

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**  
**B722/02**  
**GATEWAY SCIENCE**  
**ADDITIONAL SCIENCE B**  
**Additional Science modules B4, C4, P4**  
**(Higher Tier)**  
**FRIDAY 17 JUNE 2016 – Morning**  
**DURATION: 1 hour 30 minutes**  
**plus your additional time allowance**  
**MODIFIED ENLARGED 24pt**

<b>Candidate forename</b>		<b>Candidate surname</b>								
<b>Centre number</b>						<b>Candidate number</b>				

**Candidates answer on the Question Paper.**  
**A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**  
**A copy of the Periodic Table**

**OTHER MATERIALS REQUIRED:**  
**Pencil**  
**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**



## **INSTRUCTIONS TO CANDIDATES**

**Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**

**Use black ink. HB pencil may be used for graphs and diagrams only.**

**Answer ALL the questions.**

**Read each question carefully. Make sure you know what you have to do before starting your answer.**

**Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.**

## **INFORMATION FOR CANDIDATES**

**The quality of written communication is assessed in questions marked with a pencil (.**

**A list of equations can be found on pages 4–5.**

**The number of marks is given in brackets [ ] at the end of each question or part question.**

**The total number of marks for this paper is 85.**

**Any blank pages are indicated.**

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## **EQUATIONS**

**energy = mass × specific heat capacity × temperature change**

**energy = mass × specific latent heat**

**efficiency =  $\frac{\text{useful energy output (} \times 100\%)}{\text{total energy input}}$**

**wave speed = frequency × wavelength**

**power = voltage × current**

**energy supplied = power × time**

**average speed =  $\frac{\text{distance}}{\text{time}}$**

**distance = average speed × time**

$$s = \frac{(u + v)}{2} \times t$$

**acceleration =  $\frac{\text{change in speed}}{\text{time taken}}$**

**force = mass × acceleration**

**weight = mass × gravitational field strength**

**work done = force × distance**

**power =  $\frac{\text{work done}}{\text{time}}$**

**power = force × speed**

$$\text{KE} = \frac{1}{2}mv^2$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

$$\text{GPE} = mgh$$

$$mgh = \frac{1}{2}mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

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Answer ALL the questions.

SECTION A – Module B4

1 Jenny grows strawberries in her garden.

Her plants have produced lots of strawberries.

She is going to preserve the strawberries so that she can eat them months later.

There are different methods she can use to preserve the strawberries.

Draw straight lines to join each METHOD on the left to HOW IT WORKS on the right.

METHOD	HOW IT WORKS
adding sugar	draws water out of microorganisms
canning	stops enzymes working in microorganisms
freezing	stops microorganisms getting to the strawberries

[2]

[TOTAL: 2]

## 2 Read this article about ash trees.

**A fungus is killing ash trees.**

**It is threatening much of Britain's native ash woodland.**

**If it kills the trees, the fungus could also affect other organisms in this ecosystem.**

**Many insect, bird and bat species, such as thorn moths, woodpeckers and horseshoe bats, rely on ash trees. They could all be in danger.**

**Organisms that could benefit are detritivores.**

- (a) (i) Explain how detritivores could benefit from the action of the fungus.**

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[1]

- (ii) Explain the difference between the terms COMMUNITY and POPULATION.**

**Use an example of each from the article to help explain the difference.**

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[3]



**(iii) If a native ash woodland dies out it might be replaced by a forestry plantation.**

**Explain why that might DECREASE the biodiversity of the area.**

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**[2]**

**(b) The fungus causes a disease called die back.**

**It blocks the xylem vessels leading to the leaves.**

**This causes the stomata to close.**

**Explain why the stomata may close.**

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**Explain why, if the stomata stay closed, the plant may die.**

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**[4]**

**[TOTAL: 10]**

**3 George and Eva are talking about the pondweed in their fish tank.**

**George says, 'If we shine light at the pondweed we can tell how fast it is photosynthesising.**

**All we have to do is measure the change in oxygen level in the water.'**

**Eva says, 'I don't think that can be right.**

**I think we need to know what happens to the oxygen level in the dark as well as in the light.'**

**They set up an experiment to test their ideas.**

**To do this, they use a black bottle and a clear bottle.**

**Into each bottle they put the same amount of water and pondweed.**

**They measure the oxygen content of the water.**

**They put both bottles next to a light.**

**After a week, they measure the oxygen content of the water again in each bottle.**



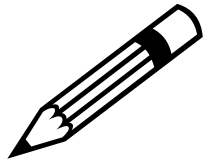
**Here are their results.**

**Oxygen level in water before experiment = 8 mg per litre**

**Oxygen level in black bottle after a week = 5 mg per litre**

**Oxygen level in clear bottle after a week = 10 mg per litre**

**(a) Explain the results of the experiment by analysing the data and use this to explain why Eva is correct.**



**The quality of written communication will be assessed in your answer to this question.**

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[6]

**(b) As well as light, plants also need magnesium for photosynthesis.**

## Explain why plants need magnesium.

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[1]

**[TOTAL: 7]**

**4 On some farms, cows are kept indoors in barns all the time.**

**On other farms, cows are kept outside in fields.**

**People often disagree on which system is better.**

**An experiment is set up to test the two different systems.**

**Ten cows are kept indoors and given food.**

**Another ten cows are kept in a field.**

**The cows in the field eat grass from the field but are given some extra food as well.**

**All the cows have the same level of nutrition.**

**The graph opposite shows the amount of milk that they produce.**

**(a) Explain the difference between the results for the two groups.**

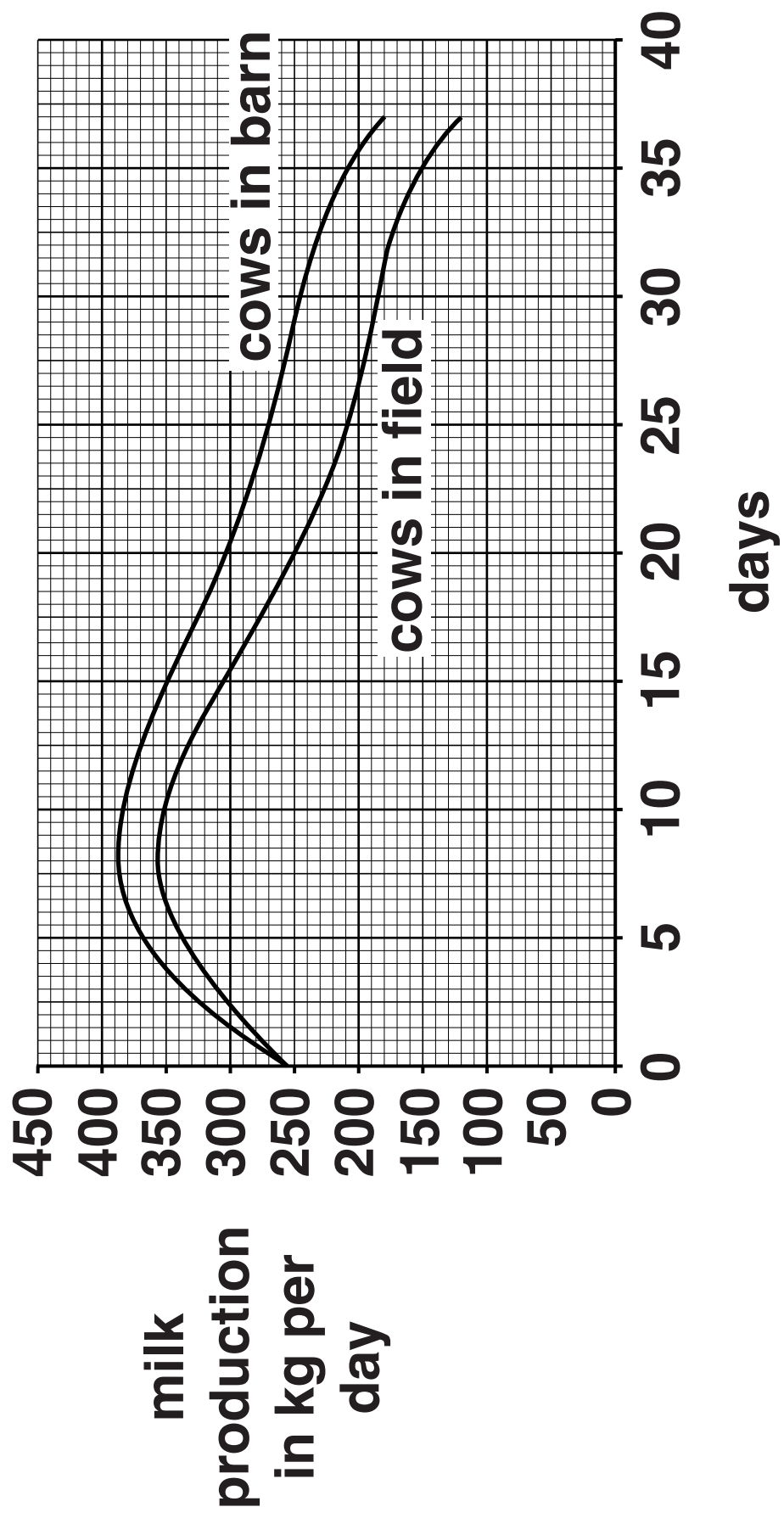
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**[2]**



**(b) The farmer can sell the milk for 50p per kg.**

**It costs the farmer £30 more per day to feed the group of cows in the barn.**

**Compare the profit from each group of cows on DAY 37.**

**Show your working.**

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[2]

**(c) Some people have ethical arguments against keeping cows in barns all the time.**

**Write about these arguments.**

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[2]

**[TOTAL: 6]**

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## **SECTION B – Module C4**

- 5 Many scientists have worked to discover the structure of the atom.**

**Dalton believed that elements were made of atoms.**

**He also believed that atoms could not be split.**

**(a) J J Thomson did some experiments.**

**What did J J Thomson discover that showed that not all of Dalton's ideas were correct?**

**Choose from:**

**electron shells**

**electrons**

**nucleus**

**neutrons**

**protons**

**answer \_\_\_\_\_ [1]**



**(b) Rutherford did some experiments about the structure of the atom.**

**Explain how Rutherford's experiments showed that not all of Dalton's ideas were correct.**

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**[2]**

**[TOTAL: 3]**

**6 Calcium, Ca, reacts with oxygen, O<sub>2</sub>, to make calcium oxide, CaO.**

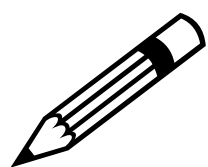
**calcium + oxygen → calcium oxide**

**Calcium oxide contains the ions Ca<sup>2+</sup> and O<sup>2-</sup>.**

**Use the formulas given to write the **BALANCED SYMBOL** equation for the reaction between calcium and oxygen.**

**Use the ‘dot and cross’ model to explain the bonding in both an O<sub>2</sub> molecule and in CaO.**

**You only need to draw the outer shell electrons.**



**The quality of written communication will be assessed in your answer to this question.**

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**[6]**

**[TOTAL: 6]**

**7 Phil and Kate analyse a solution.**

**Look at Table 7.**

**It shows the tests they use and the results they get.**

**TABLE 7**

<b>TEST NUMBER</b>	<b>TEST ON SOLUTION</b>	<b>RESULTS</b>
<b>1</b>	<b>appearance</b>	<b>colourless solution</b>
<b>2</b>	<b>flame test</b>	<b>lilac flame</b>
<b>3</b>	<b>adding sodium hydroxide solution</b>	<b>no precipitate</b>
<b>4</b>	<b>adding barium chloride solution</b>	<b>no precipitate</b>
<b>5</b>	<b>adding silver nitrate solution</b>	<b>pale yellow precipitate</b>

**(a) Kate concludes that the solution is potassium iodide.**

**Do the results support her conclusion?**

\_\_\_\_\_

**Explain your answer.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**[2]**

**(b) Describe how Kate and Phil did their flame test.**

**You may wish to draw a labelled diagram.**

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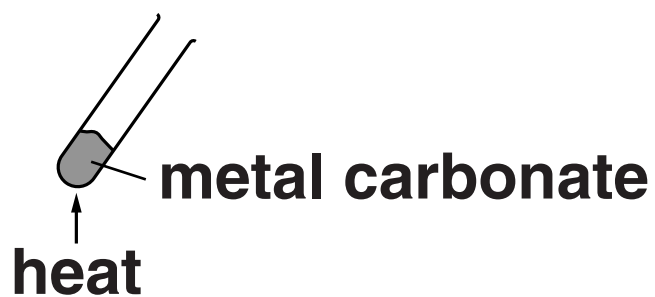
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**[3]**

**[TOTAL: 5]**

**8 Sam investigates what happens when she heats different metal carbonates.**

**Look at the apparatus she uses.**



**Sam measures the mass of metal carbonate then heats it.**

**She measures the mass of solid left in the test tube after it has cooled down.**

**Look at her results in Table 8 opposite.**

**TABLE 8**

<b>Metal carbonate</b>	<b>Mass of metal carbonate in g</b>	<b>Mass of solid in test tube after heating in g</b>
<b>copper carbonate</b>	<b>2.50</b>	<b>1.61</b>
<b>iron(II) carbonate</b>	<b>2.50</b>	<b>1.55</b>
<b>manganese carbonate</b>	<b>2.50</b>	<b>1.54</b>
<b>potassium carbonate</b>	<b>1.25</b>	<b>1.25</b>
<b>sodium carbonate</b>	<b>2.50</b>	<b>2.50</b>
<b>zinc carbonate</b>	<b>2.50</b>	<b>1.62</b>

**Some metal carbonates decompose when heated.**

**metal carbonate  $\rightarrow$  metal oxide + carbon dioxide**

**(a) Which TWO metal carbonates did NOT decompose in the investigation?**

\_\_\_\_\_ and \_\_\_\_\_ [1]

- (b) (i) Calculate the mass of carbon dioxide made when manganese carbonate is heated.

mass of carbon dioxide = \_\_\_\_\_ g [1]

- (ii) Manganese carbonate produces the greatest percentage by mass of carbon dioxide.

How can you tell from the results?

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[2]

- (c) Manganese carbonate has the formula  $\text{MnCO}_3$ .

Write the **BALANCED SYMBOL** equation for the decomposition of manganese carbonate.

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[1]

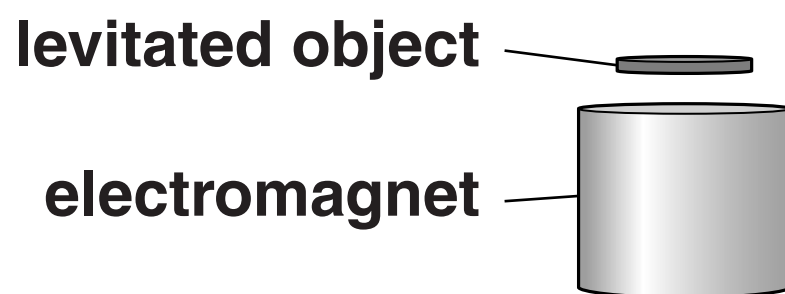
[TOTAL: 5]



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**9 Electromagnets can be used to levitate objects.**

**The electromagnets use a superconducting material.**



**Superconductors can be used to make powerful electromagnets.**

**(a) What is meant by the word SUPERCONDUCTOR?**

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[1]

**(b) Describe one OTHER possible benefit and explain one disadvantage of using a superconductor.**

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[2]

**[TOTAL: 3]**

10 A particle has the formula  $^{55}_{26}\text{Fe}^{2+}$ .

Complete the following table about this particle.

Number of protons in particle	
Number of electrons in particle	
Number of neutrons in particle	

[3]

[TOTAL: 3]

## SECTION C – Module P4

**11 (a) Ian rubs a polythene rod with a cloth.**

**The rod becomes positively charged.**

**Explain why the rod becomes positively charged.**

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[2]

**(b) Ian holds the charged rod near to a conducting sphere.**

**The conducting sphere is supported by an insulating stand.**

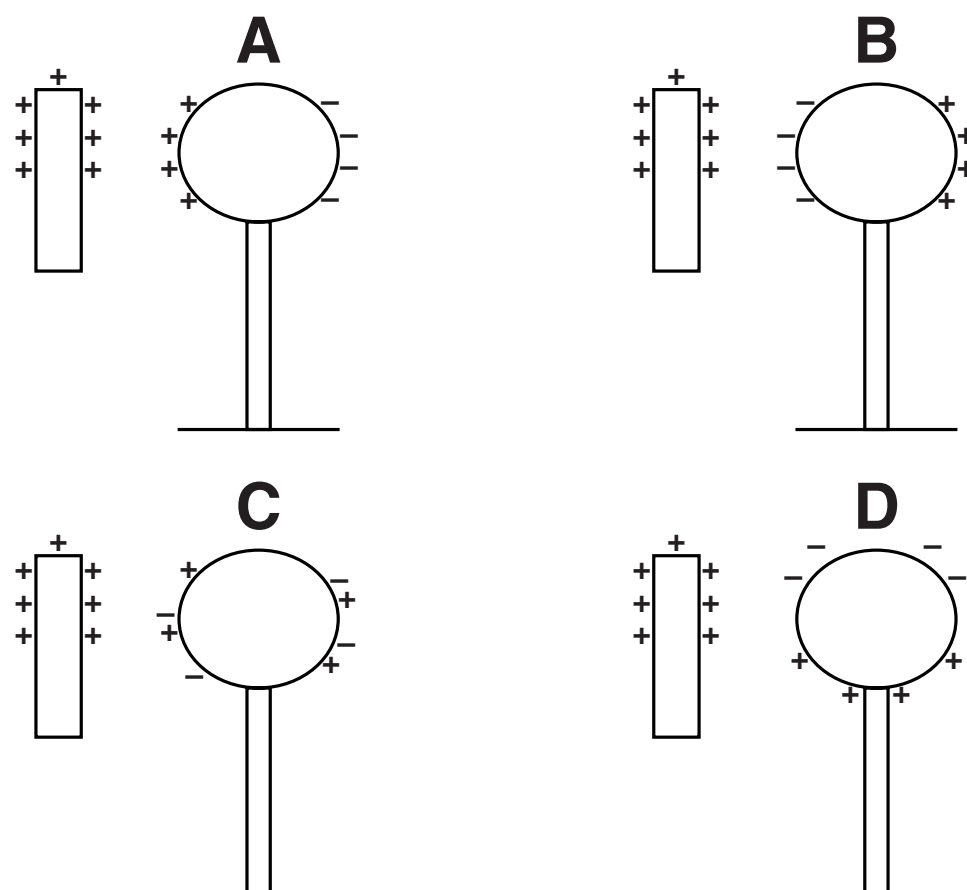
**The sphere has equal numbers of negative and positive charges.**

**Look at the diagrams opposite.**

**Which diagram shows the correct distribution of charge on the sphere?**

**Choose from:    A            B            C            D**

**answer \_\_\_\_\_ [1]**



- (c) Scientists think that static electricity has destroyed the screens on some types of electronic book readers.**

**The large electronic companies are trying to find a solution to this problem.**

**What are the advantages of using teams of scientists from different companies when trying to find out why the screens on some electronic book readers are destroyed?**

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**[2]**

- (d) Electrostatics can be useful in spray painting.**

**Describe one advantage of using an electrostatic paint sprayer when painting cars.**

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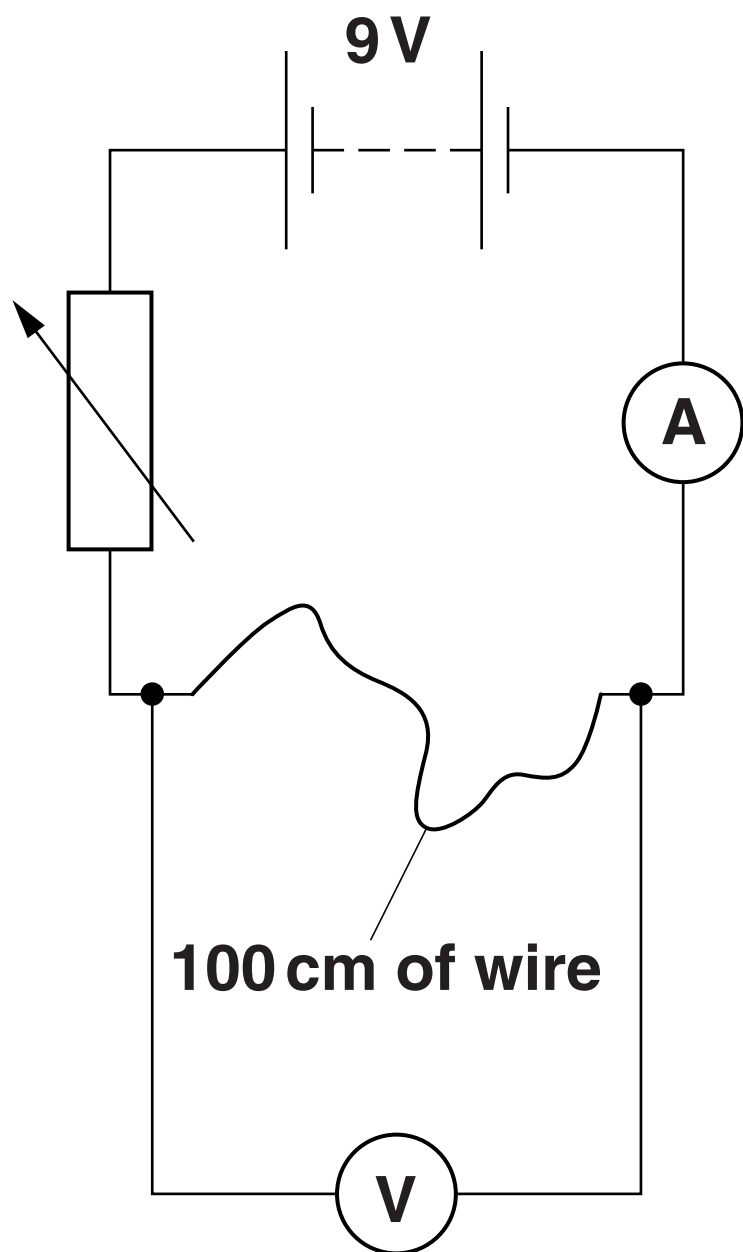
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**[1]**

**[TOTAL: 6]**

**12 Dave connects an electric circuit to find the resistance of 100 cm of wire.**

**Look at the diagram below.**



**The battery voltage is 9V.**

**The reading on the ammeter is 2 A.**

**The reading on the voltmeter is 5V.**

**(a) Calculate the resistance of the 100 cm of wire.**

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**answer** \_\_\_\_\_ **ohms**

**[2]**

**(b) Dave now uses some thinner wire.**

**A 100 cm length of this wire has a resistance of 5 ohms.**

**What length of this wire is needed to make a 2 ohm resistor?**

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**answer \_\_\_\_\_ cm [2]**

**(c) Dave has a 700W microwave oven.**

**It is connected to the 230V mains.**

**(i) Calculate the current.**

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**answer \_\_\_\_\_ A [2]**

**(ii) He finds that the fuse in the plug needs replacing.**

**Which fuse should he put in the plug?**

**Choose from:    3 A       5 A       10 A       13 A**

**answer \_\_\_\_\_ [1]**

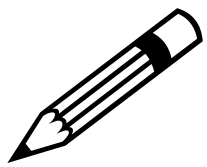
**[TOTAL: 7]**

**13 Carbon-14 is a radioactive isotope which decays by emitting a beta particle.**

**An isotope of nitrogen is formed, as shown in the nuclear equation below.**



**Complete the nuclear equation and describe in detail what happens to the particles in the nucleus of the carbon atom. Include ideas about mass number, atomic number and a description of the emitted  $\beta$  particle in your answer. [6]**



**The quality of written communication will be assessed in your answer to this question.**

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**[TOTAL: 6]**

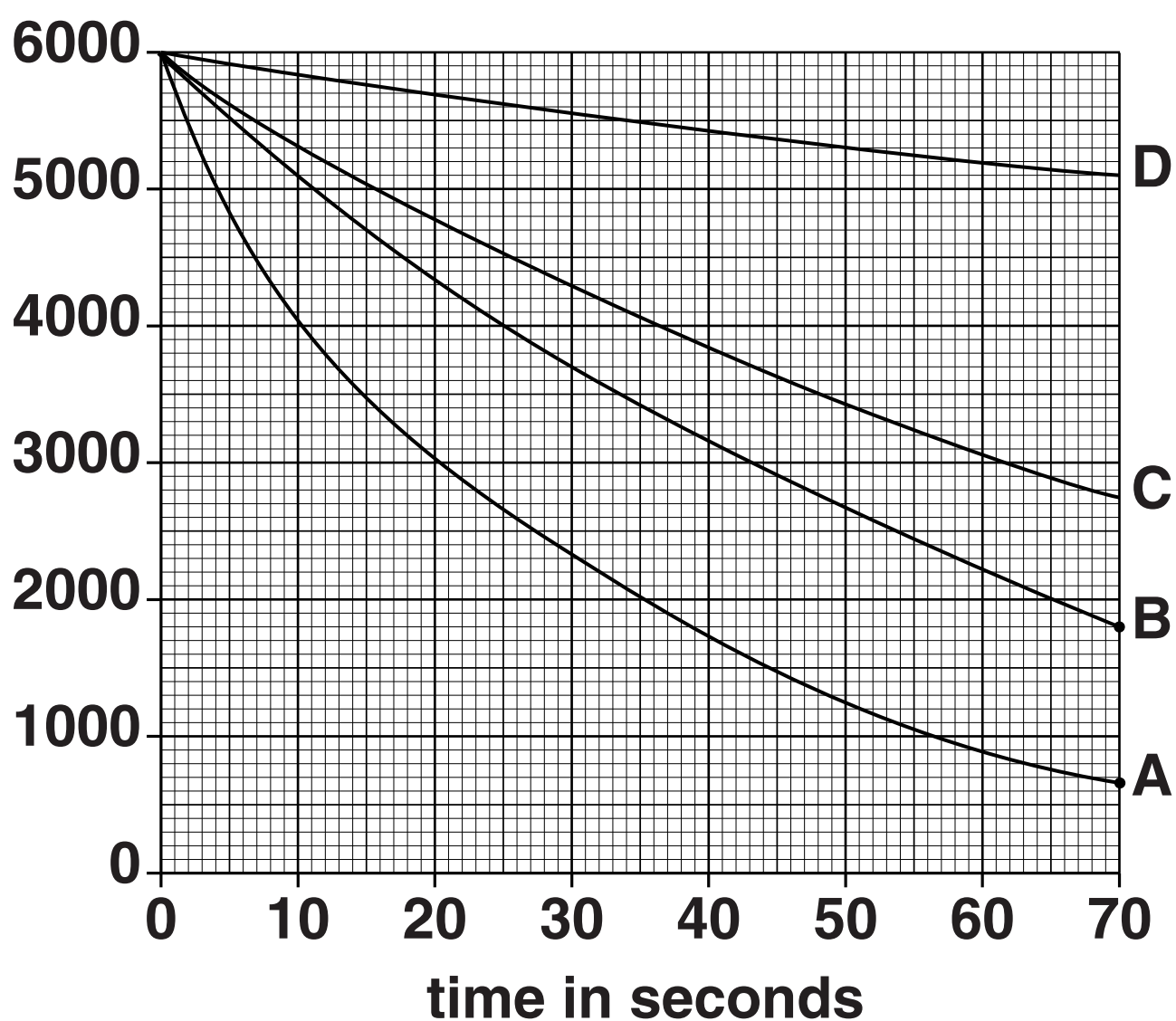
# 14 This question is about nuclear radiation.

Radioactive materials decay naturally.

The half-life is a measure of how quickly the radioactive materials decay.

(a) Look at the data below about the activity of four radioactive isotopes.

count rate  
in counts  
per minute



Which isotope has the shortest half-life?

Choose from      A                  B                  C                  D

answer \_\_\_\_\_

**Explain your answer.**

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**(b) Radioactive carbon-14 has a half-life of 5730 years.**

**(i) Carbon-14 can be used to find out the age of some materials.**

**Explain how.**

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**(ii) Wooden beams from a house are thought to be from trees cut down about 100 years ago.**

**The radiocarbon dating method cannot be used to show that 100 years is the accurate value.**

**Suggest why.**

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**[TOTAL: 6]**

**SECTION D**

**15 This question is about two types of tree.**

**Trees use leaves to make sugar by photosynthesis.**

**Some trees lose their leaves every year and grow new ones. They are called DECIDUOUS.**

**Other trees keep their leaves throughout the year. They are called EVERGREEN.**



**(a) Look at the graph opposite.**

**It shows the energy in sugars made by photosynthesis in:  
a deciduous tree  
an evergreen tree.**

**Use the graph to write about the similarities and differences for the two types of tree.**

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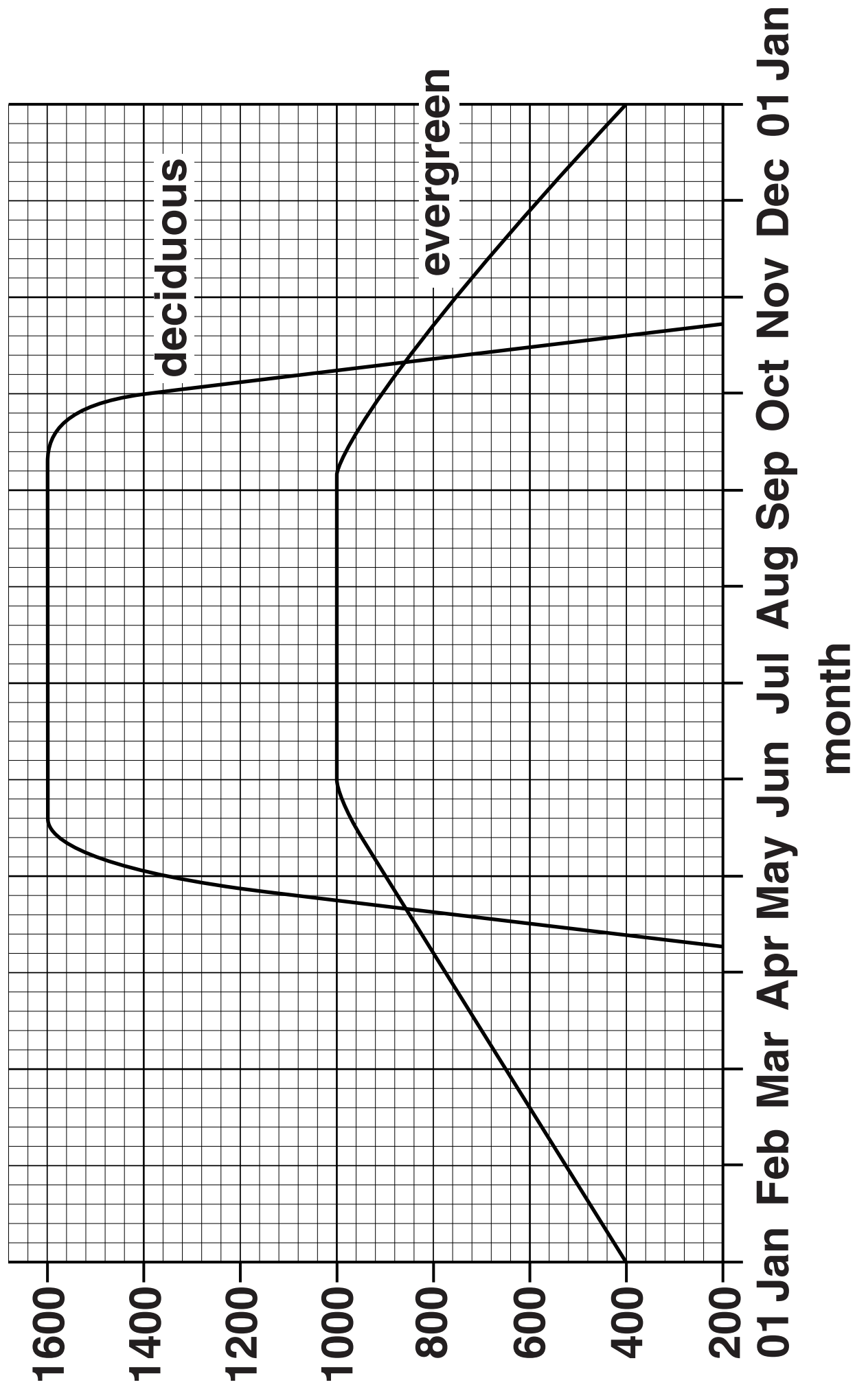
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**[3]**

energy in  
sugars  
in kJ per  
day



**(b) Scientists want to find out the total amount of light energy trapped by the leaves on a deciduous tree and an evergreen tree.**

**They measure the amount of light trapped by different parts of the trees.**

**They do this in July for trees growing in the same area.**

**The results are shown in the table below.**

	<b>Deciduous tree</b>	<b>Evergreen tree</b>
<b>energy trapped by top part of the tree in kJ per day</b>	<b>13 000</b>	<b>23 500</b>
<b>energy trapped by middle part of the tree in kJ per day</b>	<b>11 000</b>	<b>7 000</b>
<b>energy trapped by bottom part of the tree in kJ per day</b>	<b>8 000</b>	<b>1 500</b>

**(i) The scientists assume that the amount of light HITTING each 1 m<sup>2</sup> of each tree was the same.**

**Why is it reasonable to assume this?**

**Explain your answer.**

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[2]

- (ii) The graph on page 37 shows that in July the deciduous tree makes more sugar than the evergreen tree.

Is this because it traps more light?

Use the data in the table on page 38 to explain your answer.

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[1]

- (c) The scientists work out how efficiently the trees make use of the trapped light.

They do this using the formula:

$$\text{efficiency} = \frac{\text{energy in sugars made per day}}{\text{total energy trapped by the tree per day}} \times 100$$

- (i) The efficiency for the evergreen tree in July is 3.1%.

Use the information from the GRAPH and the TABLE to work out the efficiency for the deciduous tree in July.

efficiency = \_\_\_\_\_ % [2]

**(ii) Trees need to produce a certain amount of sugar each year to survive.**

**Explain how deciduous trees can survive in the same habitat as evergreen trees.**

**Use the graph on page 37 and the answer to your calculation in question (c)(i).**

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[2]

**[TOTAL: 10]**

**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).**

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