OCR
Oxford Cambridge and RSA

Tuesday 19 October 2021 – Afternoon

A Level Biology B (Advancing Biology)

H422/03 Practical skills in biology

Time allowed: 1 hour 30 minutes

You must have:
- the Insert (ns de th s document)
- a ru er (cm/mm)

You can use:
- a sc ent f c or graph ca ca cu ator

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 **60**.
- 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 Memory loss occurs as part of the normal ageing process in the human brain.

Researchers carried out an investigation into the effect of ageing on short-term memory using a word recall task as described below.

- 40 participants were divided into two groups, **A** and **B**, dependent on age.
- Group **A** consisted of 20 people aged between 25 and 45 years old.
- Group **B** consisted of 20 people aged between 55 and 75 years old.
- A list of 12 words was read out to each participant.
- After a short pause, each participant was asked to recall words from the list and write them down.
- The researchers recorded the number of words that had been correctly **and** incorrectly recalled.
- Correctly recalled words were on the list of 12 words read out. Incorrectly recalled words were not on the list.

(a) (i) State the independent variable for this investigation.

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

(ii) The sex of the participants was controlled during the investigation by ensuring that there were an equal number of men and women in each group.

Apart from sex, state **one** other variable that needed to be controlled and suggest how it could have been controlled by the researchers.

Variable .....

How it could have been controlled .....

.....

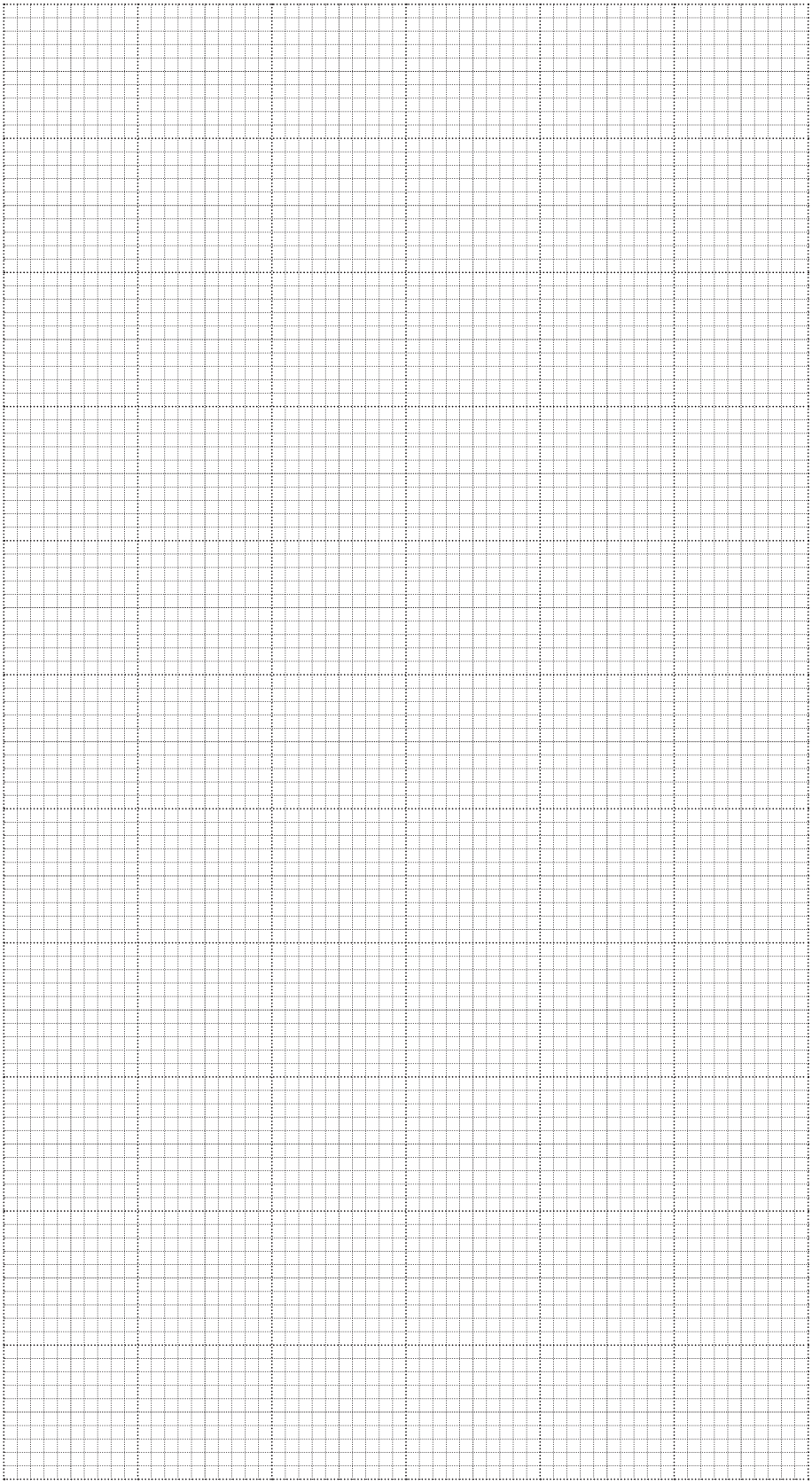
..... **[2]**

(iii) **Table 1.1** shows some of the processed data from the investigation.

Group	Mean number of words correctly recalled	Standard Deviation	Mean number of words incorrectly recalled	Standard Deviation
A	8.1	2.3	0.5	0.4
B	5.3	1.9	0.7	0.3

Table 1.1

Plot the data in **Table 1.1** as a suitable graph using an appropriate key for groups **A** and **B**. **[4]**



(b) Memory loss is one of the symptoms of Alzheimer's disease (AD).

AD leads to the death of neurones in the brain resulting in loss of cognitive function and behavioural changes.

AD is described as multifactorial, as several factors may lead to the development of the disease.

(i) Ageing is one of the risk factors for AD.

Apart from ageing, state **one** other risk factor for AD.

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

(ii) The data for two risk factors, **G** and **H**, are shown in **Table 1.2**.

	Number of people exposed to the risk factor	**Number of people that developed AD**
Risk factor G	6000	85
Risk factor H	7000	94

Table 1.2

The relative risk of developing a disease from a particular risk factor can be calculated as follows:

$$\text{Relative risk} = \frac{\text{Incidence of the disease in people exposed to the risk factor}}{\text{Incidence of the disease in people not exposed}}$$

The incidence of AD in people that were not exposed to either risk factor was 8.4 per 1000 people.

Using the information and the data in **Table 1.2**, calculate the relative risk for factors **G** and **H** and state which risk factor gives a higher relative risk of developing AD.

Risk factor for **G** = ...

Risk factor for **H** = ...

Factor which gives higher relative risk is .....

[3]

(c) **Fig. 1.1**, on the **Insert**, shows PET scans of a normal brain and the brain of a patient diagnosed with AD.

Using **Fig. 1.1**, describe the effects of AD on the **structure** of the brain.

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

(d) It has been suggested that *Porphyromonas gingivalis*, a bacterium involved in the development of gum disease, may also cause the symptoms associated with AD.

P. gingivalis is known to release gingipain, a protease enzyme, which has been found at elevated levels in the brain tissue of AD patients.

Using your knowledge of AD, suggest how the presence of gingipain in brain tissue could cause the symptoms associated with AD.

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

(e) Scientists studying the effects of *P. gingivalis* in the brain tissue of laboratory mice carried out the following investigation:

- Samples of *P. gingivalis* were introduced into the mouths of 30 mice over a period of six weeks.
- 15 of these mice were also treated with an enzyme inhibitor during this six-week period.
- After 10 weeks, the concentration of bacterial DNA in the brains of these 30 mice was measured.
- The concentration of bacterial DNA was also measured in the brains of 15 mice that had not been given *P. gingivalis* nor treated with enzyme inhibitor.

The results of the investigation are shown in **Fig. 1.2**.

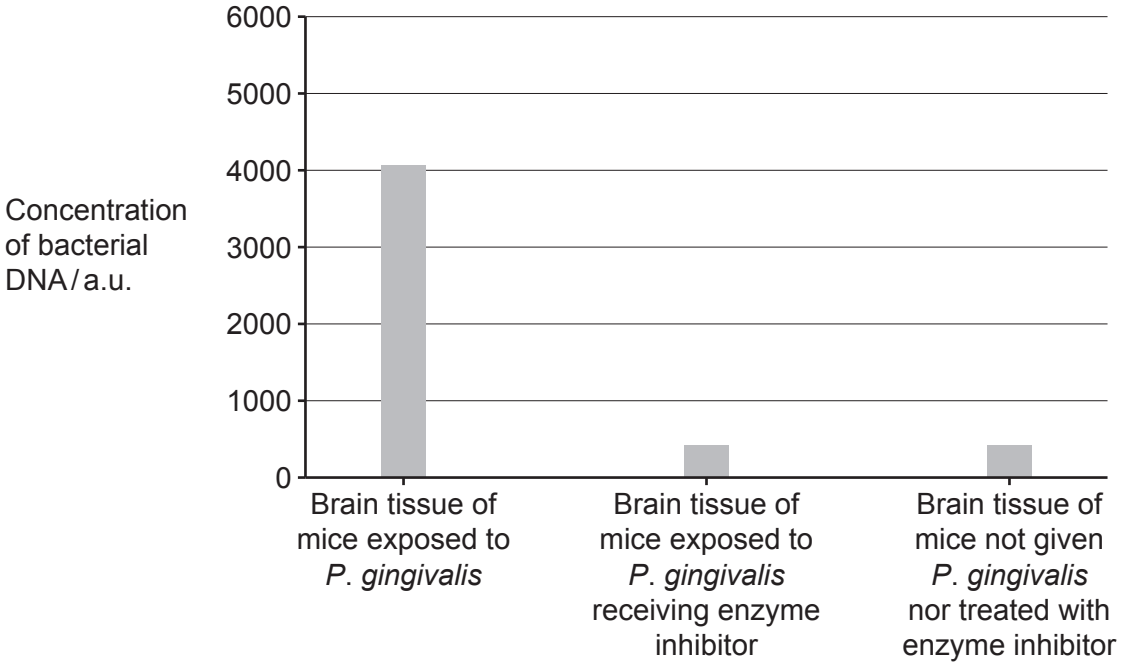

Fig. 1.2

One of the scientists stated that:

'The results show that AD patients could be treated with an enzyme inhibitor to slow the development of the disease.'

Comment on the validity of this statement.

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

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2 Haemoglobin and myoglobin are respiratory pigments.

(a) Complete the table below by placing a tick (✓) in the appropriate boxes to identify which pigment matches each description.

Description	Haemoglobin	Myoglobin
Can bind with four oxygen molecules		
Has higher affinity for oxygen		
Located inside skeletal muscle		

[2]

(b) Portable haemoglobinometers can be used by patients at home to measure the haemoglobin concentration in their blood.

A haemoglobinometer works as follows:

- The patient drinks a litre of water to ensure they are well-hydrated.
- A small sample of blood is taken by a finger prick technique.
- The blood is put into a container and mixed with a chemical that releases haemoglobin from the red blood cells.
- The container is put into the haemoglobinometer to measure the colour intensity of the solution.
- The results are displayed on the screen of the haemoglobinometer.

(i) State **one** advantage to the patient of using a portable haemoglobinometer.

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

(ii) Suggest **one** reason for measuring haemoglobin concentration in the blood.

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

(iii) The patient drinks a litre of water before the test to ensure that they are well-hydrated.

Suggest how hydration levels could affect the validity of the results.

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

(c) Oxygen dissociation curves are used to help understand how the blood carries and releases oxygen.

The oxygen dissociation curve for adult haemoglobin is shown in **Fig. 2**.

Item removed due to third party copyright restrictions. Link to material: https://mathsmadeeasy.co.uk/wp-content/uploads/2017/10/Haemoglobin-and-Dissociation-Curves-AS-Biology-Answers-AQA-OCR-Edexcel.pdf

Fig. 2

(i) Describe the shape of the oxygen dissociation curve in **Fig. 2**.

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

(ii) The partial pressure of oxygen in the blood of alveolar capillaries was measured at 12.5 kPa and in venous blood at 5.5 kPa.

Using **Fig. 2**, state the percentage saturation of haemoglobin in:

Alveolar capillaries ..... %

Venous blood ..... %
[1]

(iii) The table shows data for fetal haemoglobin.

Plot these data **on Fig. 2** and draw an appropriate oxygen dissociation curve for fetal haemoglobin.

Partial pressure of oxygen (kPa)	Oxygen saturation of fetal haemoglobin (%)
1	8
2	18
3	35
4	58
5	72
6	80
7	86
8	90
9	94
10	95
11	96
12	97

[Answer on Fig. 2] **[2]**

(iv) Explain the significance of the difference between the different oxygen dissociation curves for adult and fetal haemoglobin.

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

3 During transpiration water vapour is lost from the leaves of a plant through stomata.

A group of students set up the potometer shown in **Fig. 3.1** to estimate the rate of transpiration in *Pelargonium inquinans*, a dicotyledonous plant.

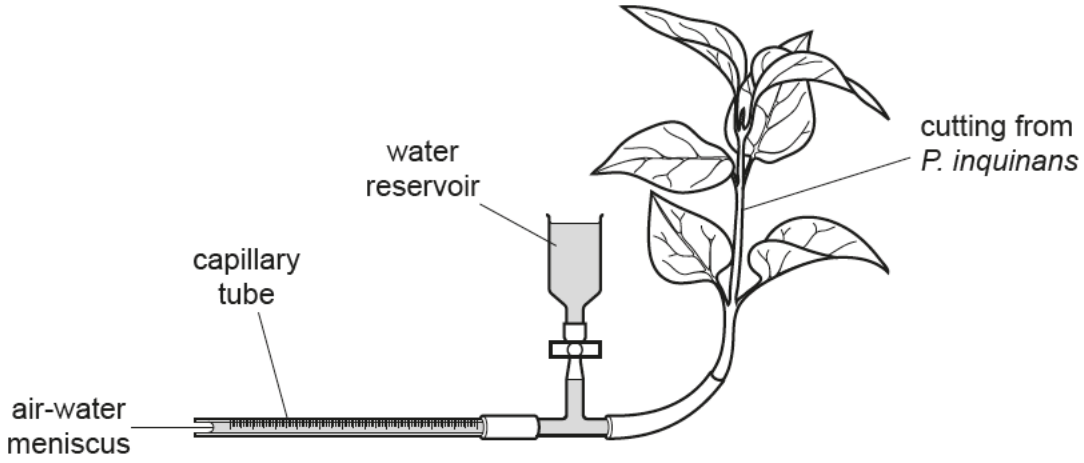

Fig. 3.1

(a)* Explain how this set up could be used to obtain valid results to estimate the rate of transpiration in *P. inquinans* at different light intensities.

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Additional answer space if required.

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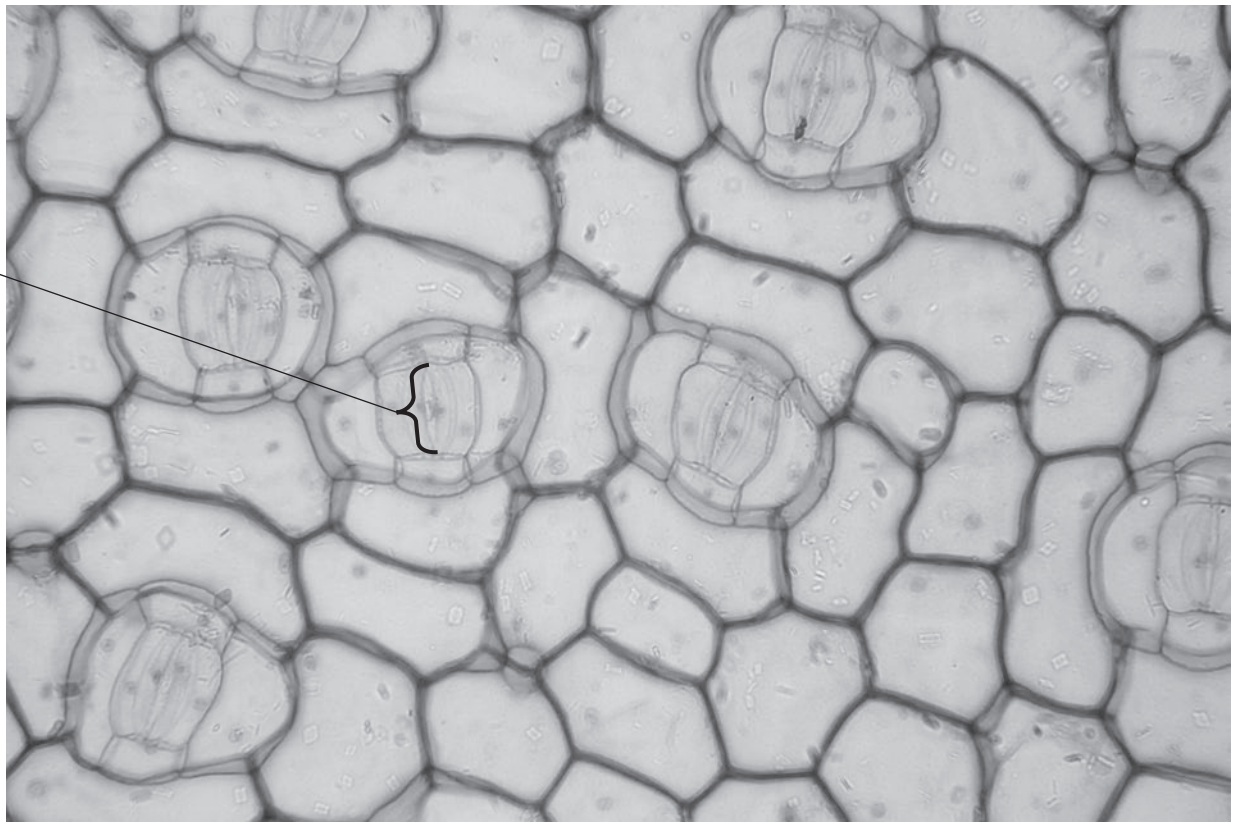
Question 3(b) begins on page 16

(b) **Fig. 3.2** is a photomicrograph of the lower surface of a leaf showing stomata as viewed using a light microscope.



×1200

Fig. 3.2

Calculate the actual length of the stoma labelled **P** on **Fig. 3.2**.

Actual length = ... μm **[2]**

(c) During an investigation into the response of plants to drought conditions, changes in transpiration rate with changes in leaf water potential were measured.

Fig. 3.3 shows some of the data from this investigation.

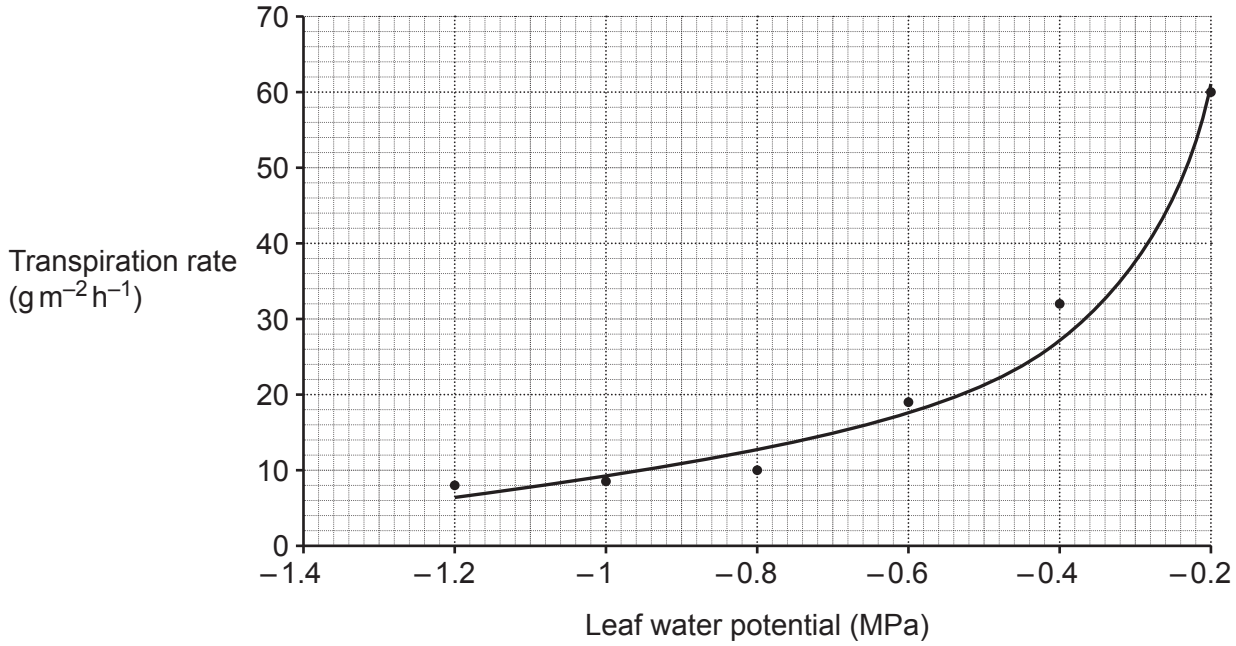


Fig. 3.3

(i) Using **Fig. 3.3**, describe and explain the effect of **decreasing** leaf water potential on the transpiration rate for the plants in this investigation.

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

(ii) Use the curve in **Fig. 3.3** to calculate the rate of change in transpiration at −0.7 MPa.

Rate of change = ... g m ^{2} h ^{1} MPa ^{1} **[2]**

4 Respiratory diseases, such as asthma, can be acute or chronic.

(a) State **one** difference between an acute and a chronic disease.

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

(b) A study was carried out into the effects of long-term exposure to air pollution on the risk of mortality from respiratory diseases.

- The study took place in the community involving a representative sample of a UK population.
- National surveys and questionnaires were used to gather data about individuals between 1971 and 2001.
- The concentration of pollutants in the air for each year of the study was obtained from a national database and used to estimate exposure for each individual over the 30-year period.

(i) Suggest what is meant by a **representative sample** in this study.

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

(ii) In 1971, the representative sample consisted of 511 670 individuals. However, 154 312 individuals were excluded from the results at the end of the study.

Calculate the percentage of individuals whose data were **included** in the results.

Give your answer to **2** significant figures.

Individuals included = ... % **[2]**

(iii) Suggest **one** reason why individuals may have been excluded from the results at the end of the study.

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

(iv) The study concluded that:

There was a positive correlation between the length of exposure to air pollution and the risk of mortality from respiratory diseases.

Discuss the limitations of the study that could affect the validity of this conclusion.

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5 Regular training programmes can improve aerobic fitness and affect skeletal muscle.

(a)* Discuss the benefits of improved aerobic fitness and the factors that should be taken into account when designing a regular training programme.

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Additional answer space if required.

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(b) **Fig. 5**, on the **Insert**, shows a photomicrograph of human skeletal muscle tissue as seen using a light microscope.

Using the space below, draw a **labelled** diagram of the tissue shown in **Fig. 5** and annotate **two** of the parts you have labelled.

[4]

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).