OXFORD
INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

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Forename(s) _____

Candidate signature _____
I declare this is my own work.

INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 5 Synoptic paper

Tuesday 13 June 2023 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a pencil
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- 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).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.
- In Question 6, 2 marks will be awarded for the quality of your written communication. You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

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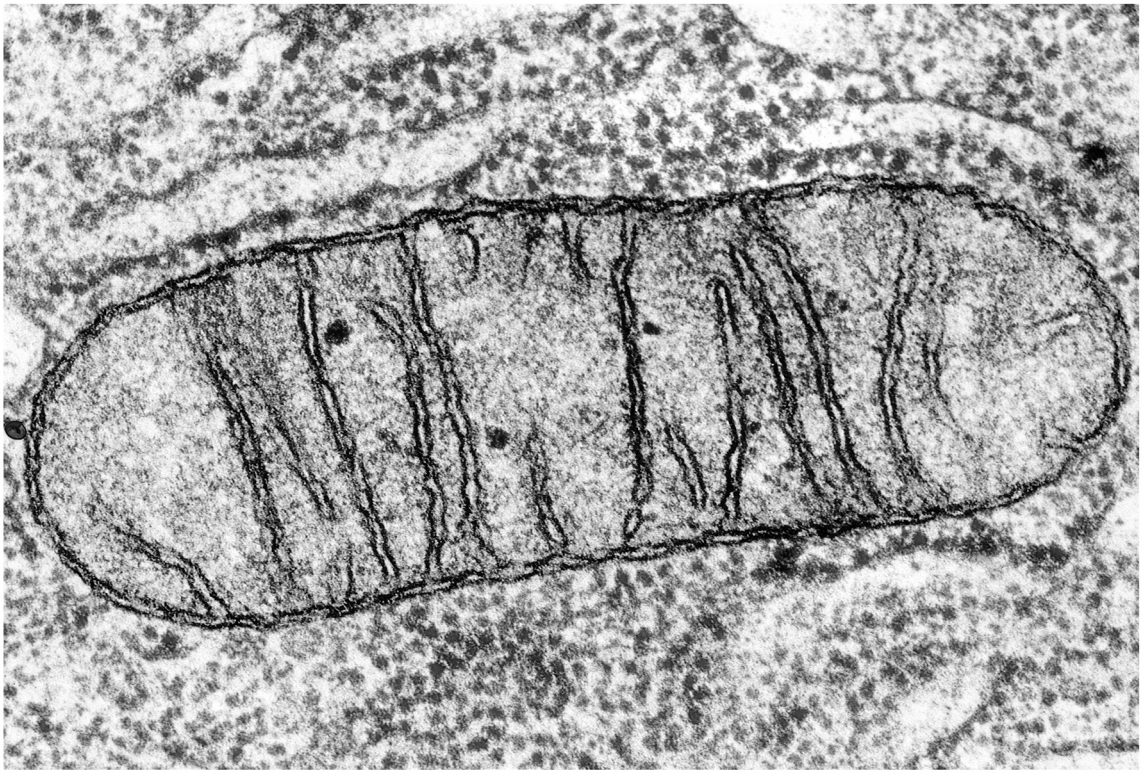
Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows a mitochondrion in a liver cell.

Figure 1



× 60 000

0 1 . 1 Name the type of microscope used for producing **Figure 1**.

[1 mark]

_____

Do not write outside the box

0 1 . 2 Draw a large, clear diagram of the mitochondrion in **Figure 1**.

[2 marks]

0 1 . 3 The magnification of **Figure 1** is × 60 000.

Calculate the actual volume of the mitochondrion shown in **Figure 1**.

Assume that the mitochondrion is a cylinder.

Give your answer in μm^3 to 3 significant figures.

Volume of cylinder = $\pi r^2 h$

$\pi = 3.14$

[3 marks]

Volume of mitochondrion = _____ μm^3

Question 1 continues on the next page

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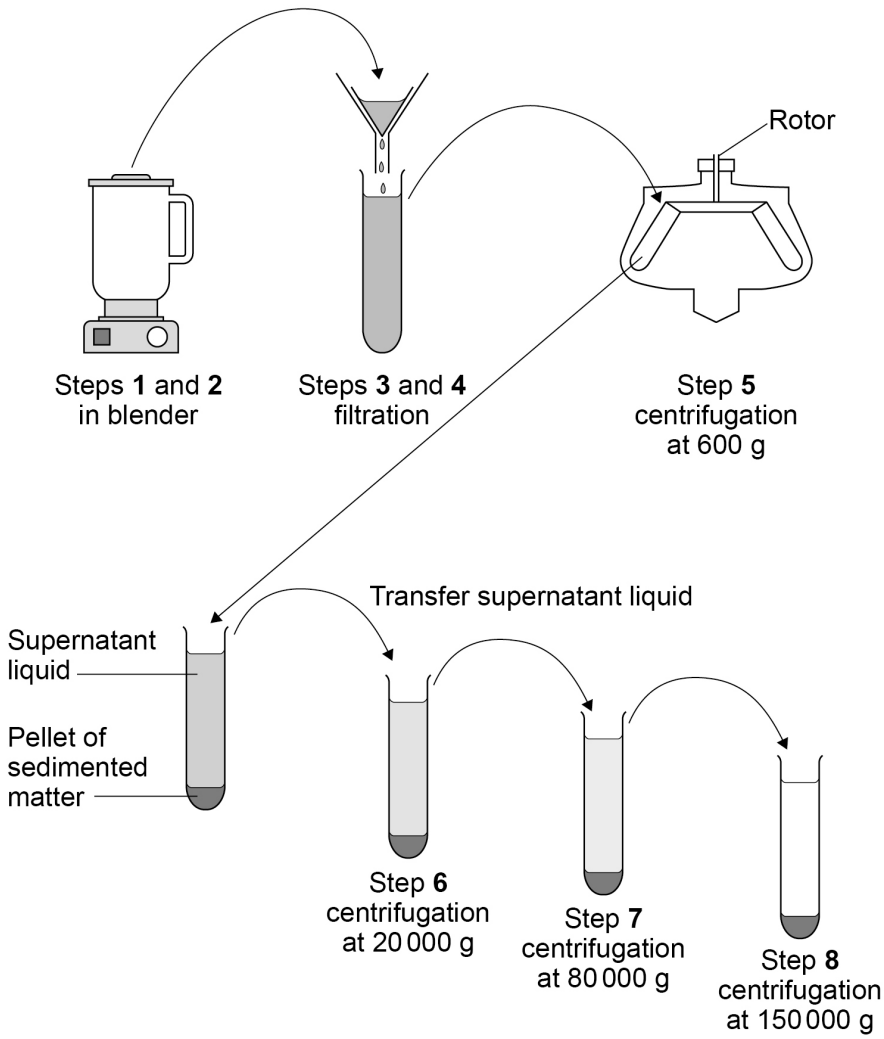
Scientists can separate mitochondria from other organelles in liver cells using the techniques of cell fractionation and ultracentrifugation.

The scientists:

1. put some liver tissue in 0.25 mol dm^{-3} sucrose solution at pH 7.4 and a temperature of 4 °C
2. gently break open the liver cells in a blender
3. filter the material from the blender to remove larger pieces of cell debris
4. put the filtrate in a centrifuge tube
5. spin the centrifuge at 600 g (600 × the force of gravity) for 10 minutes
6. transfer the supernatant liquid from Step **5** to another centrifuge tube and spin at 20 000 g for 20 minutes
7. transfer the supernatant liquid from Step **6** to another centrifuge tube and spin at 80 000 g for 60 minutes
8. transfer the supernatant liquid from Step **7** to another centrifuge tube and spin at 150 000 g for 3 hours.

Figure 2 gives a summary of the scientists' method.

Figure 2



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0 1 . 4 During the whole investigation, the scientists keep the material from the liver:

- in 0.25 mol dm^{-3} sucrose solution
- at pH 7.4
- at a temperature of 4 °C.

Explain how each of these conditions prevents damage to the mitochondria.

[4 marks]

0.25 mol dm^{-3} sucrose solution _____

_____

_____

_____

pH 7.4 _____

_____

Temperature of 4 °C _____

_____

0 1 . 5 Centrifugation at 80 000 g (step **7**) causes sedimentation of lysosomes and pieces of membrane.

Complete **Table 1** to show which centrifugation step causes sedimentation of:

- mitochondria
- nuclei
- ribosomes.

[1 mark]

Table 1

Step	Centrifugal g-force	Organelle sedimented
5	600	
6	20 000	
7	80 000	Lysosomes
8	150 000	

Question 1 continues on the next page

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0 1 . 6 Give the reason for your answer to Question **01.5**.

[1 mark]

The scientists investigate oxygen uptake by their preparation of mitochondria.

The scientists:

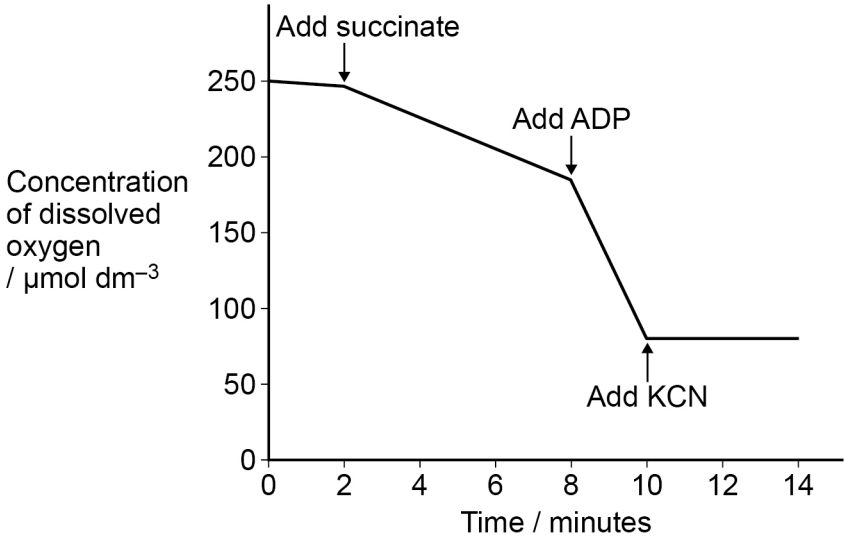
- suspend the mitochondria in 0.25 mol dm^{-3} sucrose solution at pH 7.4
- measure the concentration of dissolved oxygen in the suspension using an oxygen electrode.

The scientists test the effect of adding three substances, in sequence, to the suspension of mitochondria:

1. succinate – a substrate of the Krebs cycle
2. ADP
3. potassium cyanide (KCN) – binds to cytochrome oxidase and inhibits the final step in the electron transfer chain.

Figure 3 shows the scientists' results.

Figure 3



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0 1 . 7 Explain why adding succinate causes a decrease in the concentration of dissolved oxygen.

[2 marks]

0 1 . 8 Explain why adding ADP causes a decrease in the concentration of dissolved oxygen.

[2 marks]

0 1 . 9 Potassium cyanide (KCN) is poisonous.

Use information from **Figure 3** to explain why.

[3 marks]

19

Turn over for the next question

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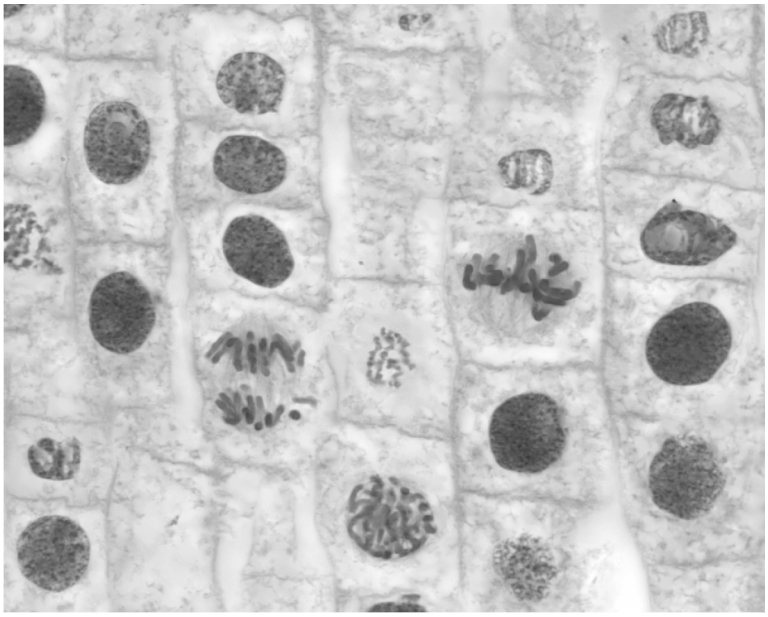
0 2 In eukaryotic organisms, cells divide by mitosis during growth.

Figure 4 shows cells from the root of an onion plant.

Figure 4



0 2 . 1 Write each of the letters **A**, **M** and **P** on **Figure 4** to label the following:

A one cell in anaphase
M one cell in metaphase
P one cell in prophase.

[3 marks]

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0 2 . 2 Describe how you would prepare a slide to show cells from an onion root similar to those in **Figure 4**.

[5 marks]

Question 2 continues on the next page

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A class of 10 students prepares slides from onion roots.

The students count the number of cells in each of the different phases of mitosis.

Table 2 shows the results.

Table 2

	Students										
Phase	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Class total**
Interphase	149	160	121	135	166	232	155	164	162	113	1557
Prophase	35	25	21	30	19	10	15	24	20	16	215
Metaphase	20	12	18	9	11	6	20	12	7	11	126
Anaphase	4	8	5	14	4	0	11	12	8	3	69
Telophase	9	6	14	11	8	4	7	8	12	12	91
Total cells	217	211	179	199	208	252	208	220	209	155	2058
Cells in mitosis	68	51	58	64	42	20	53	56	47	42	501
Mitotic index	0.31	0.24	0.32	0.32	0.20	0.08	0.25	0.25	0.22	0.27	**X**

0 2 . 3 Calculate the mitotic index, **X**, for the results from the whole class.

Use data from the **Class total** column in **Table 2**.

Give your answer to an appropriate level of accuracy.

[1 mark]

Mitotic index for results from whole class = _____

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The students calculate the standard deviation (SD) of the mitotic indices from their 10 sets of results:

SD = 0.07

The teacher states:

'There is a significant error in the results from student **6**.'

0 2 . 4 Use data from **Table 2** and your answer to Question **02.3** to explain the teacher's statement.

[2 marks]

_____

_____

_____

_____

_____

_____

0 2 . 5 Student **6** made a mistake while preparing his slide.

Suggest what mistake student **6** made.

Use information from **Table 2** to give the reason for your answer.

[2 marks]

Mistake _____

_____

Reason _____

_____

_____

13

Turn over for the next question

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0 3 Genes often have several alleles.

An allele may be dominant, recessive or codominant.

0 3 . 1 Explain how a **codominant** allele is different from a **dominant** allele.

Use **all** the words from the box in your answer.

genotype	**heterozygous**	**homozygous**	**phenotype**

[2 marks]

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The human **ABO** blood group system is an example of a characteristic controlled by multiple alleles. The alleles show a mixture of being dominant, codominant and recessive.

A person can have one of four possible blood groups:

group **A** group **B** group **AB** group **O**

The blood group is determined by the inheritance of three different alleles:

I^A = allele for blood group **A**
I^B = allele for blood group **B**
I^O = allele for blood group **O**

0 3 . 2 A man with blood group **A** and a woman with blood group **B** have two children:

a child with blood group **O**
a child with blood group **AB**

Complete the genetic diagram in **Figure 5** to explain how the children can inherit different blood groups.

You should include **all** possible offspring genotypes and phenotypes in your answer.

[4 marks]

Figure 5

	Man	**Woman**
Parental phenotypes	Group **A**	Group **B**
Parental genotypes	_____	_____
Genotypes of gametes	_____ _____	_____ _____

Offspring genotypes _____

Offspring phenotypes _____

6

Turn over ►

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0 4 Farmers can spray crop plants with hormones to control the growth of the plants.

Scientists investigate the effect of a plant growth hormone called GA_3 on the growth of avocado fruits.

The scientists:

1. spray 10 avocado trees with a solution of GA_3
2. spray 10 more avocado trees with water as a control
3. take two fruits from each tree at intervals for 135 days
4. remove a 10 g sample of flesh from each of the fruits
5. determine the dry mass of each sample
6. calculate the dry mass as a percentage of each sample.

0 4 . 1 Describe how the scientists could determine the dry mass of each sample (step **5**).

[2 marks]

Question 4 continues on the next page

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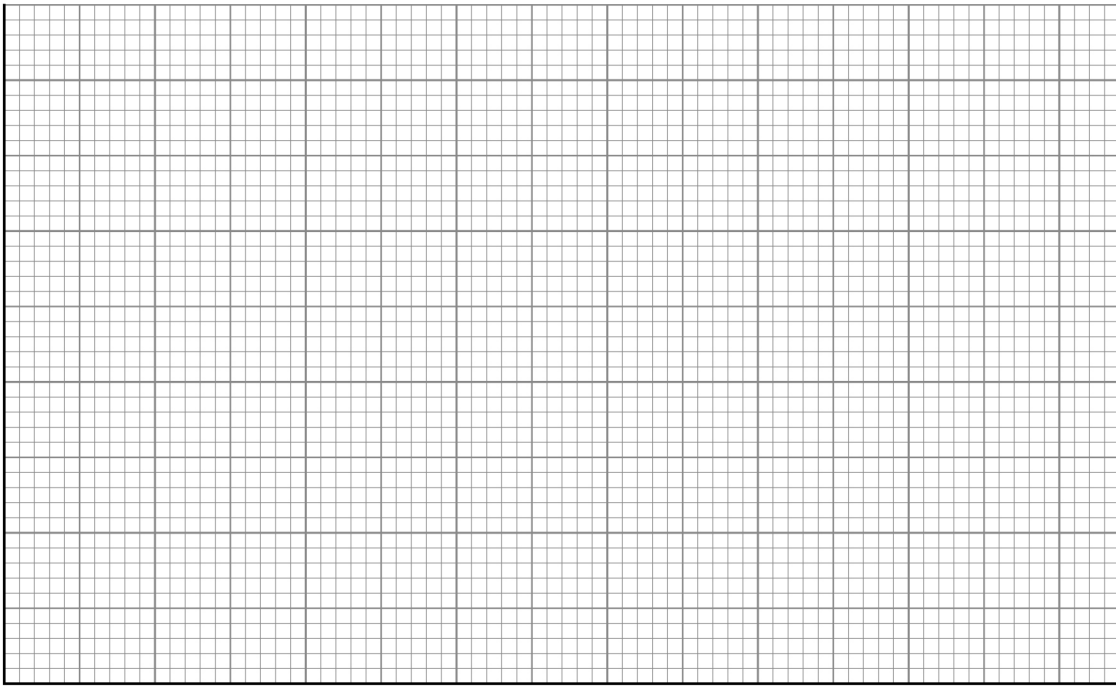
Table 3 shows the scientists' results.

Table 3

Time / days	Mean percentage dry mass of avocado flesh	
	+GA_3	**Control**
0	16.2	16.2
45	19.3	18.8
75	21.7	20.3
105	22.0	21.7
135	22.7	22.5

0 4 . 2 Plot a graph of the data in **Table 3**.

[4 marks]



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0 4 . 3 During the first 75 days, the avocado fruits grew faster on the GA_3-sprayed trees than on the control trees.

Calculate the percentage increase in growth rate of the fruits sprayed with GA_3 compared with the growth rate of the control fruits during the first 75 days.

Give your answer to 3 significant figures.

[2 marks]

Percentage increase in growth rate = _____

0 4 . 4 Avocado fruits are mature when they contain at least 21.5% dry matter.

A farmer looked at the scientists' data.

Suggest why the farmer decides to spray some avocado trees with GA_3 and to leave some trees unsprayed.

Use data from your graph in Question **04.2** in your answer.

[2 marks]

_____

_____

_____

_____

_____

_____

10

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0 5 Omega-3 and omega-6 are two types of unsaturated fatty acid.

Doctors think that a diet with a high ratio of omega-3 to omega-6 fatty acid is good for human health.

Scientists are investigating how to produce meat from sheep that contains a higher proportion of omega-3 fatty acids.

Three different methods are being used:

- selective breeding
- adding fish oils to the diet of the sheep
- genetic engineering.

0 5 . 1 Suggest how selective breeding could be used to increase the proportion of omega-3 in sheep.

[2 marks]

0 5 . 2 Suggest **one** reason why feeding sheep with fish oils containing a high omega-3 concentration may **not** affect the ratio of omega-3 to omega-6 fatty acids in meat from sheep.

[1 mark]

Question 5 continues on the next page

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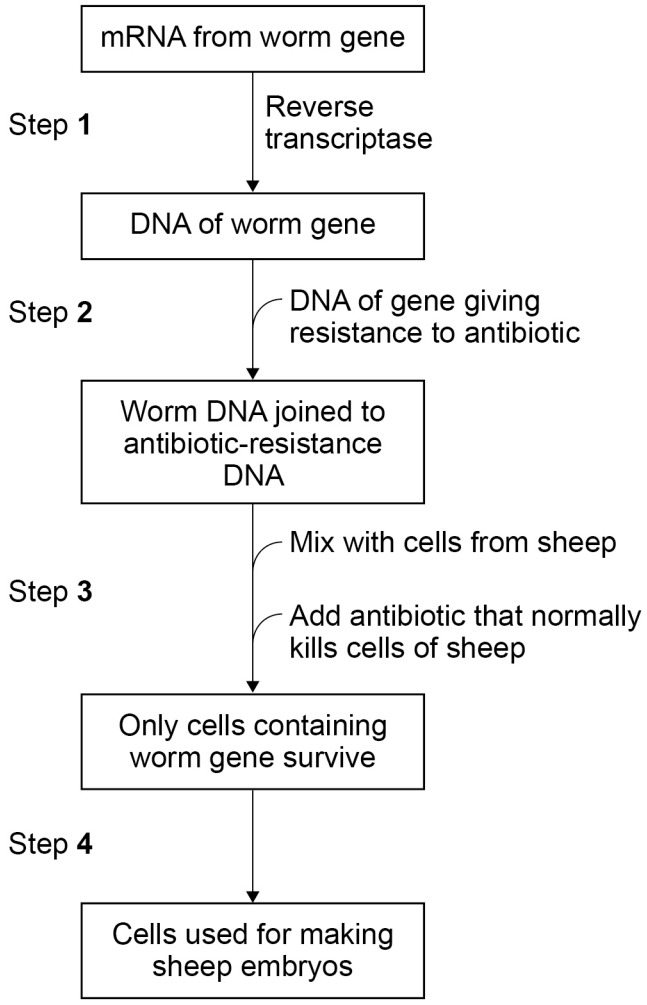
Scientists have produced genetically-modified sheep containing a gene from a worm. This gene codes for an enzyme that changes omega-6 fatty acids into omega-3 fatty acids.

Figure 6 shows the method used for producing the genetically-modified sheep.

Figure 6



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0 5 . 3 Give **two** advantages of using mRNA to make the worm gene at step **1**, instead of using a restriction enzyme to cut the gene from the worm's DNA.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 5 . 4 Explain why a gene giving resistance to an antibiotic is attached to the DNA at step **2**.

[2 marks]

_____

_____

_____

_____

_____

_____

7

Turn over for the next question

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You are reminded that **2** marks will be awarded
for the quality of your written communication in **Question 6**.

0 6 Carbohydrates are important to all living organisms.

0 6 . 1 Ribose is a pentose sugar.

Ribose is a component of adenosine triphosphate (ATP).

Describe the structure and the function of ATP in living cells.

[6 marks]

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0 6 . 2 Starch is a polysaccharide made by plants.

The enzyme amylase catalyses the reaction:

$$\text{starch} + \text{water} \xrightarrow{\text{amylase}} \text{reducing sugars}$$

Describe how you could investigate the effect of temperature on the activity of amylase.

[6 marks]

Question 6 continues on the next page

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0 6 . 3 Describe how different types of carbohydrate are used by living organisms.

[6 marks]

Quality of written communication [2 marks]

END OF QUESTIONS

20

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