OCR
Oxford Cambridge and RSA

H

Monday 23 November 2020 – Morning

GCSE (9–1) Biology B (Twenty First Century Science)

J257/04 Depth in Biology (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)

You can use:
- an HB pencil
- a scientific or graphical calculator

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J257704

Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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Answer **all** the questions.

1 Beth is investigating the rate of cellular anaerobic respiration in yeast. She tests different sugar solutions to see what effect they have on respiration in the yeast. One of the solutions contains glucose.

(a) Beth starts by measuring out 30 cm^3 of glucose solution using a measuring cylinder.

Fig. 1.1 shows four attempts she made at doing this.

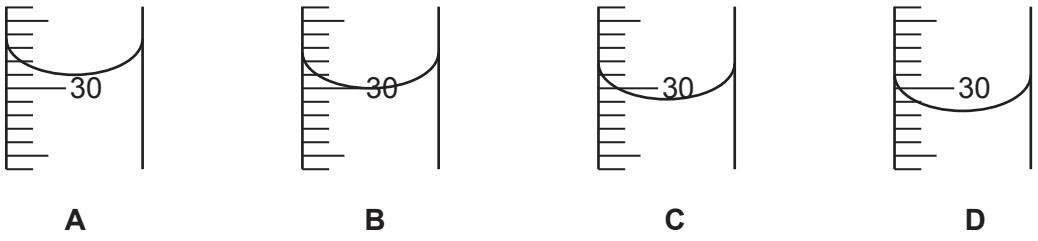

Fig. 1.1

In which attempt, **A**, **B**, **C** or **D**, did Beth have 30 cm^3 of glucose solution?

Attempt ..... **[1]**

(b) Beth sets up her materials and apparatus as shown in **Fig. 1.2**.

Anaerobic cellular respiration takes place in the yeast. This makes a gas.

Beth wants to collect the gas using a **measuring cylinder**.

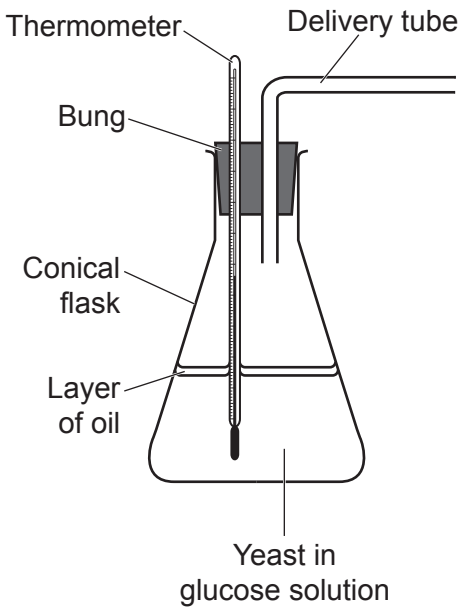

Fig. 1.2

Complete the diagram in **Fig. 1.2** to show how Beth should set up the **measuring cylinder** to collect the gas.

Add labels to your diagram. **[3]**

(c) Beth collects some of the gas made by the anaerobic cellular respiration.
She tests the gas by putting a glowing splint into it.

Table 1.1 describes the results she would see for different gases.

Gas	Result of the test
Air	The splint would continue glowing.
Carbon dioxide	The splint would stop glowing.
Hydrogen	There would be a squeaky pop.
Oxygen	The splint would start burning with a flame.

Table 1.1

What result would you expect to see for the gas Beth has collected?

Explain your answer.

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..... **[2]**

(d) Beth noticed that the reading on the thermometer increased during the experiment.

The temperature in the room did **not** increase.

Explain why the glucose solution containing yeast warmed up.

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..... **[1]**

Another student, Jamal, is also investigating the rate of anaerobic cellular respiration in yeast.

Jamal sets up his materials and apparatus differently to Beth, as shown in **Fig. 1.3**.

- He places the conical flask in a water bath at room temperature.
- He uses a gas syringe to collect the gas made by anaerobic cellular respiration.

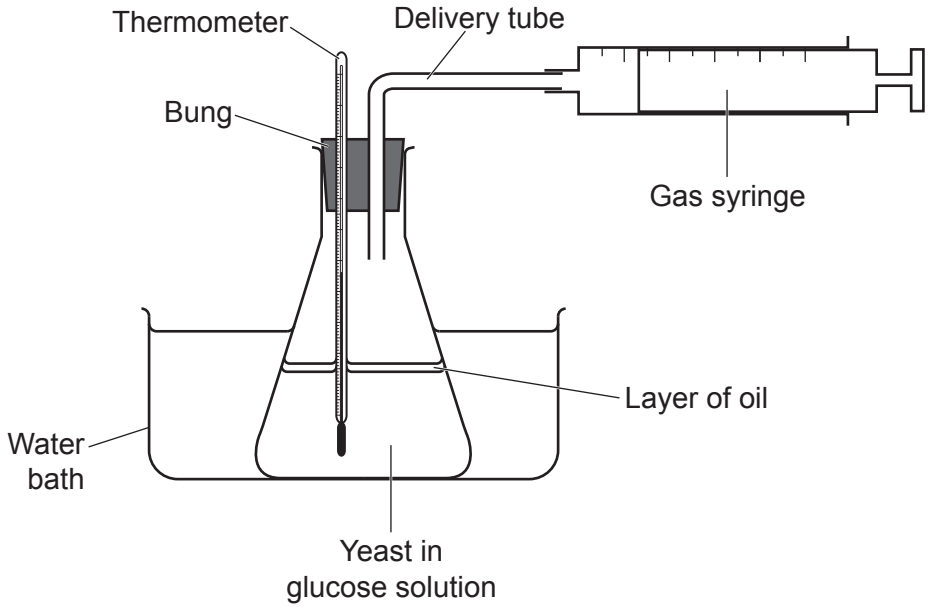

Fig. 1.3

Jamal wants to find out what effect different sugar solutions have on the rate of anaerobic cellular respiration in the yeast.

Jamal collects data from the yeast in the glucose solution and then from the yeast in sucrose solution.

(e) Using the water bath at room temperature will help Jamal to compare his results from the glucose and sucrose more fairly.

Suggest **two** reasons why.

1 .....

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2 .....

..... **[2]**

Jamal plots his results on a graph, as shown in **Fig. 1.4**.

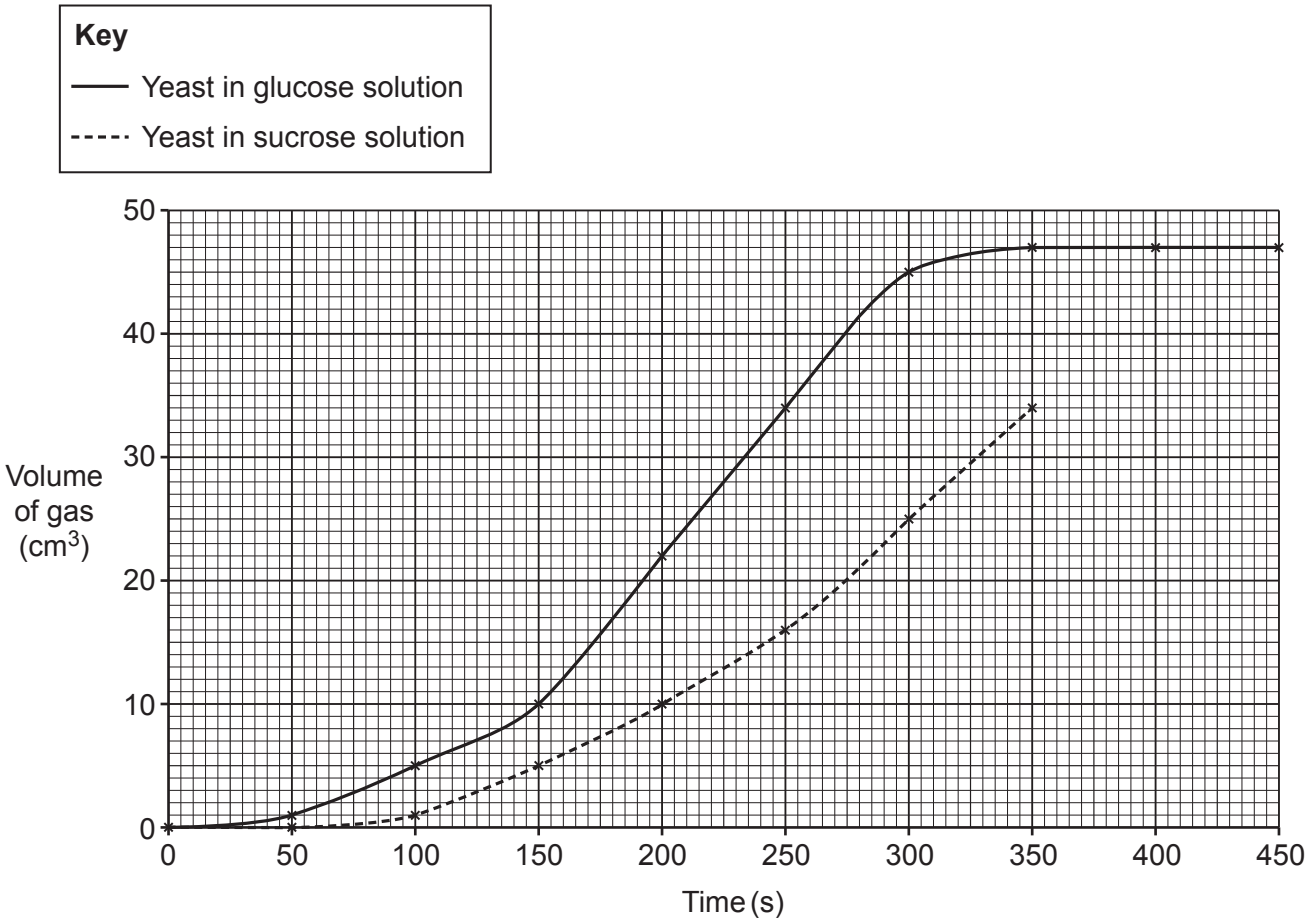

Fig. 1.4

(f) The final measurements for the yeast with the sucrose solution are shown in **Table 1.2**.

Time (s)	Volume of gas (cm^3)
400	42
450	45

Table 1.2

Plot the final measurements on the graph. **[1]**

(g) What volume of gas is collected from the yeast with the sucrose solution after 275 seconds?

Volume = ... cm^3 **[1]**

(h) How long did it take for the yeast to use all of the glucose from the glucose solution?

Explain your answer.

Time ..... s

Explanation .....

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..... **[2]**

(i) Calculate the rate of anaerobic respiration in the yeast with glucose solution between 150 seconds and 250 seconds.

Give the **appropriate units** in your answer.

Rate = ... units ..... **[3]**

(j) Jamal concludes that the rate of anaerobic cellular respiration is faster when yeast is in glucose solution.

Describe **two** pieces of evidence from the graph in **Fig. 1.4** that support Jamal's conclusion.

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2 .....

..... **[2]**

2 Milk contains proteins and other nutrients.

(a) Milk can be tested for proteins by adding a reagent.

Draw **one** line to connect the correct **reagent** with the correct **result if proteins are present**.

Reagent	Result if proteins are present
Benedict's solution	Brown-black colour
Biuret solution	Cloudy white emulsion
Ethanol	Lilac colour
Iodine solution	Red-brown precipitate

[2]

(b) Carbohydrates, lipids and proteins are all nutrients found in milk. Digestion breaks them down into smaller molecules that are absorbed into the blood.

Complete the table to identify the smaller molecules.

Large molecule	**Smaller molecules it is broken down into**
Carbohydrate	Sugars
Lipid	..... AND .....
Protein	.....

[2]

(c)* Milk contains a carbohydrate called lactose. Only people with a particular mutation in their DNA can digest lactose.

If people **without** the mutation drink milk, they can suffer very unpleasant stomach pains and diarrhoea.

The mutation first appeared in a small number of people approximately 10 000 years ago. It is now found in almost half the world's population.

Explain how natural selection caused the mutation to become so common.

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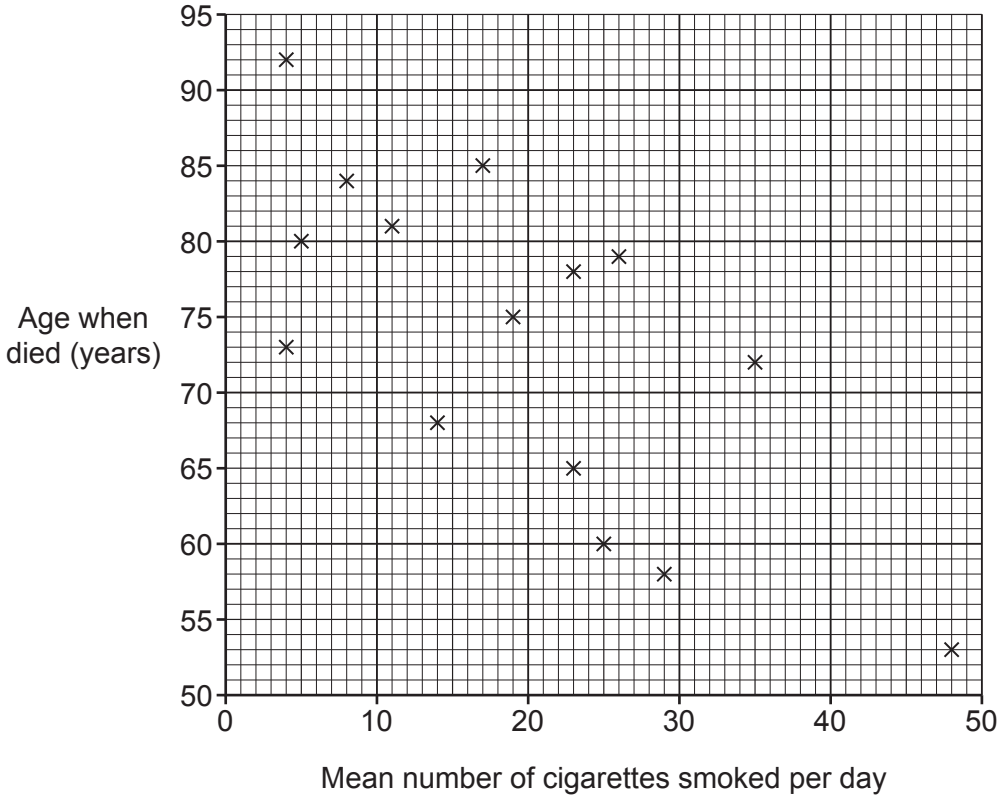
..... **[6]**

3 Smoking cigarettes has effects on the human body.

(a) Scientists studied 15 men from one town. The men were all 50 years old when the study began.

The men recorded how many cigarettes they smoked per day. The scientists recorded the age at which the men died.

The scatter diagram shows the results of the study.



(i) Describe the trend shown on the scatter diagram.

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..... **[2]**

(ii) Smoking cigarettes is a risk factor for cardiovascular disease, which can be life-threatening. This is one possible explanation for the trend shown in the scatter diagram.

Name **one** other disease caused by smoking that may help to explain the trend.

..... **[1]**

(iii) Suggest **two** reasons why some of the results do not fit the trend.

1 .....

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..... **[2]**

(iv) Suggest why the findings from this study may **not** apply to the rest of the population.

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(b) Jack is a man in his 30s.
He smokes, is overweight and has high blood pressure.

Jack is already showing signs of cardiovascular disease. Cardiovascular disease can block an artery in the heart, which can cause a heart attack.

A doctor suggests that Jack should change his lifestyle.

(i) Describe **two** ways Jack could change his lifestyle to reduce his risk of a heart attack.

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..... **[2]**

(ii) Using medicines is an alternative way to treat Jack's cardiovascular disease.

Evaluate the advantages of making changes to Jack's lifestyle rather than him taking medicines.

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..... **[2]**

(iii) State one **other** way to treat Jack's cardiovascular disease.

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..... **[1]**

4 Mistletoe is a very unusual plant. Instead of growing in the ground, mistletoe grows on another plant such as a tree, as shown in **Fig. 4.1**.

Fig. 4.1

(a) Mistletoe does not have roots in the soil.

Mistletoe takes all the water it needs from a tissue in the tree. This tissue transports water from the tree's roots to the tree's leaves.

(i) What is the name of the tissue in the tree that the mistletoe takes water from?

..... **[1]**

(ii) Explain why water moves through this tissue from the roots to the leaves in a normal tree.

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..... **[4]**

(iii) Suggest one **other** substance that the mistletoe could take from this tissue in the tree.

..... **[1]**

(b) Very little photosynthesis takes place in the mistletoe.

It takes most of the sugar it needs from phloem tissue in the tree. Phloem transports sugars around the tree.

A diagram of the phloem tissue is shown in **Fig. 4.2**.

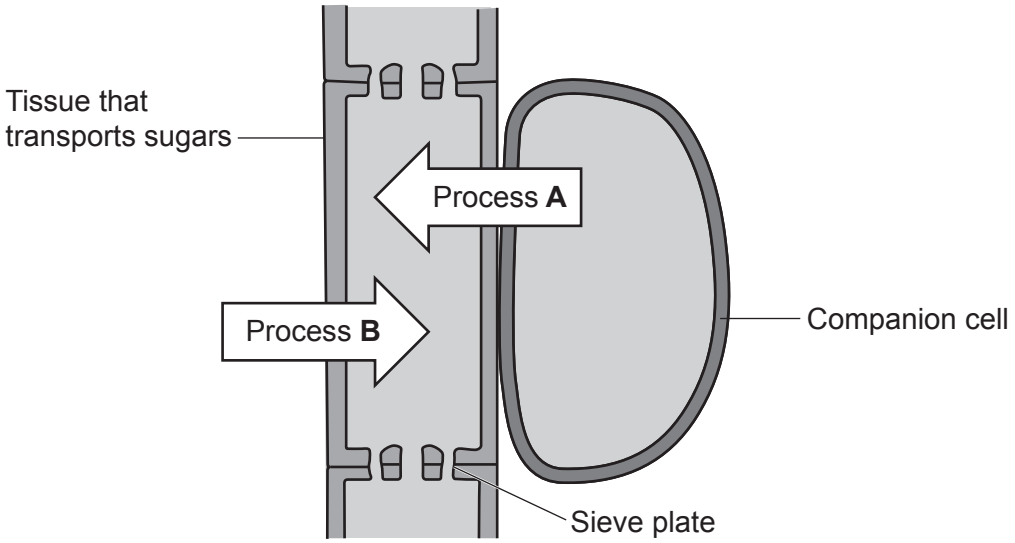

Fig. 4.2

(i) Process **A** and process **B** move substances into the phloem tube.

Describe process **A** and process **B**.

In your answer you should include:
- the names of the processes
- what is moved by each process.

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(ii) Explain how sugars are moved along a phloem tube.

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(iii) The phloem tube is made of living cells, but these cells do not have any mitochondria.

Explain why they depend on the companion cells, which do have mitochondria.

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(c) Mistletoe can catch diseases from the tree it is growing on.

A scientist thinks some bacteria have spread from a tree to some mistletoe that is growing on it. They collect a sample of the bacteria from the mistletoe.

Fig. 4.3 shows an image of some of the bacteria from the mistletoe.

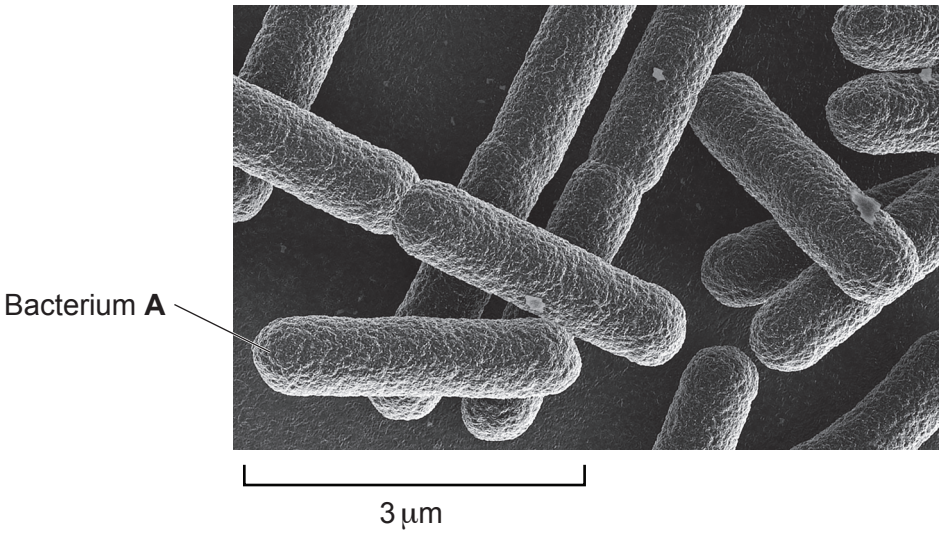

Fig. 4.3

(i) The actual length of bacterium **A** is 3 μm.

In the image in **Fig. 4.3** it appears to be 4.5 cm long.

1 μm = 0.0001 cm

Calculate the magnification of the image.

Use the equation: magnification = measured size ÷ actual size

Magnification = × ..... **[2]**

(ii) Each bacterium from the tree is 3×10^{-4} cm long.

Is it possible that the bacteria from the tree are the same bacteria as bacterium **A** from the mistletoe?

Yes ☐

No ☐

Explain your answer.

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..... **[2]**

(d) The scientist has made some monoclonal antibodies that recognise the bacteria from the tree.

(i) Describe how scientists make monoclonal antibodies that recognise the bacteria from the tree.

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..... **[4]**

(ii) The monoclonal antibodies are designed to recognise the bacteria from the tree.

The scientist wants to test whether they also recognise the bacteria from the mistletoe.

Describe how the scientist could do this in a diagnostic test **and** what the scientist would see if the result was positive.

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..... **[3]**

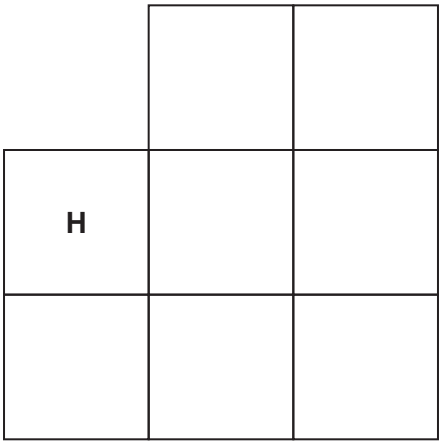
5 Huntington's disease is caused by a faulty allele of a single gene.

(a) The allele that causes the disease is dominant. The other allele is recessive.

A couple are planning to have a baby.

- The female's genotype is heterozygous dominant.
- The male's genotype is homozygous recessive.

Complete the Punnett square to show the predicted proportion of their offspring that will have Huntington's disease.



Proportion of offspring with Huntington's disease = ... in every ..... **[2]**

(b) Give **two** reasons why a Punnett square **cannot** be used to predict most of a person's features.

1 .....

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2 .....

..... **[2]**

(c) When a person has Huntington's disease, neurons in their brain start to die.
The person becomes confused. Eventually they cannot control their body movements and cannot speak.

(i) Explain why it is difficult to investigate brain function in a person with Huntington's disease.

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(ii) The neurons that make up the brain cannot undergo mitosis.

Explain what this means, and therefore why the brain damage caused by Huntington's disease does not heal.

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(iii) Doctors hope to use embryonic stem cells to treat the brain damage caused by Huntington's disease.

Explain how stem cells can be used for this type of treatment.

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(iv) Discuss risks and ethical issues associated with this type of treatment.

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(d) The allele that causes Huntington's disease contains instructions to make a protein that kills neurons in the brain.

Scientists have developed a drug that destroys the mRNA made from the instructions in the allele. This prevents the brain damage caused by Huntington's disease.

(i) Explain how the drug prevents the brain damage caused by Huntington's disease.

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..... **[3]**

(ii) The drug is injected into the patient's blood.

Give **two** reasons why the drug must be able to move through cell membranes but does **not** need to enter the cell nucleus.

1 .....

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2 .....

..... **[2]**

6* Alex has not had a drink of water for some time. This means there is less water in his blood.

Describe how Alex's body detects and responds to this, and how his blood and urine are affected by the body's response.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).