OCR
Oxford Cambridge and RSA

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Friday 17 June 2016 – Morning

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B722/02 Additional Science modules B4, C4, P4 (Higher Tier)

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

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- 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**.
- This document consists of **32** pages. Any blank pages are indicated.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

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

power = force × speed

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

momentum = mass × velocity

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

GPE = mgh

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

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

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** to **how it works**.

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.

.....

..... **[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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.....

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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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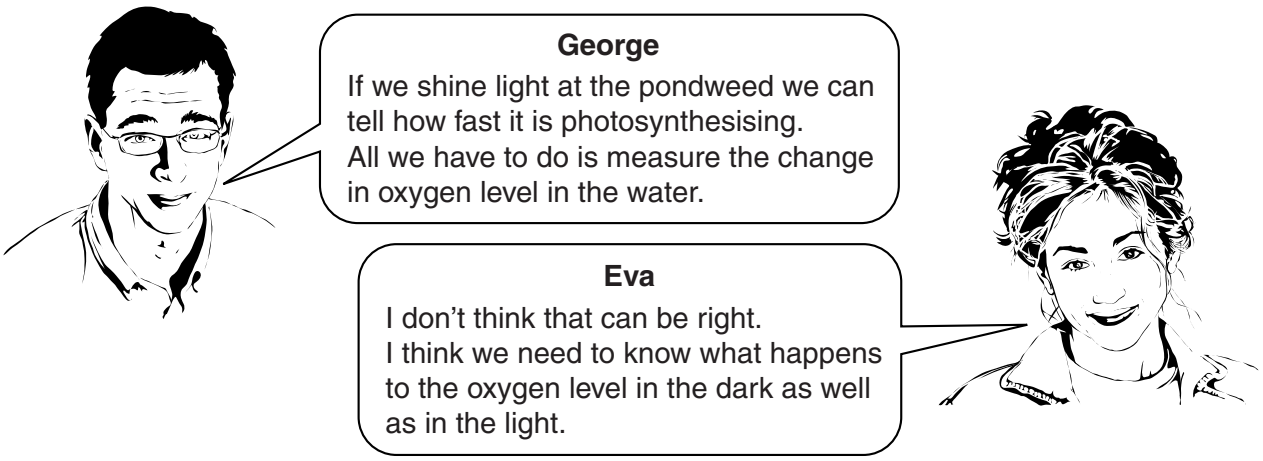
[4]

[Total: 10]

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



They set up an experiment to test their ideas.

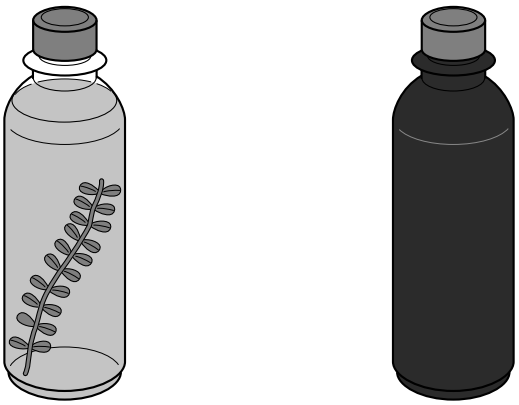
To do this, they use a black bottle and a clear bottle.

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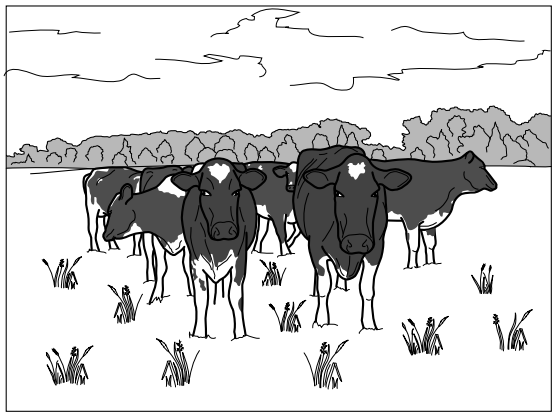
..... **[1]**

[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.

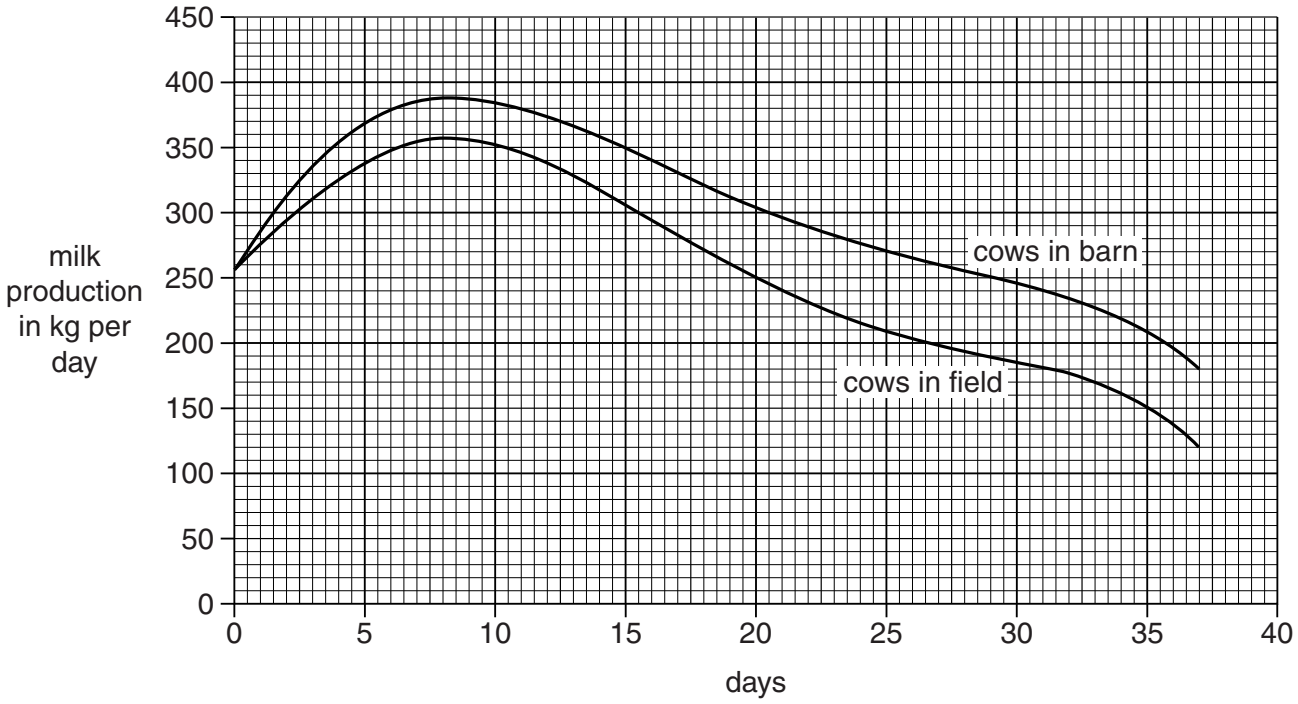
Ten cows are kept indoors and given food.

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 below 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.

.....

.....

.....

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

[Total: 6]

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_2, to make calcium oxide, CaO.

calcium + oxygen $\rightarrow$ calcium oxide

Calcium oxide contains the ions Ca^{2+} and O^{2-}.

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_2 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.

Test number	Test on solution	Results
1	appearance	colourless solution
2	flame test	lilac flame
3	adding sodium hydroxide solution	no precipitate
4	adding barium chloride solution	no precipitate
5	adding silver nitrate solution	pale yellow precipitate

Table 7

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

Do the results support her conclusion? .....

Explain your answer.

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

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

You may wish to draw a labelled diagram.

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

[Total: 5]

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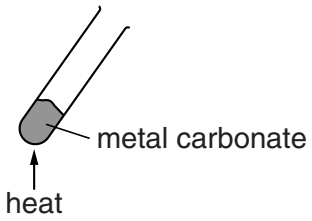
Question 8 begins on page 14

PLEASE DO NOT WRITE ON THIS PAGE

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.

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

Table 8

Some metal carbonates decompose when heated.

$$\text{metal carbonate} \longrightarrow \text{metal oxide} + \text{carbon dioxide}$$

(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 $MnCO_3$.

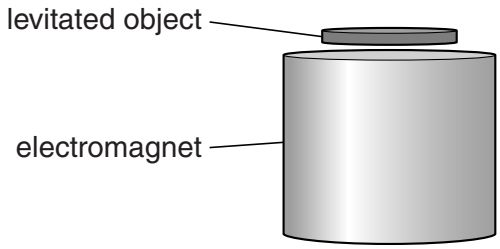
Write the **balanced symbol** equation for the decomposition of manganese carbonate.

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

[Total: 5]

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**?

.....

..... **[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 $^{55}_{26}Fe^{2+}$.

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]

Question 11 begins on page 18

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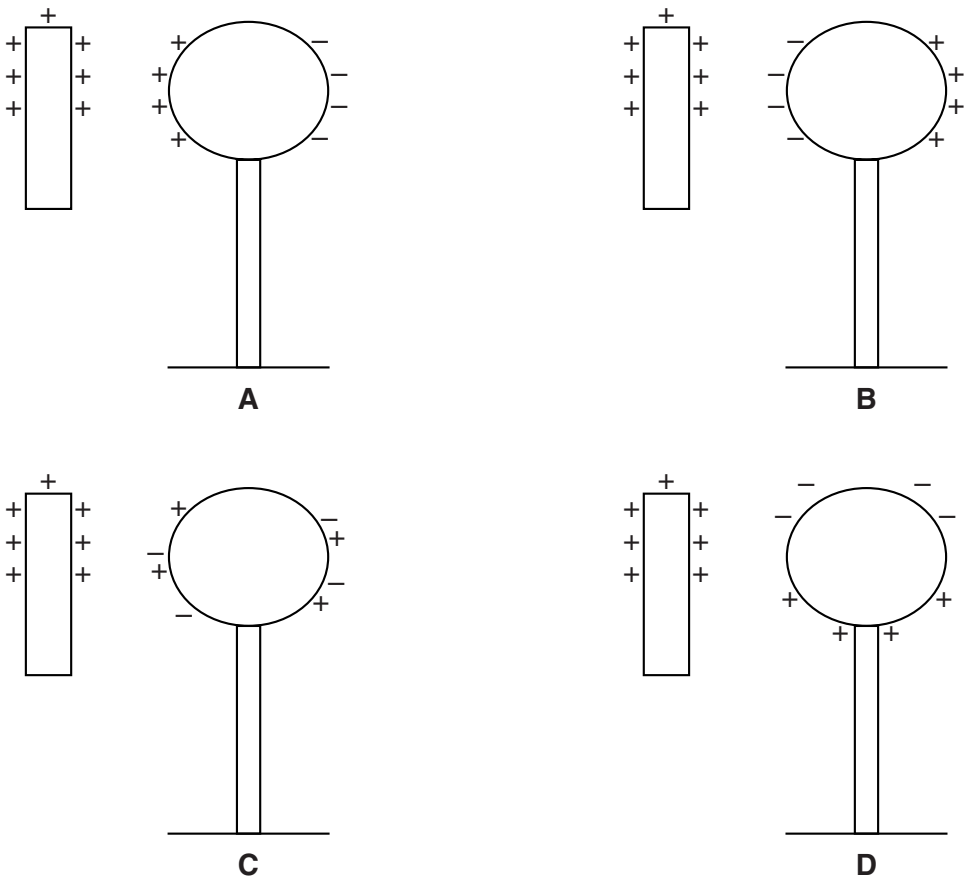
..... **[2]**

(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.



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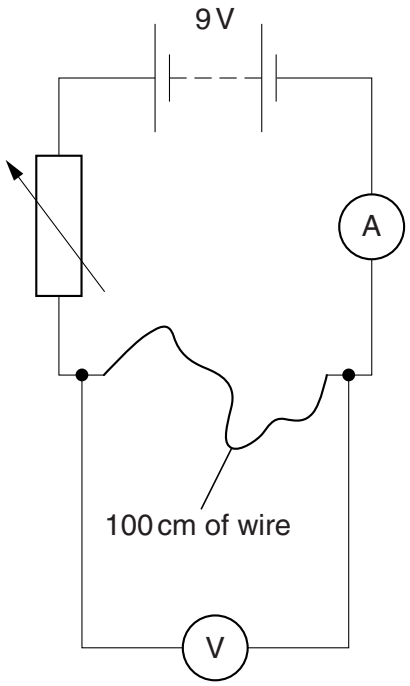
..... **[1]**

[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 9 V.

The reading on the ammeter is 2 A.

The reading on the voltmeter is 5 V.

(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 700 W microwave oven.

It is connected to the 230 V 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.

$$^{14}_{6}C \rightarrow \begin{matrix}\text{.....}\\ \text{.....}\end{matrix} N + \begin{matrix}\text{.....}\\ \text{.....}\end{matrix} \beta$$

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 β particle in your answer.

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

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

[Total: 6]

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Question 14 begins on page 24

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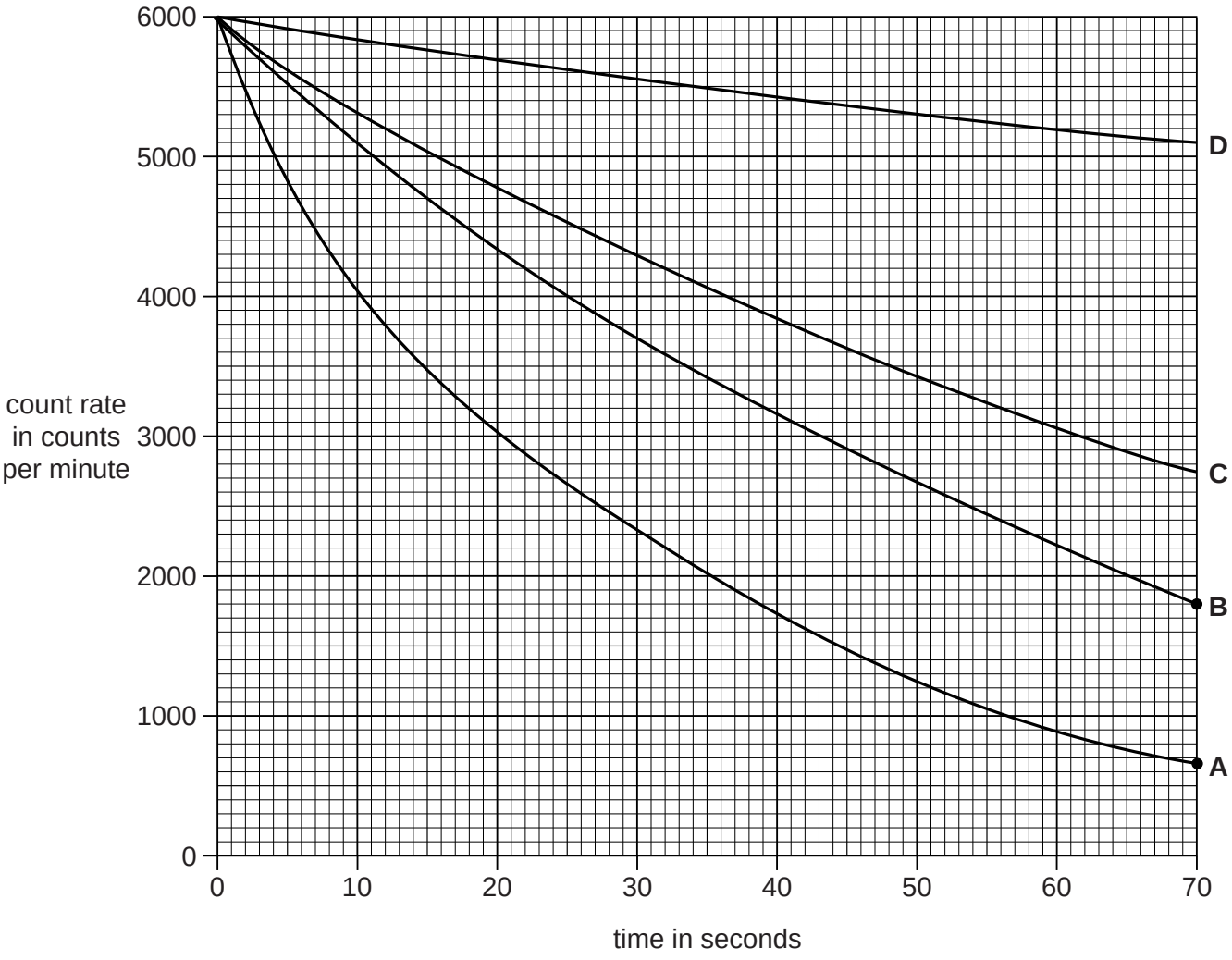
14 This question is about nuclear radiation.

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.



Which isotope has the shortest half-life?

Choose from **A** **B** **C** **D**

answer .....

Explain your answer.

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

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

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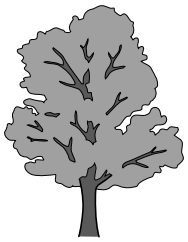
..... **[1]**

[Total: 6]

SECTION D

15 This question is about two types of tree.

Trees use leaves to make sugar by photosynthesis.



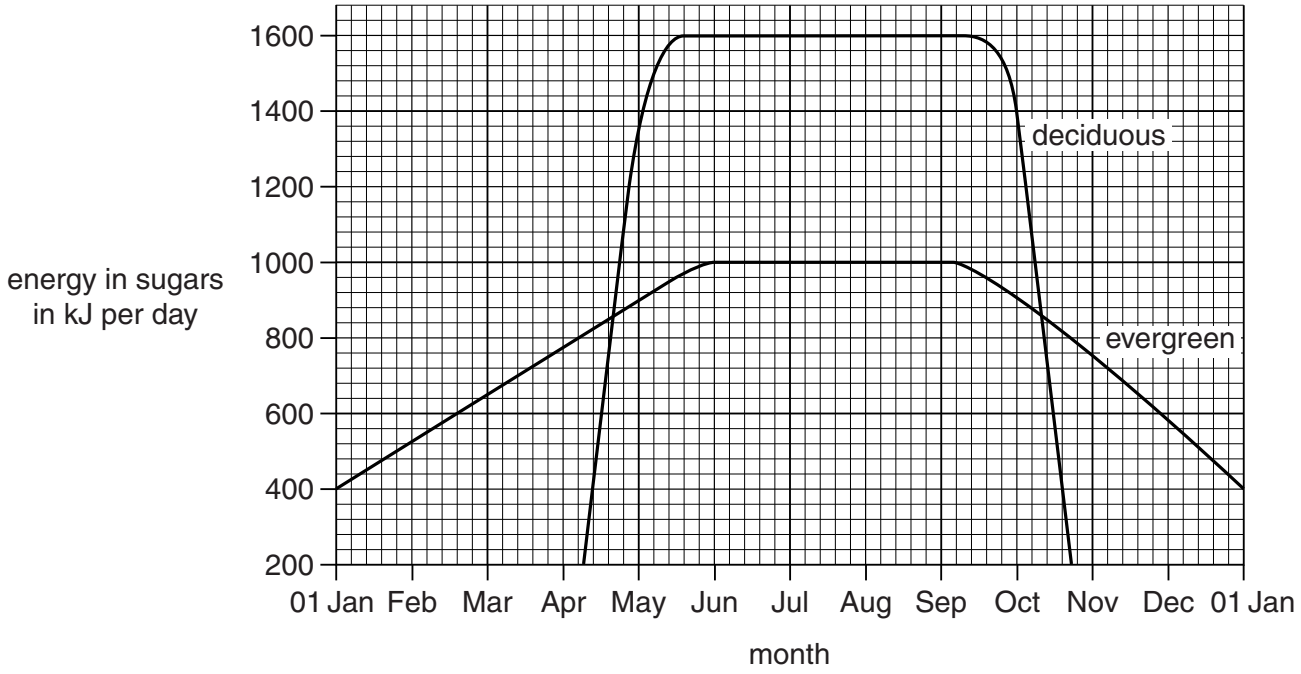
Some trees lose their leaves every year and grow new ones.
They are called **deciduous**.

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

(a) Look at the graph below.

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

(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.

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

(i) The scientists assume that the amount of light **hitting** each $1\,m^2$ 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 26 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 above to explain your answer.

.....

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

Turn over for the remainder of question 15

(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 in **(a)** and the answer to your calculation in **(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 margins.

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.*

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.