SPECIMEN MATERIAL

AS
BIOLOGY
(7401/2)
Paper 2

Specimen 2014 Session Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

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Candidate signature _____

Answer **all** questions in the spaces provided.

1 A student investigated mitosis in the tissue from an onion root tip.

0 1 . 1 The student prepared a temporary mount of the onion tissue on a glass slide. She covered the tissue with a cover slip. She was then given the following instruction.

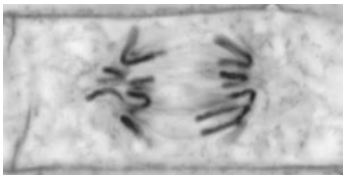
"Push down hard on the cover slip, but do not push the cover slip sideways."

Explain why she was given this instruction.

[2 marks]

Figure 1 shows one cell the student saw in the onion tissue.

Figure 1



0 1 . 2 The student concluded that the cell in **Figure 1** was in the anaphase stage of mitosis. Was she correct? Give **two** reasons for your answer.

[2 marks]

1

2

0 1 . 3 The student counted the number of cells she observed in each stage of mitosis. Of the 200 cells she counted, only six were in anaphase.

One cell cycle of onion root tissue takes 16 hours. Calculate how many minutes these cells spend in anaphase.

Show your working.

[2 marks]

Answer = _____ minutes

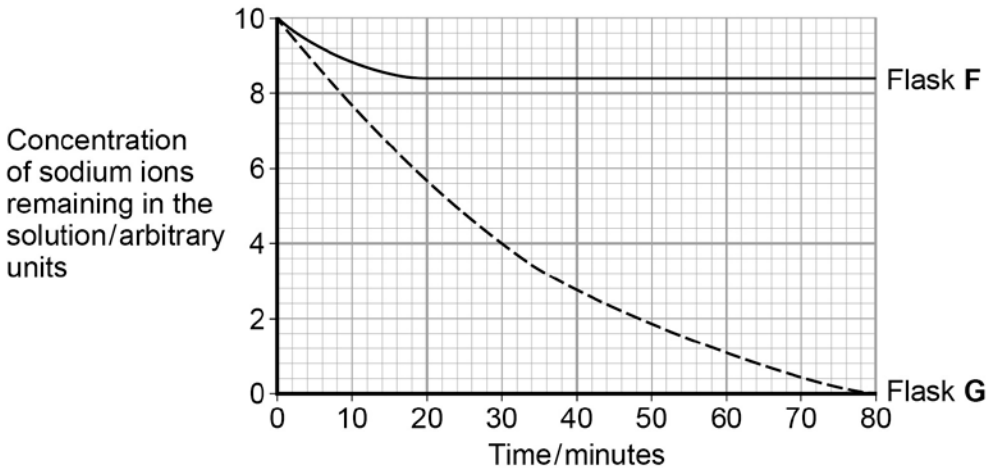
Turn over for the next question

2 A scientist investigated the uptake of sodium ions by animal tissue.
To do this, he:

- used two flasks, **F** and **G**
- put equal masses of animal tissue into each flask
- added equal volumes of a solution containing sodium ions to each flask
- added to flask **F** a solution of a substance that prevents the formation of ATP by cells
- measured the concentration of sodium ions **remaining** in the solution in each flask.

Figure 2 shows his results.

Figure 2



0 2 . 1 Calculate the rate of uptake of sodium ions by the tissue in flask **G** during the first 20 minutes of this investigation.

[1 mark]

Answer = _____ arbitrary units per minute

0 2 . 2 The scientist concluded that the cells in flask **G** took up sodium ions by active transport. Explain how the information given supports this conclusion.

[4 marks]

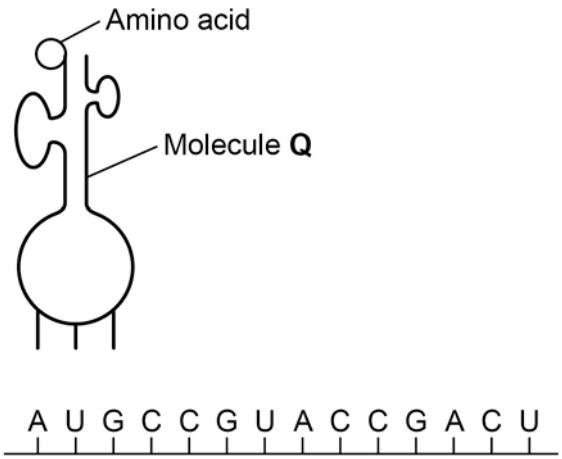
[Extra space]

0 2 . 3 The curve for flask **F** levelled off after 20 minutes. Explain why.

[2 marks]

3 **Figure 3** represents one process that occurs during protein synthesis.

Figure 3



0 3 . 1 Name the process shown.

[1 mark]

_____

0 3 . 2 Identify the molecule labelled **Q**.

[1 mark]

_____

0 3 . 3 In **Figure 3**, the first codon is AUG. Give the base sequence of:

[2 marks]

the complementary DNA base sequence _____

the missing anticodon _____

Table 1 shows the base triplets that code for two amino acids.

Table 1

Amino acid	Encoding base triplet
Aspartic acid	GAC, GAU
Proline	CCA, CCG, CCC, CCU

0 3 . 4 Aspartic acid and proline are both amino acids. Describe how two amino acids differ from one another. You may use a diagram to help your description.

[1 mark]

0 3 . 5 Deletion of the sixth base (G) in the sequence shown in **Figure 3** would change the nature of the protein produced but substitution of the same base would not. Use the information in **Table 1** and your own knowledge to explain why.

[3 marks]

[Extra space]

4 Breathing out as hard as you can is called forced expiration.

0 4 . 1 Describe and explain the mechanism that causes forced expiration.

[4 marks]

Two groups of people volunteered to take part in an experiment.

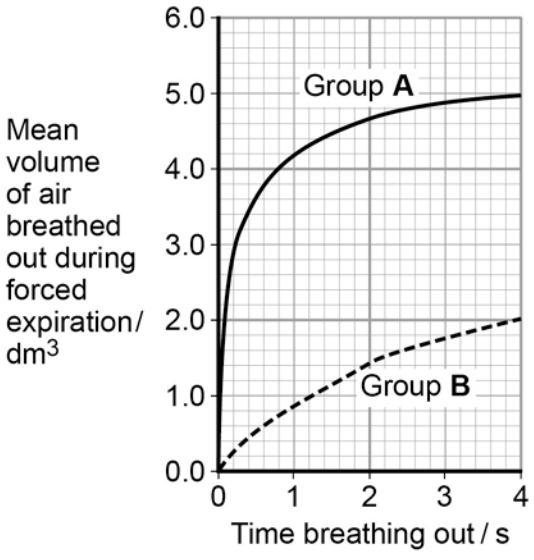
- People in group **A** were healthy.
- People in group **B** were recovering from an asthma attack.

Each person breathed in as deeply as they could. They then breathed out by forced expiration.

A scientist measured the volume of air breathed out during forced expiration by each person.

Figure 4 shows the results.

Figure 4



0 4 . 2 Forced expiration volume (FEV) is the volume of air a person can breathe out in 1 second.

Using data from the first second of forced expiration, calculate the percentage decrease in the FEV for group **B** compared with group **A**.

[1 mark]

Answer = _____ %

0 4 . 3 The people in group **B** were recovering from an asthma attack.
Explain how an asthma attack caused the drop in the mean FEV shown in **Figure 4**.

[4 marks]

[Extra space] _____

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5 Newborn babies can be fed with breast milk or with formula milk. Both types of milk contain carbohydrates, lipids and proteins.

- Human breast milk also contains a bile-activated lipase. This enzyme is thought to be inactive in milk but activated by bile in the small intestine of the newborn baby.
- Formula milk does not contain a bile-activated lipase.

Scientists investigated the benefits of breast milk compared with formula milk.

0 5 . 1 The scientists used kittens (newborn cats) as model organisms in their laboratory investigation.

Other than ethical reasons, suggest **two** reasons why they chose to use cats as model organisms.

[2 marks]

1 _____

_____

2 _____

_____

0 5 . 2 Before starting their experiments, the scientists confirmed that, like human breast milk, cat's milk also contained bile-activated lipase.

To do this, they added bile to cat's milk and monitored the pH of the mixture.

Explain why monitoring the pH of the mixture could show whether the cat's milk contained lipase.

[2 marks]

_____

_____

_____

_____

Question 5 continues on the next page

The scientists then took 18 kittens. Each kitten had been breastfed by its mother for the previous 48 hours.

The scientists divided the kittens randomly into three groups of six.

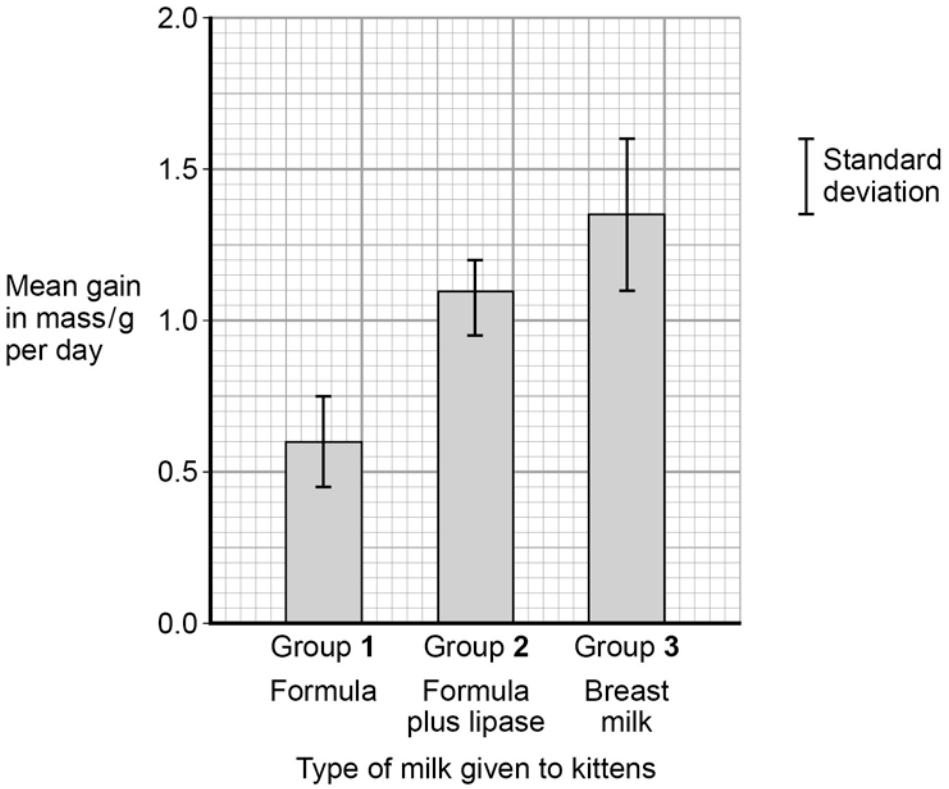
- The kittens in group **1** were fed formula milk.
- The kittens in group **2** were fed formula milk plus a supplement containing bile-activated lipase.
- The kittens in group **3** were fed breast milk taken from their mothers.

Each kitten was fed 2 cm^3 of milk each hour for 5 days.

The scientists weighed the kittens at the start of the investigation and on each day for 5 days.

Figure 5 shows the scientists' results.

Figure 5



0 5 . 3 What can you conclude from **Figure 5** about the importance of bile-activated lipase in breast milk?

[3 marks]

[Extra space]

Turn over for the next question

6 A student investigated the distribution of plants in a heathland.
Table 2 shows the number of plants he found in a sample area of 1 m^2.

Table 2

Species of plant	Number counted in 1 m^2
Common heather	2
Red fescue	14
Vetch	2
White clover	8

0 6 . 1 What is the species richness of this sample?

[1 mark]

0 6 . 2 Calculate the index of diversity of this sample. Show your working.

Use the following formula to calculate the index of diversity.

$$d = \frac{N(N-1)}{\Sigma n(n-1)}$$

where N is the total number of organisms of all species
and n is the total number of organisms of each species

[2 marks]

Index of diversity = _____

0 6 . 3 Suggest how this student would obtain data to give a more precise value for the index of diversity of this habitat.

[2 marks]

Turn over for the next question

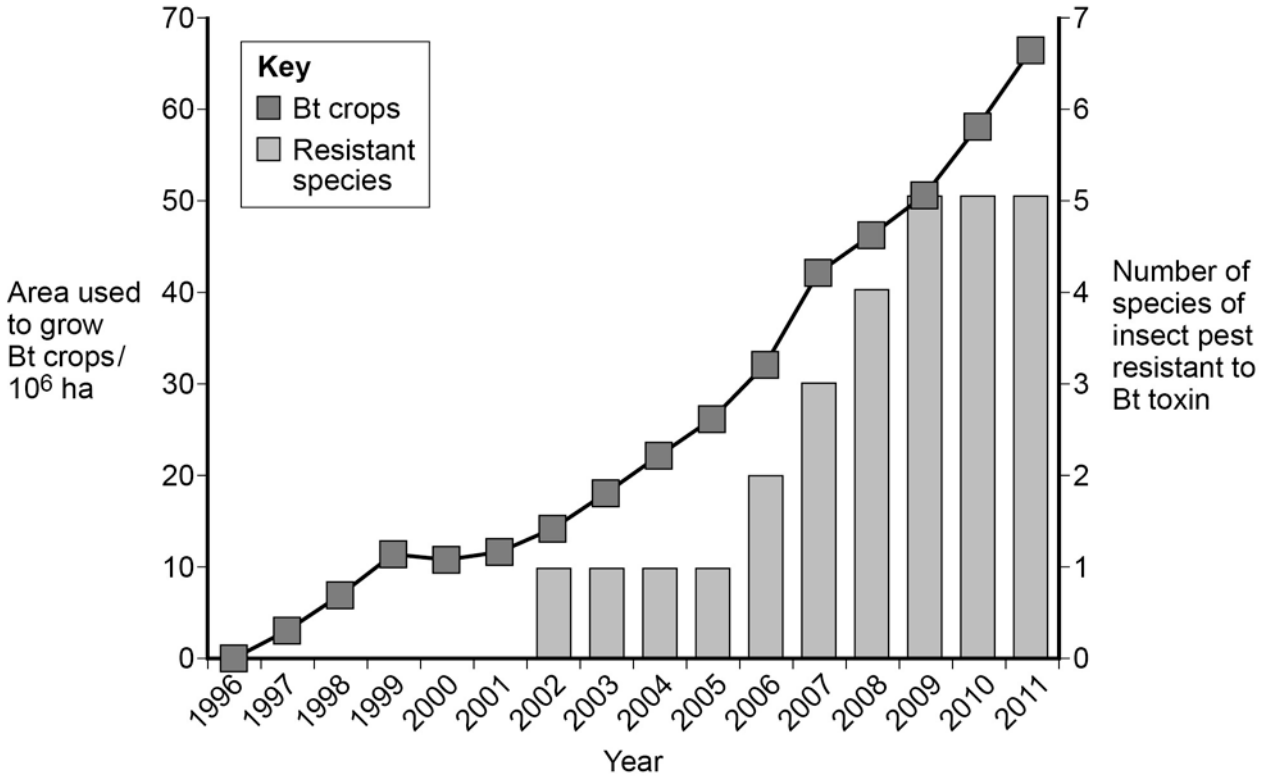
7 To reduce the damage caused by insect pests, some farmers spray their fields of crop plants with pesticide. Many of these pesticides have been shown to cause environmental damage.

Bt plants have been genetically modified to produce a toxin that kills insect pests. The use of Bt crop plants has led to a reduction in the use of pesticides.

Scientists have found that some species of insect pest have become resistant to the toxin produced by the Bt crop plants.

Figure 6 shows information about the use of Bt crops and the number of species of insect pest resistant to the Bt toxin in one country.

Figure 6



0 7 . 1 Can you conclude that the insect pest resistant to Bt toxin found in the years 2002 to 2005 was the same insect species? Explain your answer.

[1 mark]

0 7 . 2 One farmer stated that the increase in the use of Bt crop plants had caused a mutation in one of the insect species and that this mutation had spread to other species of insect. Was he correct? Explain your answer.

[4 marks]

[Extra space]

Question 7 continues on the next page

0 7 . 3 There was a time lag between the introduction of Bt crops and the appearance of the first insect species that was resistant to the Bt toxin.
Explain why there was a time lag.

[3 marks]

[Extra space]

Turn over for the next question

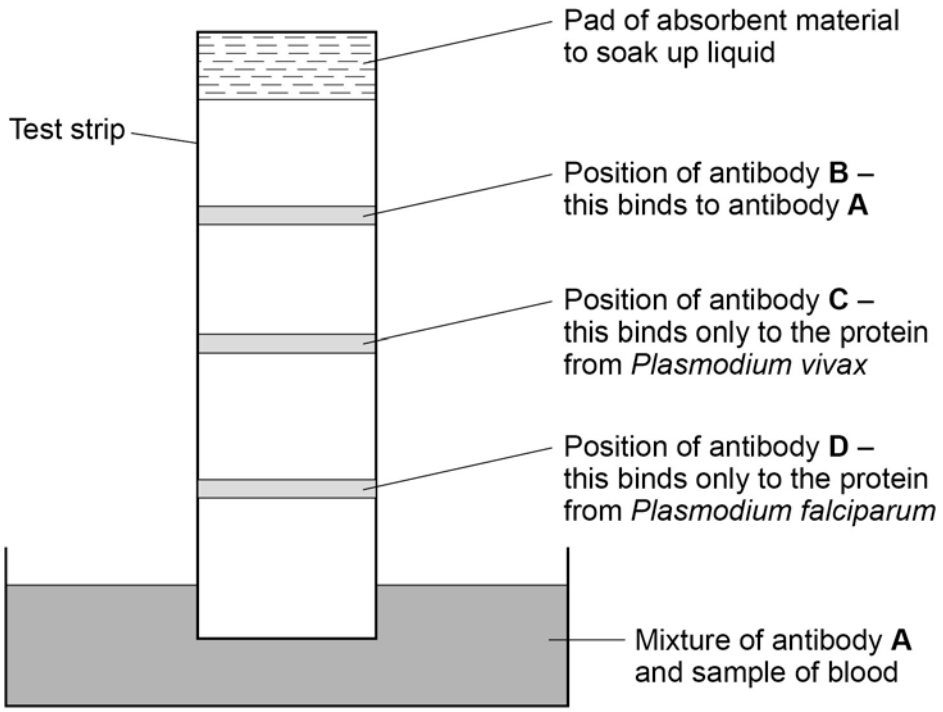
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8 Malaria is a disease caused by parasites belonging to the genus *Plasmodium*. Two species that cause malaria are *Plasmodium falciparum* and *Plasmodium vivax*.

A test strip that uses monoclonal antibodies can be used to determine whether a person is infected by *Plasmodium*. It can also be used to find which species of *Plasmodium* they are infected by.

- A sample of a person's blood is mixed with a solution containing an antibody, **A**, that binds to a protein found in both species of *Plasmodium*. This antibody has a coloured dye attached.
- A test strip is then put into the mixture. The mixture moves up the test strip by capillary action to an absorbent pad.
- Three other antibodies, **B**, **C** and **D** are attached to the test strip. The position of these antibodies and what they bind to is shown in **Figure 7**.

Figure 7



0 8 . 1 Explain why antibody **A** attaches only to the protein found in species of *Plasmodium*.

[2 marks]

0 8 . 2 Antibody **B** is important if this test shows a person is not infected with *Plasmodium*.

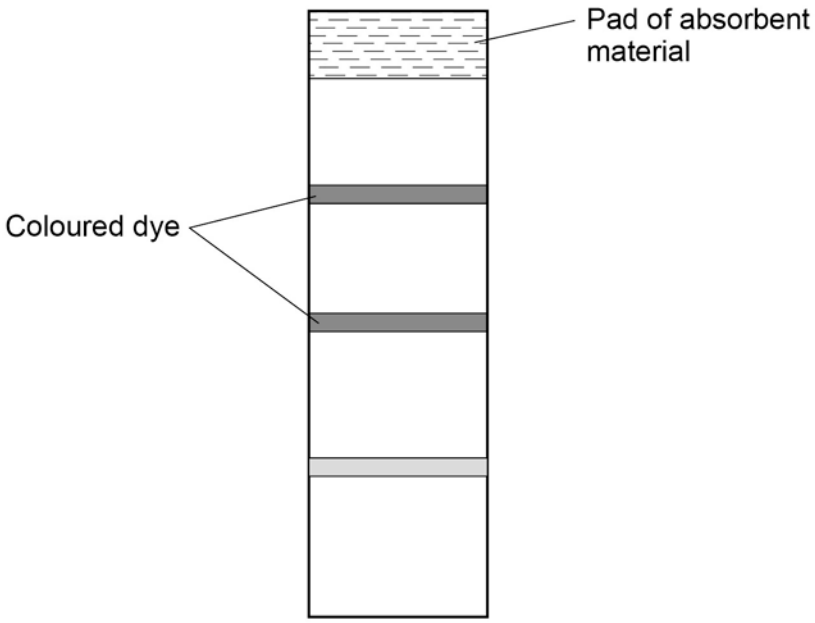
Explain why antibody **B** is important.

[2 marks]

Question 8 continues on the next page

0 8 . 3 One of these test strips was used to test a sample from a person thought to be infected with *Plasmodium*. **Figure 8** shows the result.

Figure 8



What can you conclude from this result?

Explain how you reached your conclusion.

[4 marks]

[Extra space]

9 Organic compounds synthesised in the leaves of a plant can be transported to the plant's roots.
This transport is called translocation and occurs in the phloem tissue of the plant.

0 9 . 1 One theory of translocation states that organic substances are pushed from a high pressure in the leaves to a lower pressure in the roots.

Describe how a high pressure is produced in the leaves.

[3 marks]

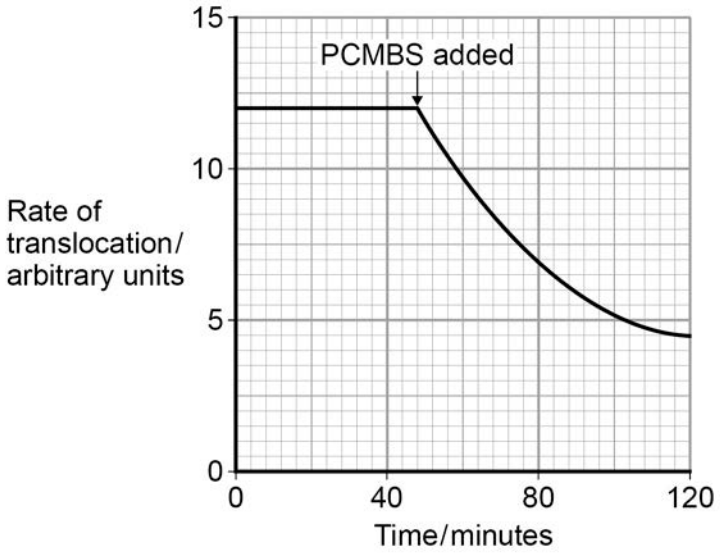
[Extra space]

Question 9 continues on the next page

PCMBS is a substance that inhibits the uptake of sucrose by plant cells.

Scientists investigated the effect of PCMBS on the rate of translocation in sugar beet. **Figure 9** shows their results.

Figure 9



0 9 . 2 During their experiment, the scientists ensured that the rate of photosynthesis of their plants remained constant.
Explain why this was important.

[2 marks]

0 9 . 3 The scientists concluded that some translocation must occur in the spaces in the cell walls.
Explain how the information in **Figure 9** supports this conclusion.

[2 marks]

Turn over for the next question

1 0 . 1 When a vaccine is given to a person, it leads to the production of antibodies against a disease-causing organism. Describe how.

[5 marks]

[Extra space]

1 0 . 2 Describe the difference between active and passive immunity.

[5 marks]

[Extra space]

END OF QUESTIONS

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