| Centre Number | | | | | | Candidate Number | | | | |
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| Surname | | | | | | | | | | |
| Other Names | | | | | | | | | | |
| Candidate Signature | | | | | | | | | | |

| For Examiner's Use | |
|---|---|
| Examiner's Initials | |
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
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| 9 | |
| TOTAL | |

General Certificate of Education
Advanced Subsidiary Examination
January 2013

# Biology BIOL2

## Unit 2 The variety of living organisms

**Tuesday 15 January 2013 1.30 pm to 3.15 pm**

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

### Time allowed
- 1 hour 45 minutes

### 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.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

### Information
- The maximum mark for this paper is 85.
- You are expected to use a calculator, where appropriate.
- The marks for questions are shown in brackets.
- Quality of Written Communication will be assessed in all answers.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

Do not write outside the box

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

**1 (a)** The table shows some statements about three carbohydrates. Complete the table with a tick in each box if the statement is true.

| Statement | Starch | Cellulose | Glycogen |
|---|---|---|---|
| Found in plant cells | | | |
| Contains glycosidic bonds | | | |
| Contains β-glucose | | | |

*(3 marks)*

**1 (b)** Name the type of reaction that would break down these carbohydrates into their monomers.

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*(1 mark)*

**1 (c)** Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature .....

Explanation .....

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*(2 marks)*

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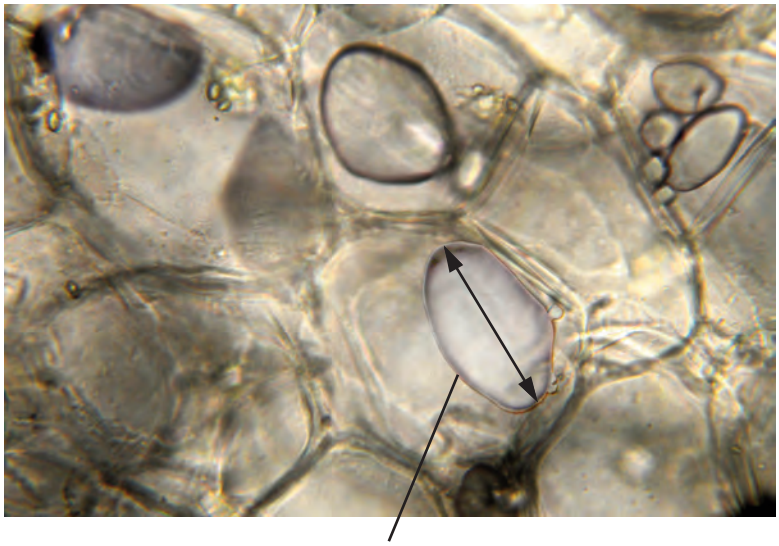
**1 (d)** The picture shows starch grains as seen with an optical microscope. The actual length of starch grain **A** is 48 µm. Use this information and the arrow line to calculate the magnification of the picture. Show your working.



Starch grain **A**

Magnification ..... times
*(2 marks)*

8

**Turn over for the next question**

Do not write outside the box

**2 (a) (i)** An arteriole is described as an organ. Explain why.

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*(1 mark)*

**2 (a) (ii)** An arteriole contains muscle fibres. Explain how these muscle fibres reduce blood flow to capillaries.

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*(2 marks)*

**2 (b) (i)** A capillary has a thin wall. This leads to rapid exchange of substances between the blood and tissue fluid. Explain why.

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*(1 mark)*

**2 (b) (ii)** Blood flow in capillaries is slow. Give the advantage of this.

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*(1 mark)*

Do not write outside the box

**2 (c)** Kwashiorkor is a disease caused by a lack of protein in the blood. This leads to a swollen abdomen due to a build up of tissue fluid.

Explain why a lack of protein in the blood causes a build up of tissue fluid.

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*(3 marks)*

*(Extra space)* .....

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8

**Turn over for the next question**

Do not write outside the box

**3 (a)** The scientific name of the leopard is *Panthera pardus*. Complete the table to show the classification of the leopard.

| **Kingdom** | **Animalia** |
|---|---|
| Phylum | Chordata |
| | Mammalia |
| | Carnivora |
| Family | Felidae |
| Genus | |
| Species | |

*(2 marks)*

**3 (b)** Leopards, cheetahs and pumas are all members of the family Felidae.

Biologists used DNA hybridisation to investigate the evolutionary relationships between leopards, cheetahs and pumas. They found that hybrid DNA from a leopard and a cheetah separated into single strands at a higher temperature than hybrid DNA from a leopard and a puma.

These results suggest that leopards are more closely related to cheetahs than to pumas. Explain why.

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*(2 marks)*

Do not write outside the box

**3 (c)** All modern cheetahs are thought to have descended from a single female. This female was part of a small population that survived an ice age a long time ago that killed almost all cheetahs. After the ice age, the number of cheetahs increased.

**3 (c) (i)** Use this information to explain what is meant by a genetic bottleneck.

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*(2 marks)*

**3 (c) (ii)** The fertility of cheetahs is low. The proportion of abnormal sperm cells produced is higher in cheetahs than in other members of the family Felidae. Suggest an explanation for this.

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*(2 marks)*

8

**Turn over for the next question**

Do not write outside the box

**4 (a)** What is *intraspecific* variation?

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*(1 mark)*

**4 (b)** Schizophrenia is a mental illness. Doctors investigated the relative effects of genetic and environmental factors on the development of schizophrenia. They used sets of identical twins and non-identical twins in their investigation. At least one twin in each set had developed schizophrenia.

- Identical twins are genetically identical.
- Non-identical twins are not genetically identical.
- The members of each twin pair were raised together.

The table shows the percentage of cases where both twins had developed schizophrenia.

| Type of twin | Percentage of cases where both twins had developed schizophrenia |
|---|---|
| Identical | 50 |
| Non-identical | 15 |

**4 (b) (i)** Explain why both types of twin were used in this investigation.

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*(2 marks)*

**4 (b) (ii)** What do these data suggest about the relative effects of genetic and environmental factors on the development of schizophrenia?

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*(1 mark)*

Do not write outside the box

**4 (b) (iii)** Suggest **two** factors that the scientists should have taken into account when selecting the twins to be used in this study.

1 .....

2 .....

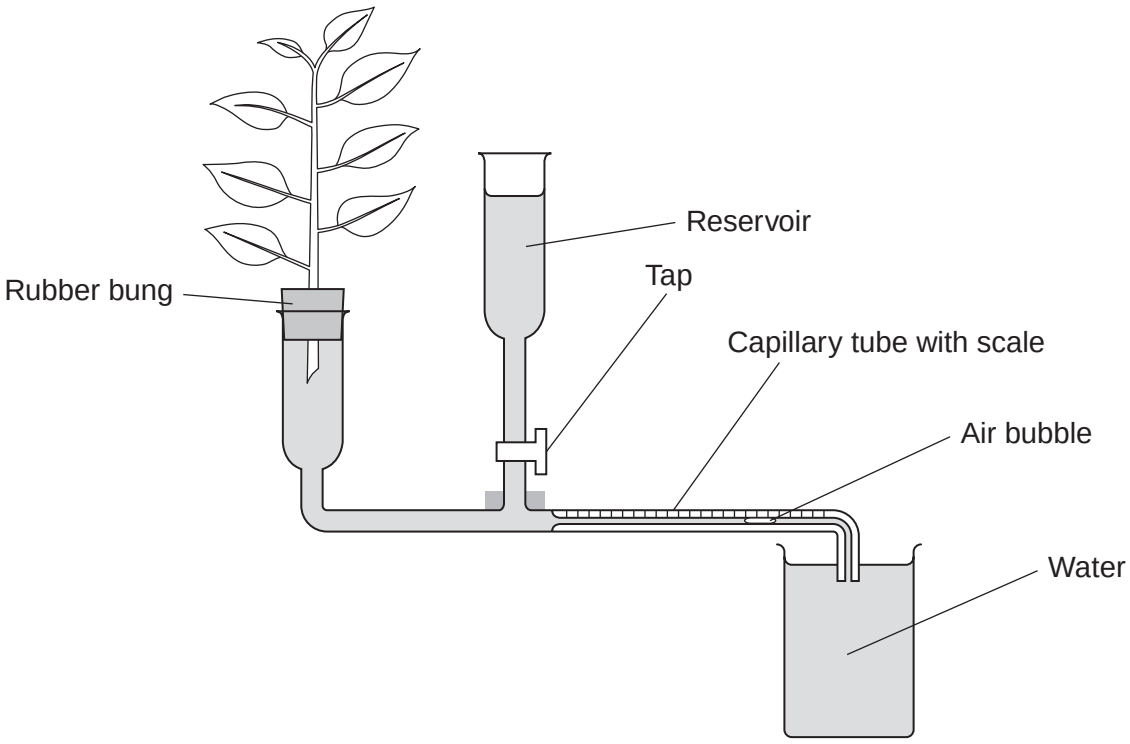
*(2 marks)*

6

**Turn over for the next question**

Do not write outside the box

**5** Students investigated the effect of removing leaves from a plant shoot on the rate of water uptake. Each student set up a potometer with a shoot that had eight leaves. All the shoots came from the same plant. The potometer they used is shown in the diagram.




**5 (a)** Describe how the students would have returned the air bubble to the start of the capillary tube in this investigation.

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*(1 mark)*

**5 (b)** Give **two** precautions the students should have taken when setting up the potometer to obtain reliable measurements of water uptake by the plant shoot.

1 .....

2 .....

*(2 marks)*

Do not write outside the box

**5 (c)** A potometer measures the rate of water uptake rather than the rate of transpiration. Give **two** reasons why the potometer does **not** truly measure the rate of transpiration.

1 .....

2 .....

*(2 marks)*

**5 (d)** The students' results are shown in the table.

| Number of leaves removed from the plant shoot | Mean rate of water uptake / $cm^3$ per minute |
|---|---|
| 0 | 0.10 |
| 2 | 0.08 |
| 4 | 0.04 |
| 6 | 0.02 |
| 8 | 0.01 |

Explain the relationship between the number of leaves removed from the plant shoot and the mean rate of water uptake.

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*(3 marks)*

*(Extra space)* .....

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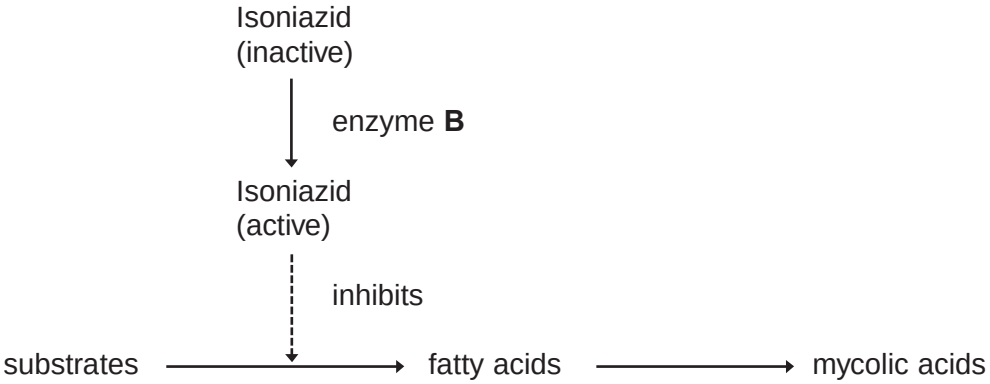
**6** Mycolic acids are substances that form part of the cell wall of the bacterium that causes tuberculosis. Mycolic acids are made from fatty acids. Isoniazid is an antibiotic that is used to treat tuberculosis. The diagram shows how this antibiotic inhibits the production of mycolic acids in this bacterium.




**6 (a)** Treatment with isoniazid leads to the osmotic lysis of this bacterium. Use information in the diagram to suggest how.

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*(2 marks)*

**6 (b)** Human cells also produce fatty acids. Isoniazid does not affect the production of these fatty acids.

Use information in the diagram to suggest **one** reason why isoniazid does **not** affect the production of fatty acids in human cells.

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*(1 mark)*

Do not write outside the box

**6 (c)** A mutation in the gene coding for enzyme **B** could lead to the production of a non-functional enzyme. Explain how.

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*(3 marks)*

*(Extra space)* .....

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**6 (d)** Using isoniazid to treat diseases caused by other species of bacteria could increase the chance of the bacterium that causes tuberculosis becoming resistant to isoniazid.

Use your knowledge of gene transmission to explain how.

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*(3 marks)*

*(Extra space)* .....

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9

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**7 (a)** There are ethical and economic arguments for maintaining biodiversity.

**7 (a) (i)** Suggest **one** ethical argument for maintaining biodiversity.

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*(1 mark)*

**7 (a) (ii)** Suggest **one** economic argument for maintaining biodiversity.

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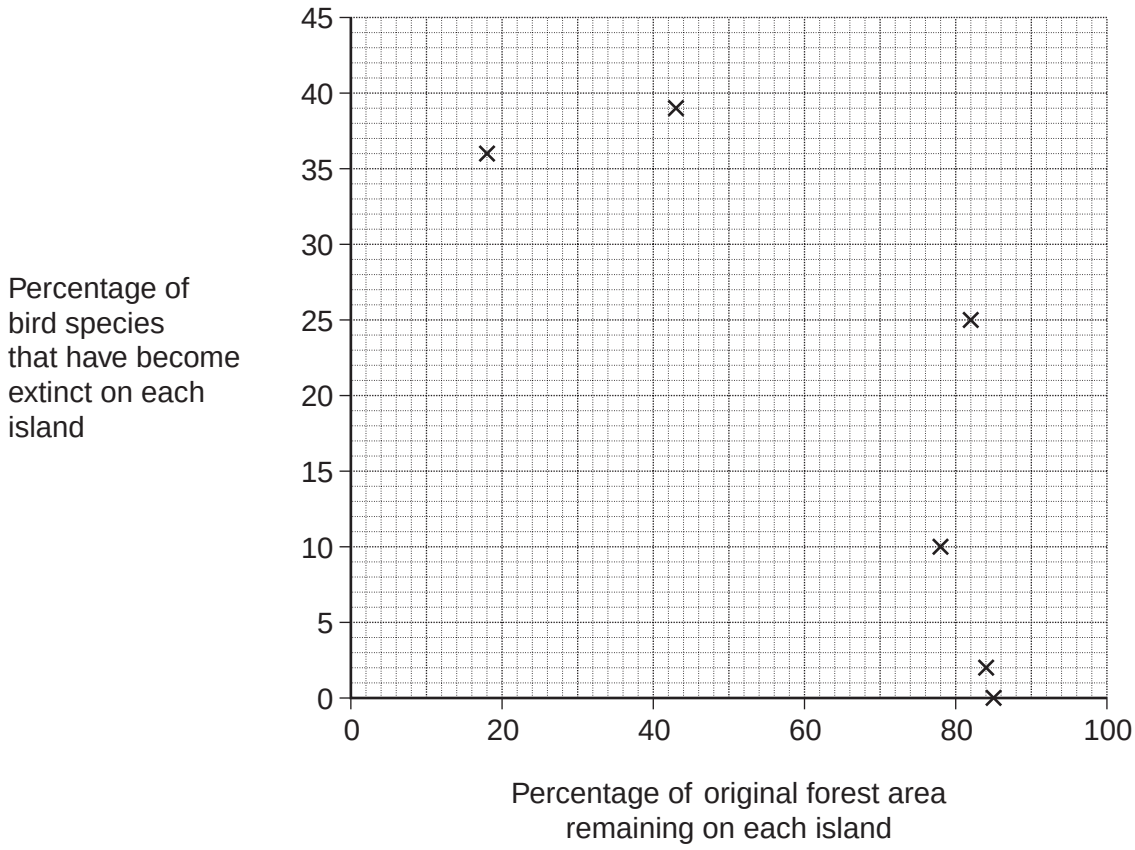
*(1 mark)*

Ecologists calculated the percentage of bird species that have become extinct on six islands in the last one hundred years. They also calculated the percentage of original forest area remaining on each island after the same time period. The graph shows their results.



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**7 (b)** Explain the relationship between the percentage of original forest area remaining and the percentage of bird species that have become extinct.

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*(2 marks)*

**7 (c)** What **two** measurements would the ecologists have needed to obtain to calculate the index of diversity of birds on each island?

1 .....

2 .....

*(2 marks)*

**7 (d)** The ecologists noted that the species of birds surviving on the coldest islands had a larger body size than those surviving on warmer islands.

Explain how a larger body size is an adaptation to a colder climate.

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*(2 marks)*

8

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**8 (a)** Describe how DNA is replicated.

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*(6 marks)*

*(Extra space)* .....

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**Question 8 continues on the next page**

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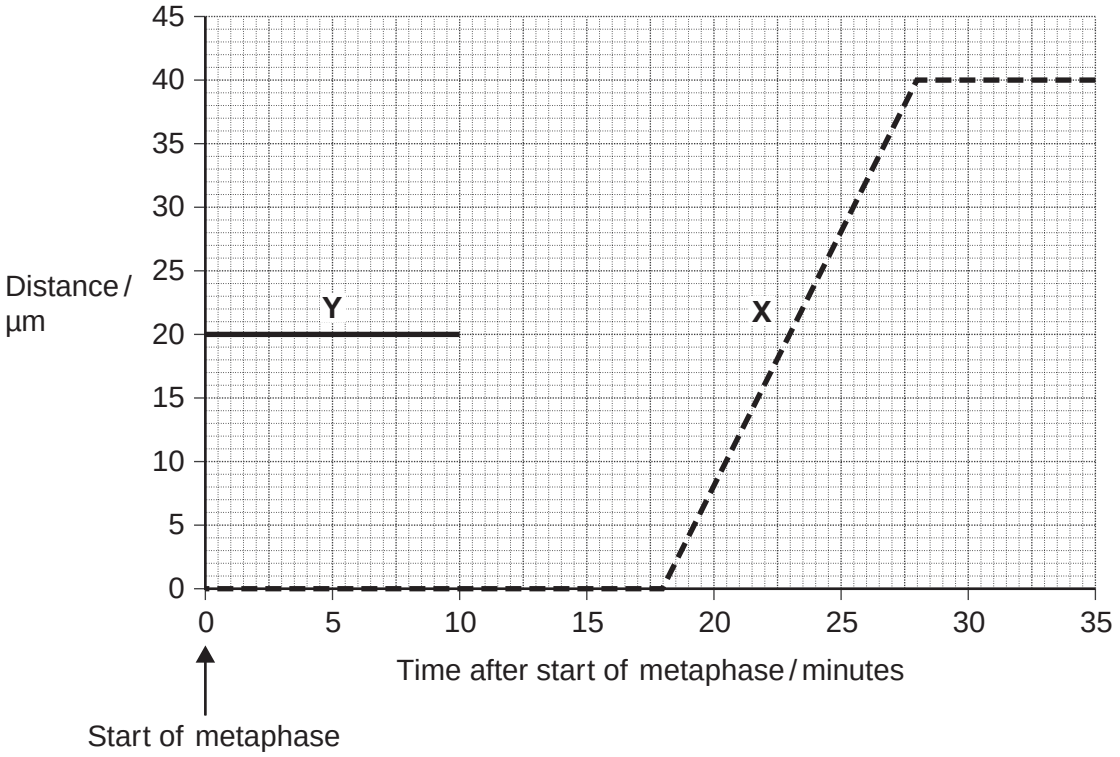
**8 (b)** The graph shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.

**Key**

- - - - = distance between chromatids

——— = distance between each chromatid and the pole to which it is moving




**8 (b) (i)** What was the duration of metaphase in this cell?

☐ minutes

*(1 mark)*

**8 (b) (ii)** Use line **X** to calculate the duration of anaphase in this cell.

☐ minutes

*(1 mark)*

**8 (b) (iii)** Complete line **Y** on the graph.

*(2 marks)*

Do not write outside the box

**8 (c)** A doctor investigated the number of cells in different stages of the cell cycle in two tissue samples, **C** and **D**. One tissue sample was taken from a cancerous tumour. The other was taken from non-cancerous tissue. The table shows his results.

| | **Percentage of cells in each stage of the cell cycle** | |
|---|---|---|
| **Stage of the cell cycle** | Tissue sample **C** | Tissue sample **D** |
| Interphase | 82 | 45 |
| Prophase | 4 | 16 |
| Metaphase | 5 | 18 |
| Anaphase | 5 | 12 |
| Telophase | 4 | 9 |

**8 (c) (i)** In tissue sample **C**, one cell cycle took 24 hours. Use the data in the table to calculate the time in which these cells were in interphase during one cell cycle. Show your working.

Time cells in interphase ..... hours
*(2 marks)*

**8 (c) (ii)** Explain how the doctor could have recognised which cells were in interphase when looking at the tissue samples.

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*(1 mark)*

**8 (c) (iii)** Which tissue sample, **C** or **D**, was taken from a cancerous tumour?
Use information in the table to explain your answer.

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*(2 marks)*

**15**

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**9** The 'placebo effect' describes the improvement in patients' symptoms due to psychological effects. Scientists investigated the placebo effect in patients with asthma. They divided a large number of asthma patients into three groups, **1**, **2** and **3**.

- Group **1** inhaled a spray containing albuterol every day. Albuterol is a drug used to treat asthma.
- Group **2** inhaled a placebo spray every day. This was identical to the spray given to group **1** but it did not contain albuterol.
- Group **3** did not receive any spray treatment.

**9 (a)** Describe **one** way the scientists could have allocated the patients to each group.

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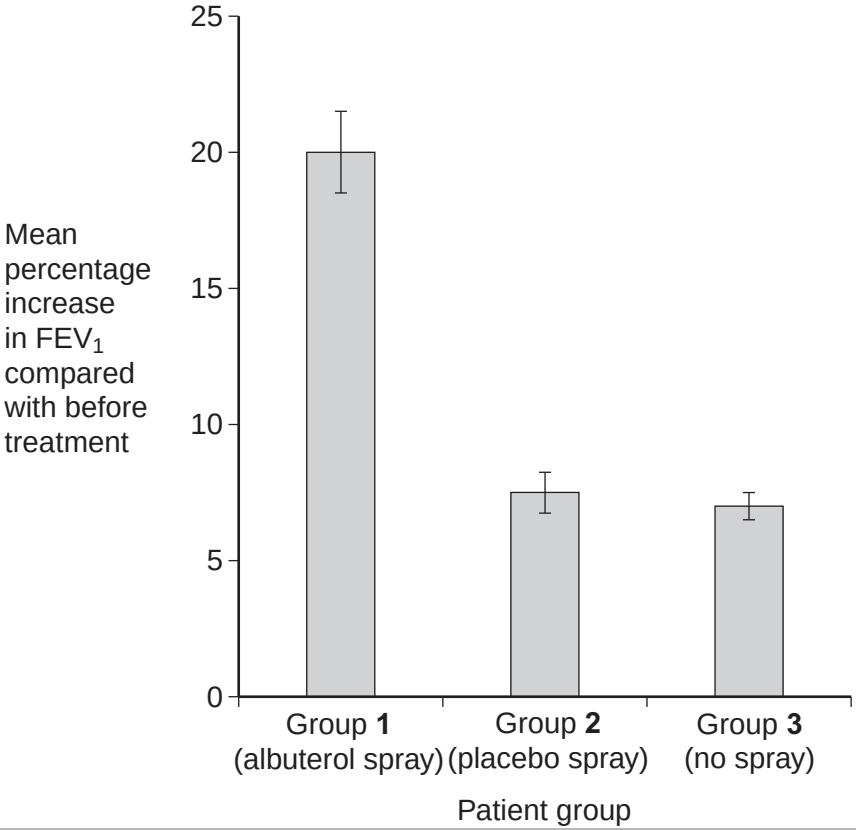
*(2 marks)*

The scientists measured the forced expiratory volume ($FEV_1$) of each patient at regular intervals. The forced expiratory volume ($FEV_1$) is the volume of air forced out of the lungs in the first second when breathing out. The scientists recorded each patient's $FEV_1$ before treatment started and after 60 days of treatment. They then calculated the mean increase in $FEV_1$ for each group. Their results are shown in the graph. The bars show the standard deviation.



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**9 (b)** What do the standard deviation bars suggest about the difference in the mean increase in $FEV_1$ between Group **1** and the other groups? Explain your answer.

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*(2 marks)*

**9 (c)** What do the data suggest about the 'placebo effect' in this investigation? Explain your answer.

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*(2 marks)*

**9 (d)** On each occasion that a patient's $FEV_1$ was measured, a doctor repeated the measurement several times. Explain why.

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*(2 marks)*

**Question 9 continues on the next page**

**9 (e)** All the patients continued with their normal treatment for asthma. The normal treatment was the same for all patients and its effects were short-lived. The patients were told to stop this treatment 24 hours before $FEV_1$ measurements were taken.

**9 (e) (i)** Suggest why all the patients were allowed to continue with their normal asthma treatment in this investigation.

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*(1 mark)*

**9 (e) (ii)** Suggest why the patients were told to stop their normal asthma treatment 24 hours before their $FEV_1$ measurements were taken.

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*(2 marks)*

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**9 (f)** After 60 days, the patients in each group were asked to give themselves an *Improvement Score* from 0 – 10 to show how much they felt their symptoms had improved. This was done before their $FEV_1$ was measured. The scientists calculated the mean *Improvement Score* for each group.

**9 (f) (i)** The scientists concluded that the data obtained for the *Improvement Scores* were less reliable than the data obtained measuring $FEV_1$. Suggest why they concluded this.

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*(2 marks)*

**9 (f) (ii)** Group **3** reported the lowest mean *Improvement Score*. Suggest **one** explanation for this.

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*(2 marks)*

**15**

**END OF QUESTIONS**

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