Write your name here

| Surname | | Other names |
|---|---|---|
| | | |

**Pearson Edexcel
Level 3 GCE**

Centre Number

Candidate Number

# Biology A
# (Salters Nuffield)

**Advanced Subsidiary
Paper 2: Development, Plants and the Environment**

| Sample Assessment Material for first teaching September 2015 **Time: 1 hour 30 minutes** | Paper Reference **8BN0/02** |
|---|---|

**You may need a ruler, a pencil and a calculator.**

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You may use a scientific calculator.
- In questions marked with an asterisk (**\***), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

## Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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**PEARSON**

**Answer ALL questions.**

**Write your answers in the spaces provided.**

**Some questions must be answered with a cross in a box ⊠. If you change your mind about an answer, put a line through the box ⊠ and then mark your new answer with a cross ⊠.**

1   A student prepared a root tip squash to view stages of mitosis.

   The diagram shows the drawing made by the student.
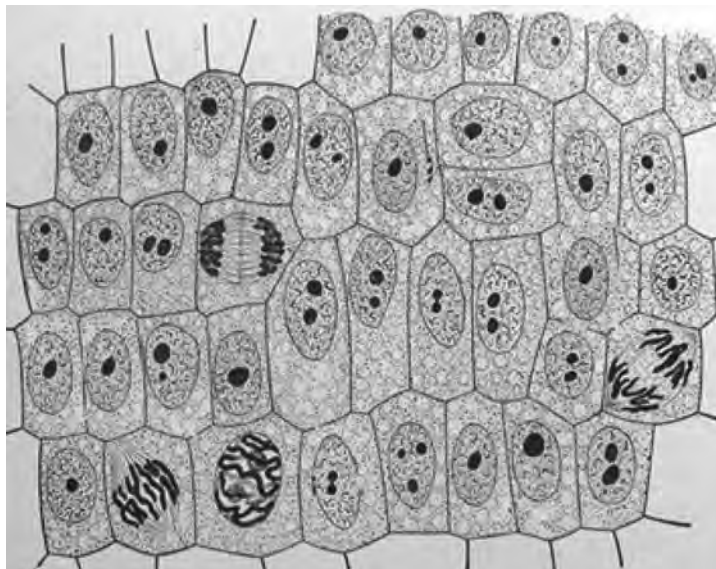


   (a) The ratio of cells in the drawing showing anaphase compared to those showing metaphase is

(1)

   ⊠ **A**   2:1

   ⊠ **B**   1:2

   ⊠ **C**   1:1

   ⊠ **D**   3:1

(b) The mitotic index is the percentage of cells undergoing mitosis.

The student calculated the mitotic index at different distances from the root tip. She used this information to plot the graph shown.
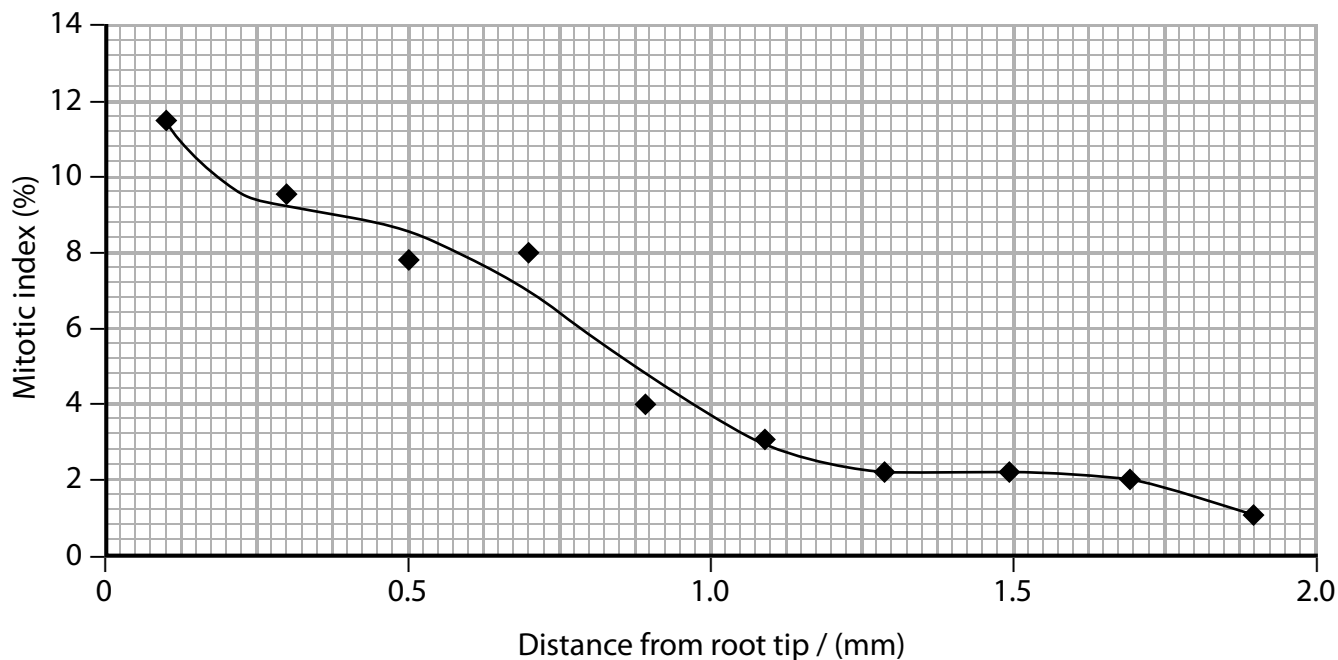


Calculate the distance from the root tip of the cells in the student's drawing.

**(2)**

Answer ...................................................

(c) (i) Which row shows the correct events that take place at each stage of cell division?

(1)

| Stage of cell division | | |
|---|---|---|
| | **Interphase** | **Prophase** |
| ⊠ **A** | DNA replicates | chromosomes condense |
| ⊠ **B** | centromeres separate | nuclear membrane breaks down |
| ⊠ **C** | chromatids are formed | spindle formation begins |
| ⊠ **D** | chromosomes decondense | nuclear membrane reforms |

(ii) Which of the following occurs during metaphase?

(1)

⊠ **A** separation of chromatids

⊠ **B** breakdown of the nuclear membrane

⊠ **C** division of the centromeres

⊠ **D** alignment of chromosomes at the equator of the cell

**(Total for Question 1 = 5 marks)**

2   The Hardy-Weinberg equation can be used to predict the number of people in a population who are carriers for a recessive allele.

The Hardy-Weinberg equation is shown below.

$$p^2 + 2pq + q^2 = 1$$

(a) Cystic fibrosis is a condition caused by a recessive allele.  Approximately 1 in 2 500 newborn babies has cystic fibrosis.

Use this information and the Hardy-Weinberg equation to complete the table below.

**(4)**

| Statement | Calculated number |
|---|---|
| The frequency of the recessive allele in the population | |
| The frequency of the dominant allele in the population | |
| The percentage of heterozygous individuals (carriers) in the population | |
| The number of babies in a sample of 100 000 that are likely to be carriers | |

(b) Explain how use of the Hardy-Weinberg equation allows scientists to determine whether evolution has occurred.

**(2)**

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(c) The use of the Hardy-Weinberg equation is valid only if the following condition occurs.

(1)

☒ **A** mutation

☒ **B** migration of individuals

☒ **C** random mating

☒ **D** natural selection

**(Total for Question 2 = 7 marks)**

**3** The diagram below shows a cross section through part of a sunflower stem.



Y

X

Z
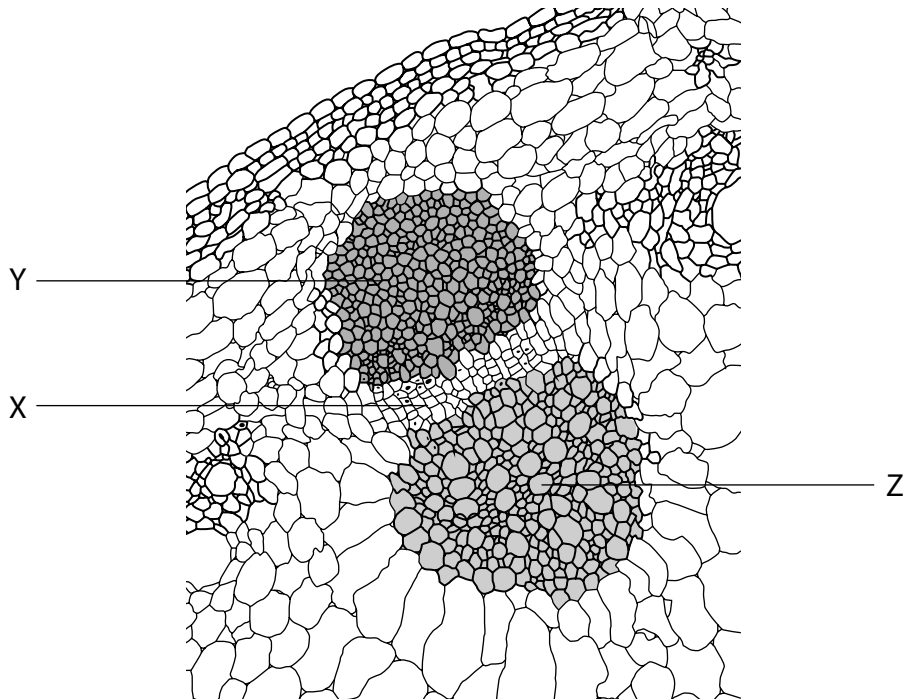
(a) (i) Which row shows the correct names for tissues **X** **Y** and **Z**

(1)

|  | Tissue X | Tissue Y | Tissue Z |
|---|---|---|---|
| ☒ **A** | sclerenchyma | xylem | phloem |
| ☒ **B** | phloem | sclerenchyma | xylem |
| ☒ **C** | phloem | xylem | sclerenchyma |
| ☒ **D** | xylem | sclerenchyma | phloem |

(ii) Which row shows the correct function for tissues X Y and Z

(1)

| | | Tissue X | Tissue Y | Tissue Z |
|---|---|---|---|---|
| ☒ | A | transports water and mineral ions | provides mechanical support | translocates organic solutes |
| ☒ | B | provides mechanical support | translocates organic solutes | transports water and mineral ions |
| ☒ | C | translocates organic solutes | provides mechanical support | transports water and mineral ions |
| ☒ | D | translocates organic solutes | transports water and mineral ions | provides mechanical support |

(b) The roots of this sunflower plant were put into a solution containing a metabolic poison. A metabolic poison prevents the production of ATP.

Explain how this would affect the transport of substances in these tissues.

(3)

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**(Total for Question 3 = 5 marks)**

**4** Some shopping bags can be made from bioplastic.

Bioplastic can be made from plant starch or cellulose.

(a) Describe the differences between the structure of starch and cellulose.

(3)

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(b) It is believed that bags made from bioplastic are better for the environment because they biodegrade faster than those made from crude oil.

An investigation compared the biodegradation of bags made from bioplastic and bags made from crude oil.

Small squares of plastic were cut from the bags. They were then weighed and buried in soil. After a period of time the small squares were reweighed.

The graph below shows the results of the investigation.
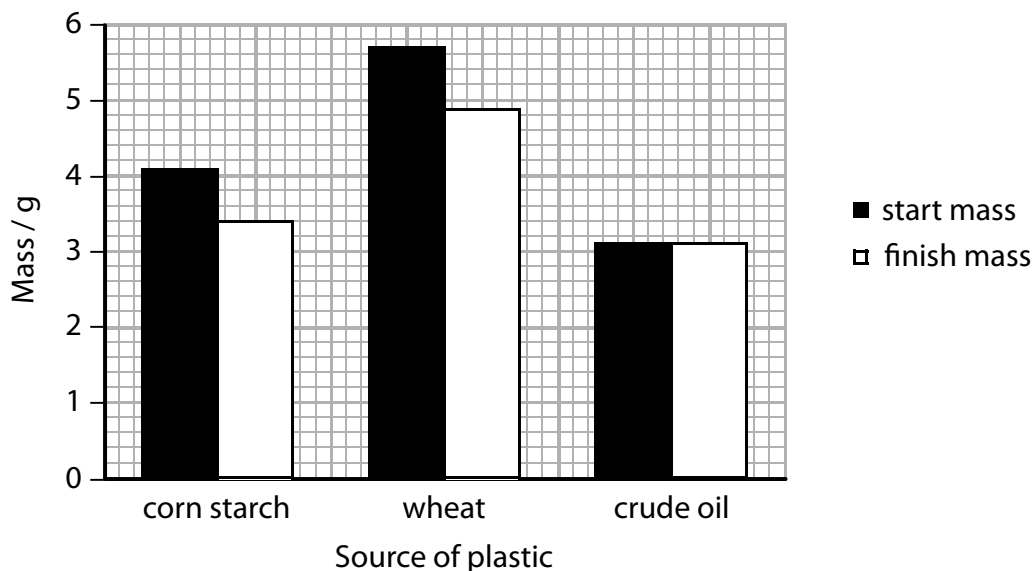


(i)　Give a reason why the soil in which the plastic squares were placed needed to be kept the same.

(1)

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(ii) State with a reason what needed to be done to the plastic squares after they had been removed from the soil for weighing.

(1)

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(c) Analyse the data to explain the advantages of using bioplastic to make bags rather than crude oil.

(3)

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**(Total for Question 4 = 8 marks)**

(3)

**5** Biodiversity can be measured by calculating species richness, genetic diversity or an index of diversity.

(a) Describe the differences between what is meant by the terms species richness and genetic diversity.

**(2)**

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(b) An index of diversity (*D*) can be used to compare the diversity of living organisms in different locations.

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

   *n* = total number of organisms of a particular species

   *N* = total number of organisms of all species

The table shows the number of insect species found living in a hedge.

| Insect species | Number of individuals |
|:---:|:---:|
| A | 1 |
| B | 2 |
| C | 12 |
| D | 8 |
| E | 9 |
| F | 3 |
| G | 3 |
| H | 2 |
| I | 5 |
| J | 7 |

Calculate an index of diversity (*D*) for insects living in this hedge.

**(3)**

Answer ...............................................

(c) The legless lizard, *Lialis burtonis*, belongs to the family Pygopodidae. The map shows the distribution of *Lialis burtonis*.
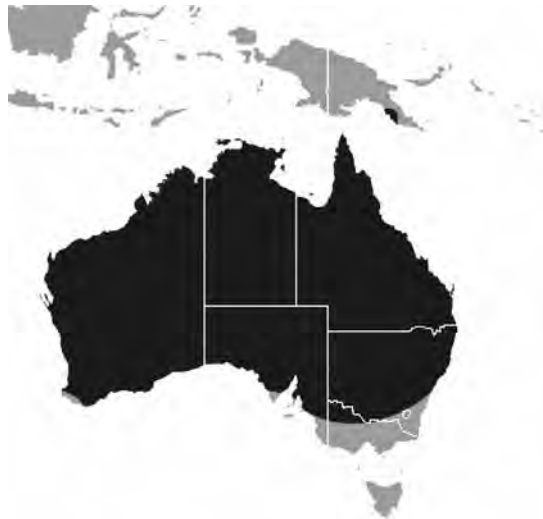


Give one reason why this lizard cannot be regarded as endemic.

(1)

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**(Total for Question 5 = 6 marks)**

**6** Pre-school aged children respond to stress by producing the hormone cortisol.

A study found that levels of cortisol were raised for children attending day care, compared with those remaining at home with their mother.

The graph below shows the results of this study.
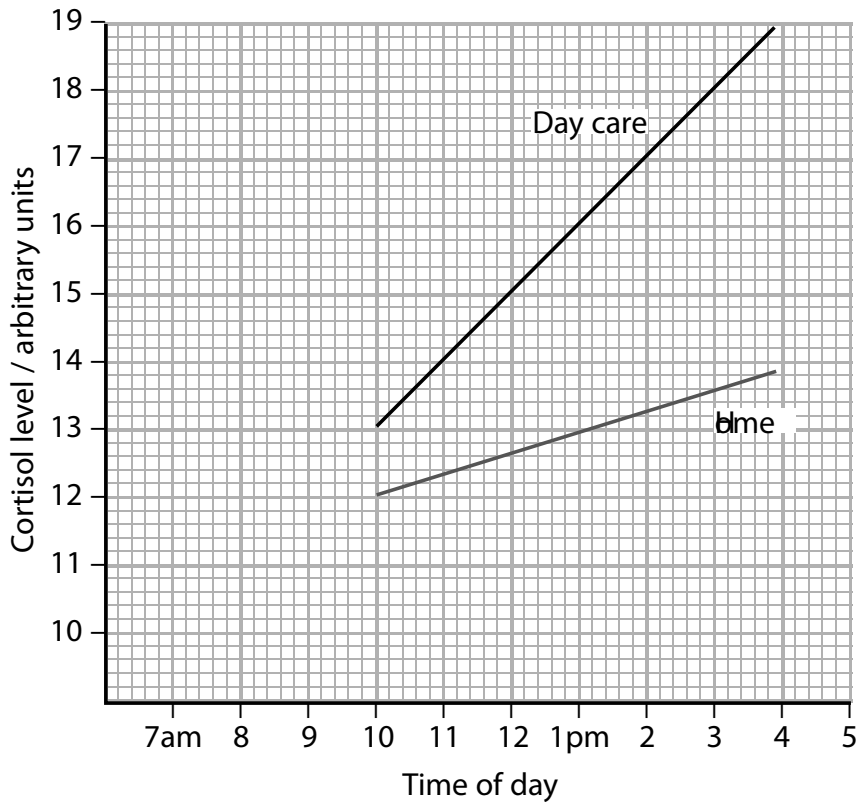


The percentage change in cortisol levels from 10am to 4pm for children who stayed at home with their mother was 13%.

(a) Calculate the percentage change in cortisol levels for the children in day care over the same time period.

Give your answer as a whole number.

**(3)**

Answer ......................................................

(b) It is thought that this difference may cause epigenetic changes.

Explain how these changes might affect the functioning of the genome.

(3)

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**(Total for Question 6 = 6 marks)**

**7** Plants can be used as sources of chemicals with antimicrobial properties.

In an investigation, Petri dishes were prepared with agar containing bacteria. Plant extracts were placed in wells cut into the agar.

The Petri dishes were incubated. The diagram shows one of the Petri dishes after incubation.

agar containing bacteria

clear zone

well containing plant extract
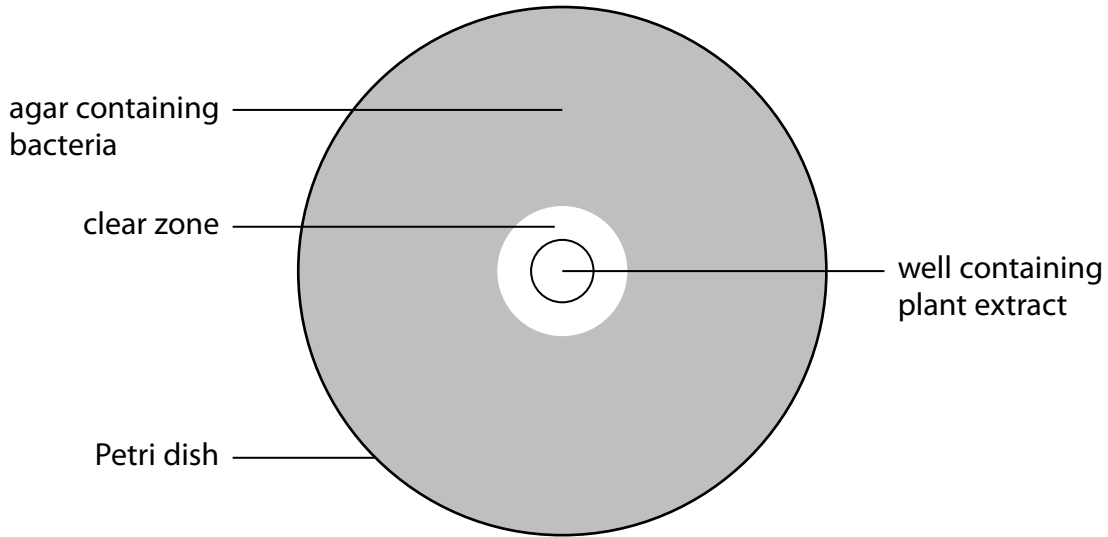
Petri dish

(a) (i) Explain the temperature that should be used to incubate the Petri dishes.

**(2)**

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(ii) Explain why the clear zone is a measure of the antimicrobial properties of the plant extract.

**(2)**

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(b) Extracts of various plant species were tested in this investigation. The results are shown in the table below.

| Plant extract | Mean diameter of clear zone / mm | Mean area of clear zone / mm² |
|---|---|---|
| Basil | 6 | 28.3 |
| Lemon balm | 8 | 50.3 |
| Rosemary | 6 | 28.3 |
| Sage | 2 | 3.1 |
| Lavender | 12 | 113.1 |

(i) Determine which is the better measure to use when comparing the antimicrobial properties of lavender and lemon balm.

(2)

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(ii) Explain why the conclusion that lavender is the plant with greatest antimicrobial properties may **not** be valid.

(2)

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**(Total for Question 7 = 8 marks)**

**8** In February 2014, the largest ever stem cell trial involving heart attack patients started.  This trial investigated the use of bone marrow as a source of stem cells to repair damaged heart tissue.

    (a)  Explain why bone marrow cells were used as a source of stem cells.

                      **(2)**

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(b) The flow chart below shows some of the steps that would be involved in the production of human tissues from bone marrow stem cells.

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┌─────────────────────────┐
│   Stem cells removed from │
│   bone marrow of the patient │
└─────────────────────────┘
            ⇩
┌─────────────────────────┐
│   Stem cells cultured in hospital │
│          laboratory      │
└─────────────────────────┘
            ⇩
┌─────────────────────────┐
│   Stem cells injected into damaged │
│       heart of the patient │
└─────────────────────────┘
```
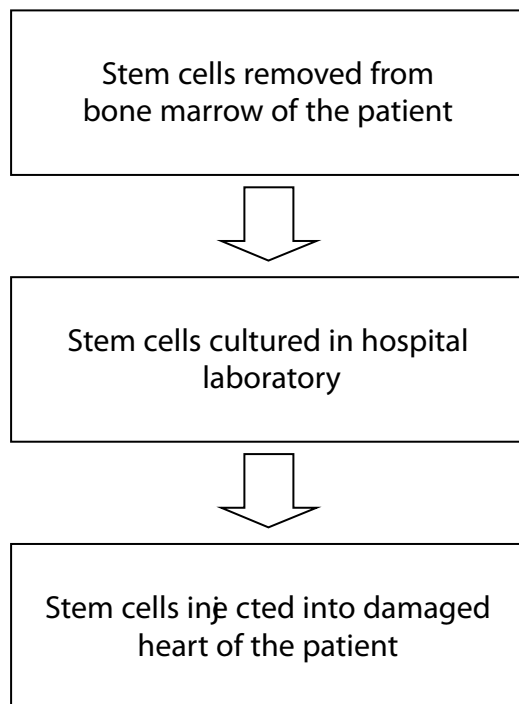
(i) Stem cells extracted from bone marrow are **pluripotent**.

State what is meant by the term pluripotent.

(2)

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(ii) Explain why these stem cells are able to repair the damaged heart tissue of this patient.

(5)

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(c) Some medical trials use embryonic stem cells, rather than bone marrow cells.

Describe how society controls the use of embryonic stem cells in medical research.

(4)

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**(Total for Question 8 = 13 marks)**

**9** Sperm are needed for the process of fertilisation. The diagram below shows a sperm cell.
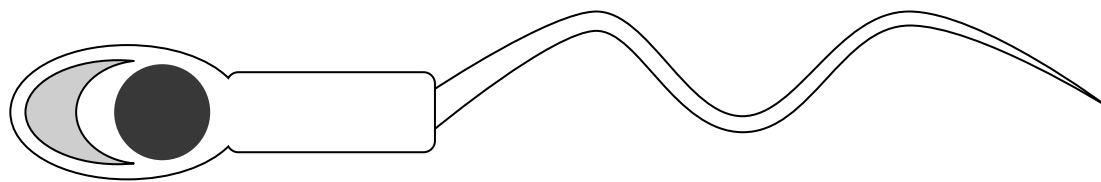


(a) (i) The actual size of a sperm head is 5 μm. The magnification of this sperm cell is

(1)

☒ **A** × 5.4

☒ **B** × 135

☒ **C** × 5480

☒ **D** × 10800

(ii) A structure in a sperm cell also found in prokaryotic cells is a

(1)

☒ **A** nucleus

☒ **B** mitochondrion

☒ **C** plasma membrane

☒ **D** lysosome

(b) To be able to swim properly sperm cells need a supply of adenosine triphosphate (ATP).

The graph below shows the correlation between sperm motility and the ATP content of a sperm cell.
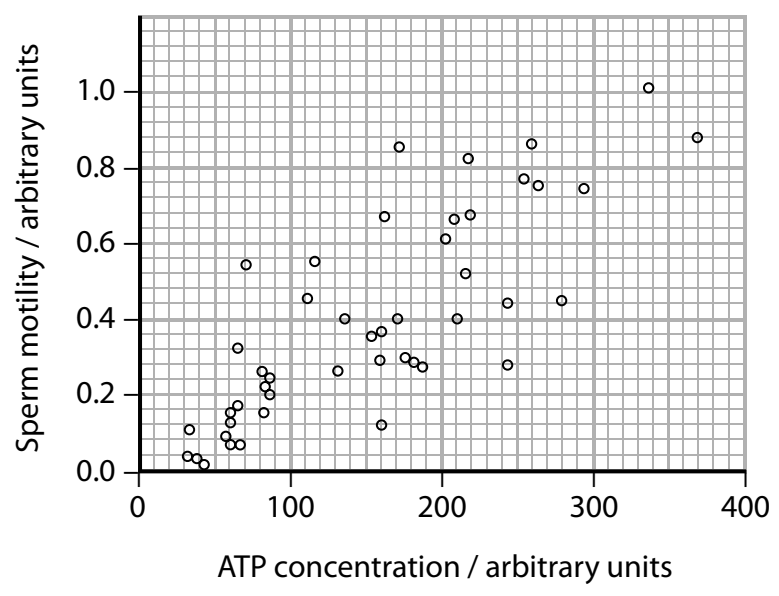


Analyse the data to explain the reason for 100% infertility in some men.

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(c) There are many products that may increase the ability of sperm to swim. One of these products contains zinc sulphate.

Devise an investigation to obtain valid data to show whether taking zinc sulphate tablets affects the ability of sperm to swim.

(6)

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**(Total for Question 9 = 11 marks)**

**10** Copper ions in soil can affect cell division in roots in plants.

Copper ions affect bonds in proteins, changing their shape. If the proteins are enzymes this may change the shape of the active site.

The effect of copper ions on the growth of mustard seedling roots was investigated. Mustard seeds were germinated on filter paper soaked in copper sulfate solution. These solutions provided copper ion concentrations ranging from 0 parts per million (ppm) to 200 ppm.

After 5 days, the lengths of the roots were measured.

The results are shown in the graph below.
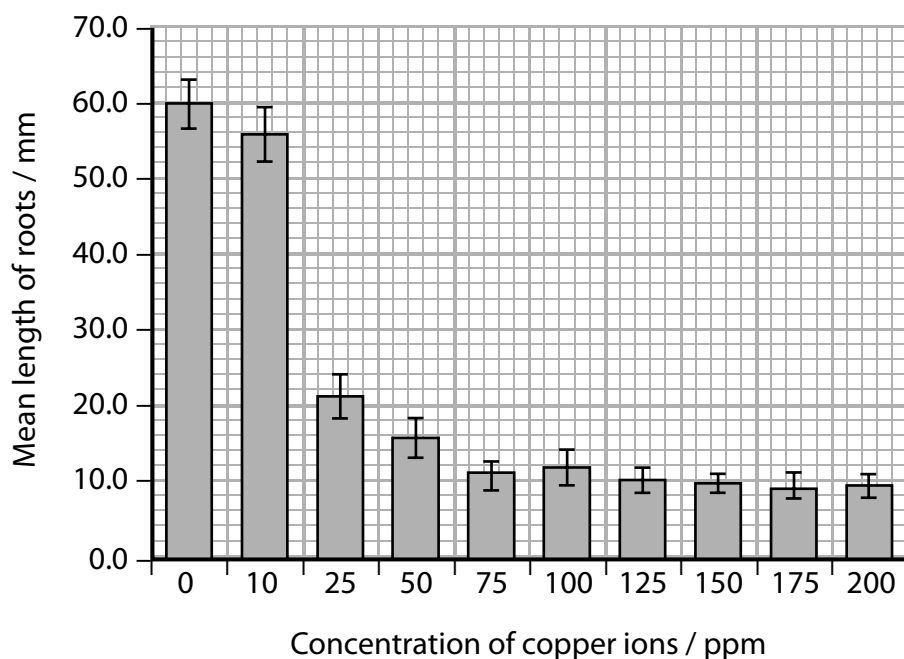


(a) (i) Analyse the data to explain the effect of copper ions on the growth of roots.

**(3)**

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(ii) Explain how this investigation could be improved.

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(b) Some grass plants possess an allele for copper tolerance. This allele allows them to grow in areas where there is a high concentration of copper ions in the soil.

Describe how natural selection has brought about different allele frequencies in the grass plants growing in these sites.

**(5)**

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**(Total for Question 10 = 11 marks)**

**TOTAL FOR PAPER = 80 MARKS**