + _____ → _____ + _____

0 4 . 3

Process **D** is decay.

Decay is caused by microorganisms.

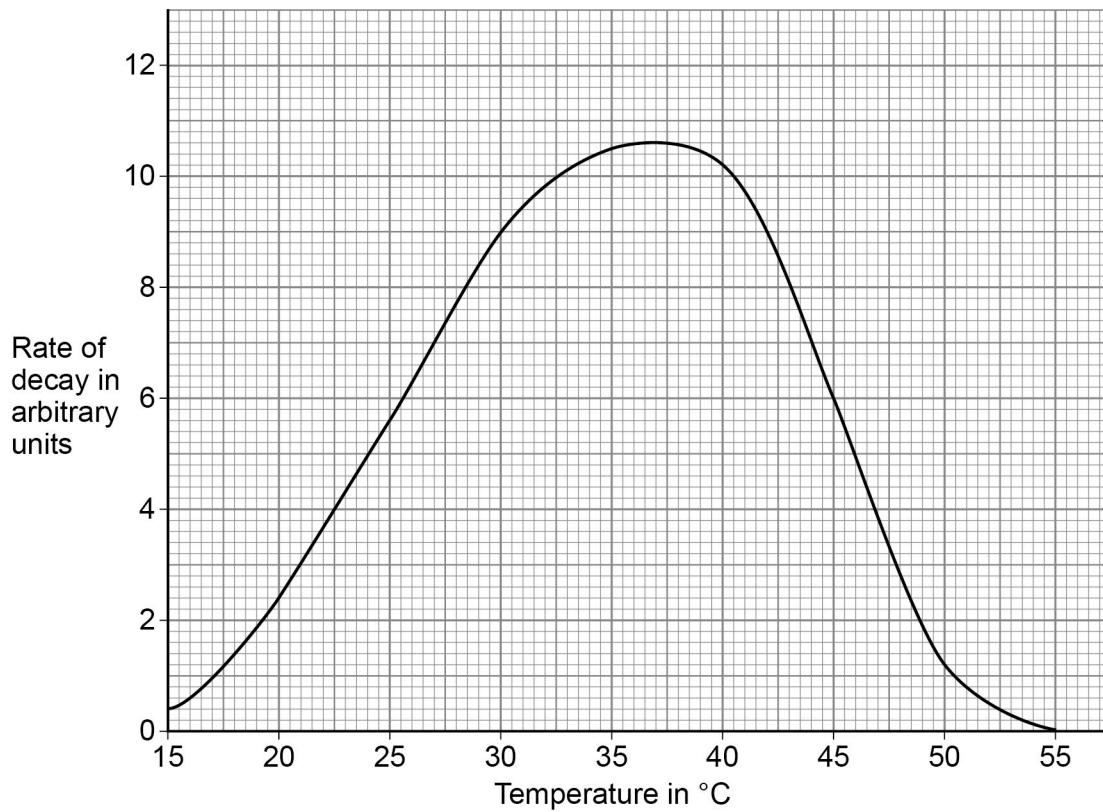
Decay happens fastest when conditions are warm.

Give **one other** factor that increases the rate of decay.

[1 mark]

Figure 7 shows how the rate of decay in a pile of garden waste changes with temperature.

Figure 7



0 4 . 4 Determine the decrease in the rate of decay from 40 °C to 45 °C.

[2 marks]

Decrease = _____ arbitrary units

0	4	.	5
---	---	---	---

Explain the shape of the graph in **Figure 7**.

[3 marks]

You should refer to enzymes in your answer.

Use data from **Figure 7**.

9

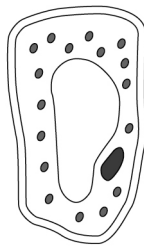
Turn over for the next question

0 5

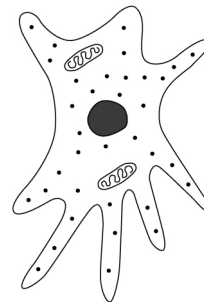
Figure 8 shows two different cells. Fibroblast cells can be found in animals.

Figure 8

Plant cell



Fibroblast cell



0 5 . 1

Give **two** structures found in plant cells that are **not** found in an animal cell.

[2 marks]

1 _____

2 _____

0 5 . 2

The plant cell divides many times for growth.

What type of cell division produces new cells for growth?

[1 mark]

0 5 . 3

Fibroblast cells carry out respiration.

Which part of a cell carries out respiration?

Tick (✓) **one** box.

[1 mark]

Cell membrane

☐

Nucleus

☐

Mitochondrion

☐

0 5 . 4

In disorder **D** fibroblast cells make weak protein fibres.

Disorder **D** is caused by a dominant allele.

Two parents have a child who does **not** have disorder **D**.

The mother has disorder **D**. The father does **not** have disorder **D**.

The parents are expecting another child.

Determine the probability that the child will have disorder **D**.

You should:

- complete **Figure 9**
- identify any offspring genotypes that would have disorder **D**
- use the symbols:

D = allele for disorder **D**

d = allele for not having disorder **D**

[4 marks]

Figure 9

		Mother	
		D	d
Father			

Probability = _____

0	6
---	---

Exercise causes the muscle cells to respire faster to release energy for contraction.

Students investigated the effect of the level of exercise on the body.

This is the method used.

1. Select six volunteers randomly from the school.
2. Ask the volunteers to sit on a low bench for 10 minutes.
3. Measure and record the heart rate of each volunteer.
4. Ask each volunteer to step onto and down from the bench 5 times.
5. Measure and record their heart rate.
6. Allow volunteers to rest.
7. Repeat steps 4 to 6 using 10, 15 and then 20 step-ups.
8. Calculate a mean heart rate for the six volunteers at each level of exercise.

0	6
---	---

1

The students did **not** have a digital heart monitor.

Describe how the students could measure heart rate in the school laboratory.

[2 marks]

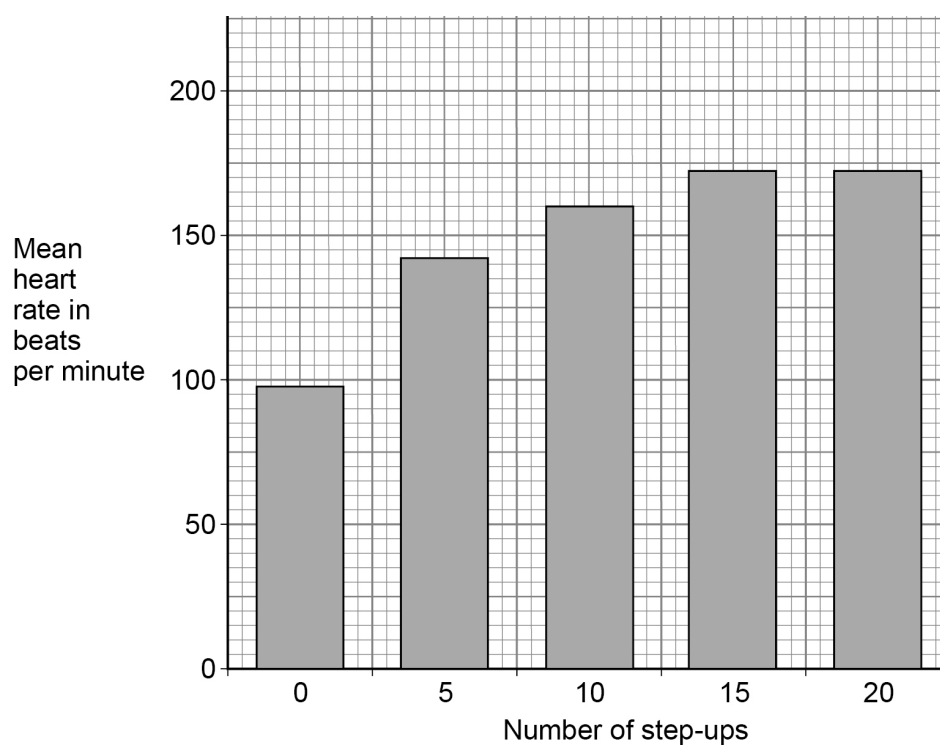
Table 2 shows the students' results.

Table 2

Number of step-ups	Mean heart rate in beats per minute
0 (resting)	98
5	143
10	161
15	174
20	174

Figure 10 shows the students' graph.

Figure 10



0 6 . 2

A teacher told the students the graph they plotted in **Figure 10** was not appropriate for the data.

Explain why the graph was **not** appropriate.

[2 marks]

0	6	.	3
---	---	---	---

Describe the trends in the data in **Table 2**.

[2 marks]

0	6	.	4
---	---	---	---

After the test with 20 step-ups some students had pain in the lower legs.

Explain why the students experienced pain after exercising hard.

[2 marks]

1

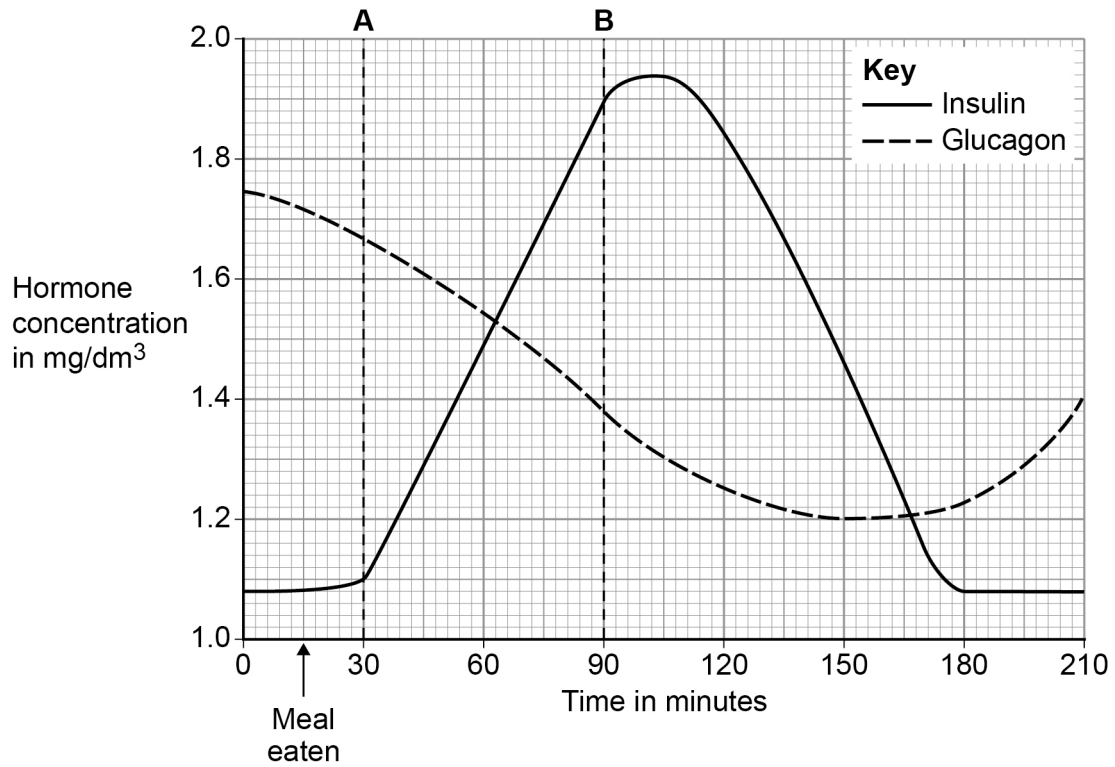
2

0 7

The human body needs to control blood glucose concentration within narrow limits.

Figure 11 shows how the concentration of insulin and glucagon change after eating a meal.

Figure 11



0 7 1

Calculate the rate of insulin release into the blood between points **A** and **B** in **Figure 11**.

You should include the units in your answer.

[4 marks]

Rate of insulin release = _____ Unit _____

0 7 . 2 Name the organ that produces glucagon.

[1 mark]

0 7 . 3 When blood glucose concentration falls too low the hormone glucagon is released.

Explain how glucagon will restore the blood glucose concentration back to the normal concentration.

[2 marks]

0 7 . 4 People with diabetes need treatment for high blood glucose concentrations in the blood.

For Type 1 diabetes, injections of insulin are given several times daily.

For Type 2 diabetes, insulin is not usually given. Instead a controlled diet and exercise are used to reduce the glucose concentration of the blood.

Explain why the treatment is different for Type 1 and Type 2 diabetes.

[3 marks]

0	8
---	---

Genetically modified (GM) plants can be produced which are resistant to:

- particular herbicides
- particular insect pests.

This process is called genetic engineering.

0	8	.	1
---	---	---	---

Describe the steps needed to genetically engineer a wheat plant to be resistant to herbicide **A**.

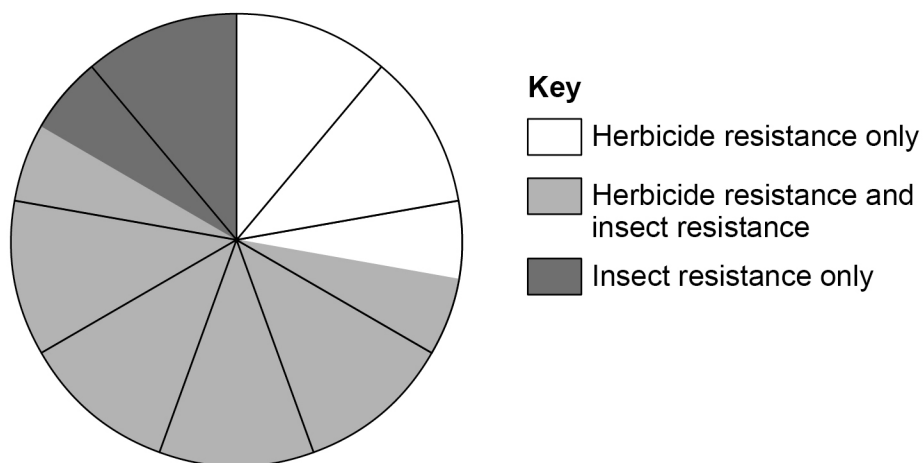
[5 marks]

Question 8 continues on the next page

0 8 . 2

Figure 12 shows how often herbicide resistant genes and insect resistant genes are used in GM plants compared to each other.

Figure 12



Complete **Table 3**.

Use **Figure 12** to estimate the proportion of GM plants that have the genes for each type of resistance.

[2 marks]

Table 3

Type of resistance	Proportion
Herbicide resistance only	
Herbicide resistance and insect resistance	
Insect resistance only	

This is the method used.

- Table 4** shows the results.

Month	Mean total leaf area per plant in cm ²	
	GM plants	Non-GM plants
0	158	152
1	98	92
2	80	64
3	72	44
4	74	32
5	80	27

Evaluate the scientist's method and conclusion.

[illegible]

09

Students set up an investigation to determine the concentration of an unknown sugar solution.

The students used tubing made from a partially permeable membrane.

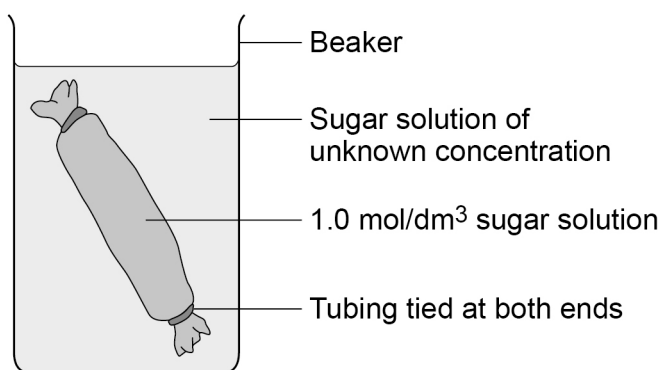
This is the method used:

1. Cut a 10 cm length of tubing and tie one end.
2. Fill the tubing with 10 cm³ of 1.0 mol/dm³ sugar solution and tie the other end.
3. Measure and record the mass of the tubing.
4. Repeat steps 1 to 3 with five other known concentrations of sugar solution.
5. Place each length of tubing into a separate beaker containing sugar solution of the same unknown concentration.
6. Leave the beakers for 12 hours at 20 °C.
7. Remove each length of tubing from the beakers.
8. Measure and record the mass of each tubing.

09.1

Figure 13 shows the apparatus set up for the 1.0 mol/dm³ sugar solution.

Figure 13



Give **two** control variables the students used in the investigation.

[2 marks]

1

2

09.2

A teacher said that the students should roll each length of tubing on a paper towel before weighing it.

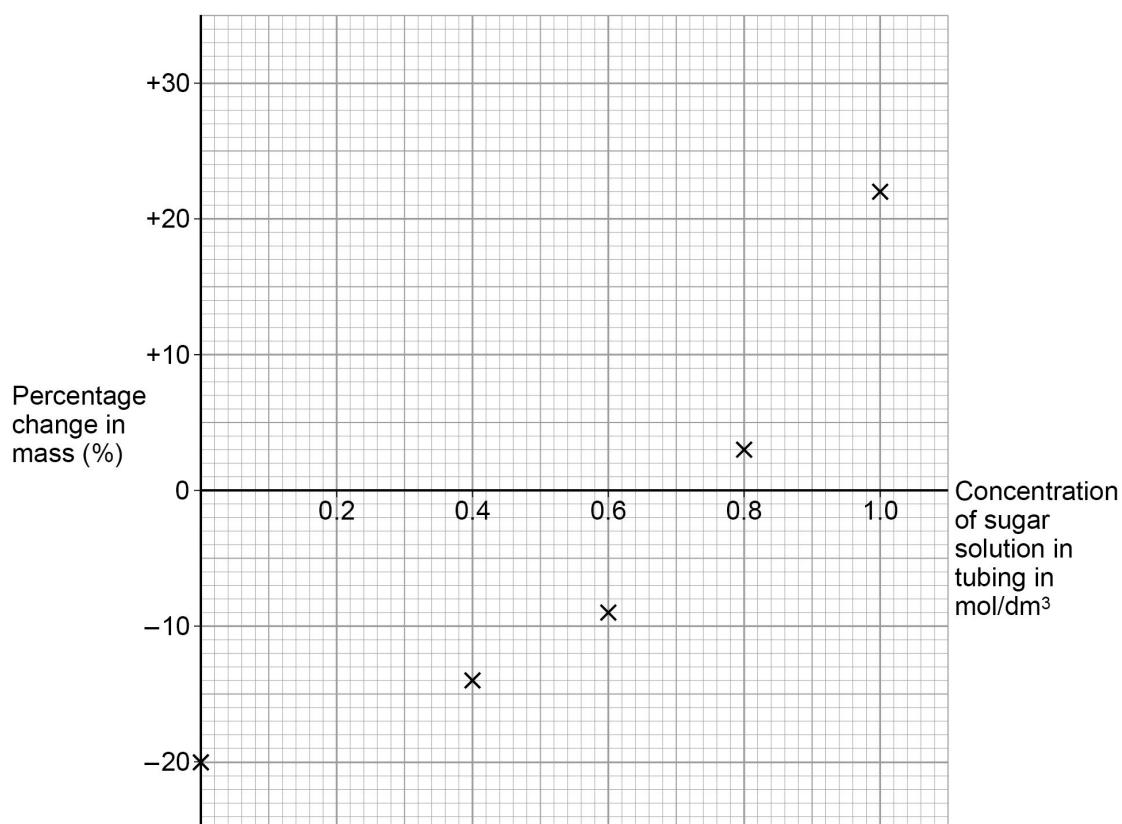
Suggest why.

[1 mark]

09.3

Figure 14 shows the results.

Figure 14



Determine the concentration of the unknown sugar solution in the beakers.

Use the graph in Figure 14.

[2 marks]

Concentration = _____ mol/dm³

0 9 . 4

Suggest **one** improvement to the student's method which would increase the validity of the results.

[1 mark]

0 9 . 5

Suggest why the students calculated the percentage change in mass rather than plotting the change in mass in grams.

[1 mark]

0 9 . 6

Storing fruit in a concentrated sugar solution prevents the fruit decaying.

Explain how a concentrated sugar solution prevents fruit decaying.

[4 marks]

1 0

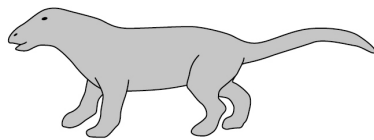
In the 1800s, Darwin and Lamarck had different theories about how organisms evolved.

Lamarck thought that changes occurring in an organism during its lifetime could be inherited by its offspring.

Figure 15 shows an ancestor of the dolphin and a present-day dolphin.

Figure 15

Ancestor of the dolphin

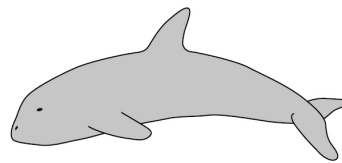


Lived on land.

Had four legs.

Spent more and more time in the water getting food.

Present-day dolphin



Lives in water.

Has flippers where the front legs used to be and a bone with no function where the back legs used to be.

Eats fish and other seafood.

1 0

1

Explain how **Lamarck's** theory would account for the evolution of the water-living dolphin from the land-living ancestor.

[4 marks]

1	0	.	2
---	---	---	---

Give **one** reason why most scientists now accept Darwin's theory of evolution.

[1 mark]

Figure 16 and **Table 5** show information about the evolution of the horse.

Figure 16

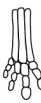
Horses are preyed upon by other animals.

The earliest ancestors of the horse lived in forests with soft ground.

Over millions of years the ground gradually became dry and hard.

The forests were replaced with grassland.

Table 5

	Name of animal	Height in metres	Bones in foot
Present day  60 million years ago	Equus	1.60	
	Pliohippus	1.25	
	Merychippus	1.00	
	Mesohippus	0.60	
	Hyracotherium	0.40	

1	0	.	3
---	---	---	---

Explain how the Hyracotherium species of horse evolved into the Equus species of horse.

Use information from **Figure 16** and **Table 5**.

[6 marks]

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11

END OF QUESTIONS

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