

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**B722/02**

**GATEWAY SCIENCE**  
**ADDITIONAL SCIENCE B**

**Additional Science modules B4, C4, P4**  
**(Higher Tier)**

**FRIDAY 12 JUNE 2015: Afternoon**

**DURATION: 1 hour 30 minutes**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

## **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 3–5.**

**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.**

## **EQUATIONS**

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

**energy = mass × specific latent heat**

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

**wave speed = frequency × wavelength**

**power = voltage × current**

**energy supplied = power × time**

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

**distance = average speed × time**

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

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

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

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

$$\text{power} = \text{force} \times \text{speed}$$

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

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

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

$$\text{GPE} = mgh$$

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

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

**Answer ALL the questions.**

**SECTION A – Module B4**

**1 Read the article.**

**THE MOST SALTY LAKE IN THE WORLD**

**Scientists have found a small lake in Antarctica.**

**Don Juan pond is the most salty lake in the world.**

**Temperatures in the lake are as low as  $-40^{\circ}\text{C}$ .**

**However it does not freeze up.**

**This is because it is twelve times MORE salty than normal sea water.**

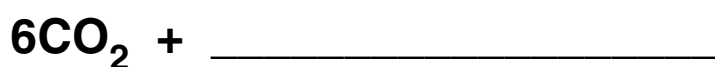
**Some scientists claim they have found bacteria living in the water.**

**Other scientists say that this is not possible.**

**(a) The bacteria in the lake may be able to use photosynthesis to make glucose.**

**They may use the same reaction as green plants.**

**Finish the balanced symbol equation for photosynthesis.**



**[2]**

- (b) Some scientists think that it is NOT possible for bacteria to live and photosynthesise in the lake.**

**Explain how these features of the lake would support the scientists' claim.**

- (i) Very low temperatures.**

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- (ii) High salt levels.**

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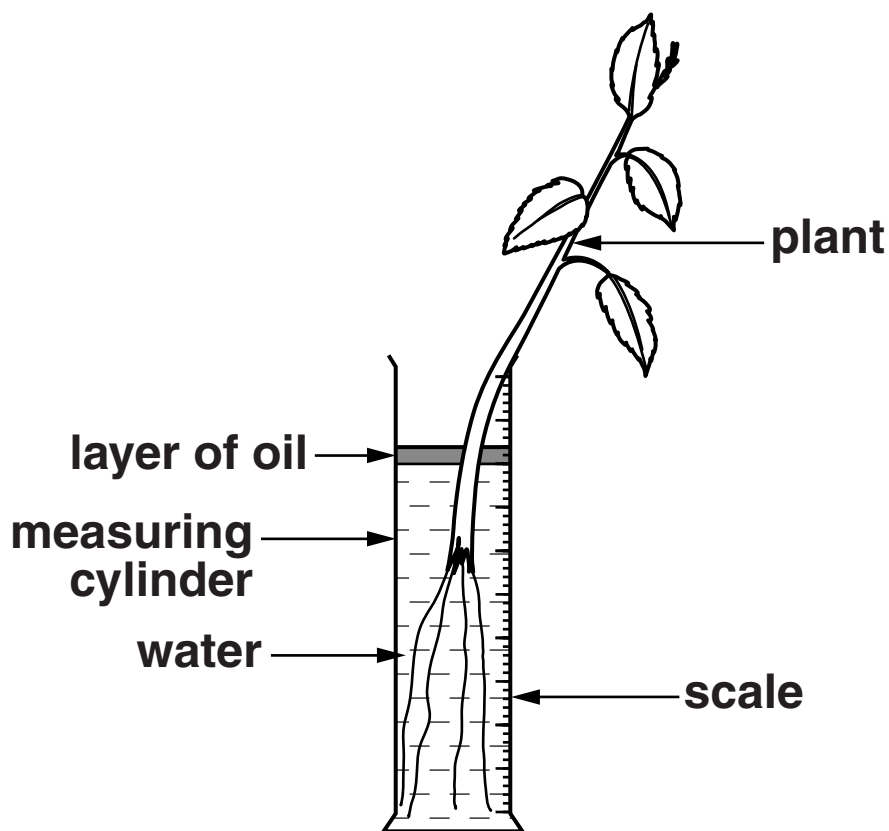
**[3]**

**2 Harold investigates the loss of water from the leaves of a plant.**

**He digs up a plant and puts it into a measuring cylinder with water.**

**Then he puts a small amount of oil on the surface of the water.**

**Harold measures the level of water in the measuring cylinder.**



**Harold leaves the plant in the measuring cylinder for six hours.**

**He then measures the level of water on the measuring cylinder.**



His results are shown in the table.

Time	Reading on measuring cylinder in cm <sup>3</sup>
Start	80
After 6 hours	74

- (a) Water enters the roots of the plant from the measuring cylinder.

Explain how it moves up inside the plant to the leaves.

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[2]

- (b) Suggest why Harold puts a layer of oil on top of the water.

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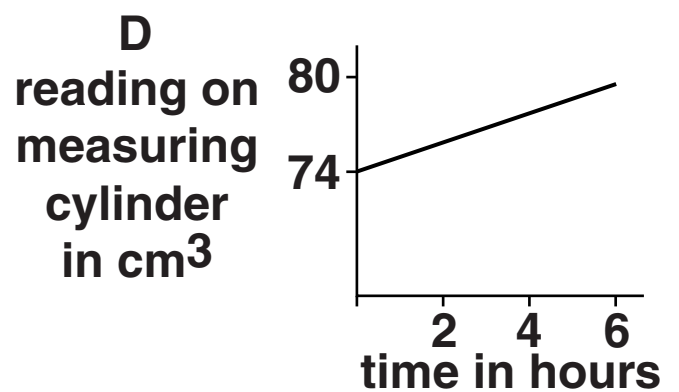
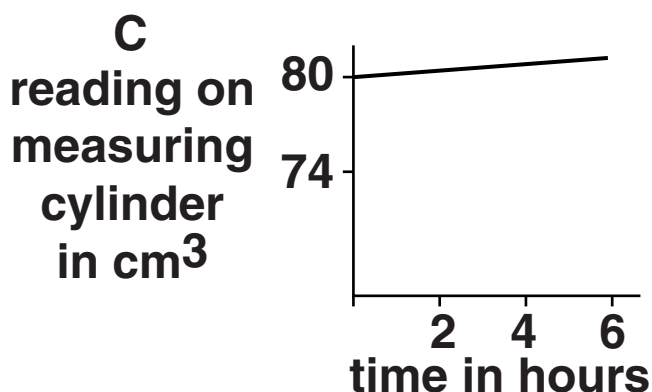
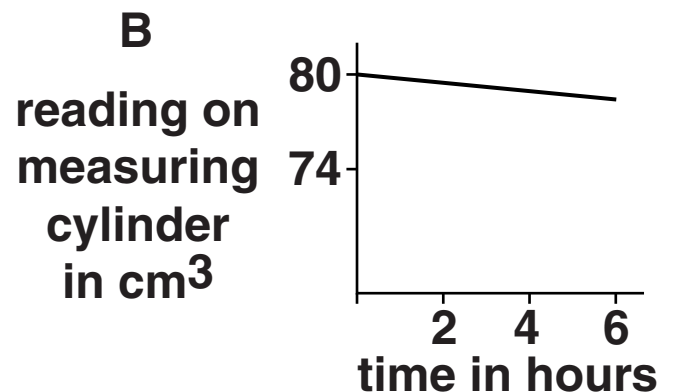
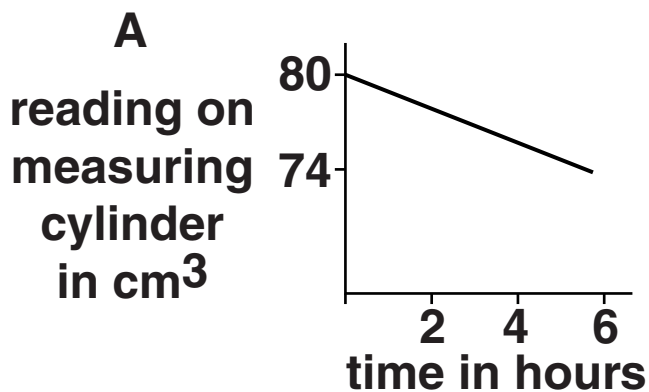
[1]

(c) Harold repeats his experiment but **TURNS OFF THE LIGHTS** in the room.

He takes measurements on the measuring cylinder every two hours.

He is going to plot a graph of his results.

Look at the graphs.



**(i) What will Harold's graph look like?**

**Choose from A, B, C or D.**

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

**[1]**

**(ii) Explain your answer to part (i) using ideas about stomata and guard cells.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ **[2]**

**3 This question is about growing crops and fertiliser use.**

**The two graphs opposite give information about three different factors**

**the mass of fertiliser used on land per person in the world**

**the area of land used to grow grain crops per person in the world**

**the production of grain per person in the world.**

**Explain how the minerals in fertilisers help crops to grow and write about how the use of fertilisers can explain the patterns shown on the graphs.**



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

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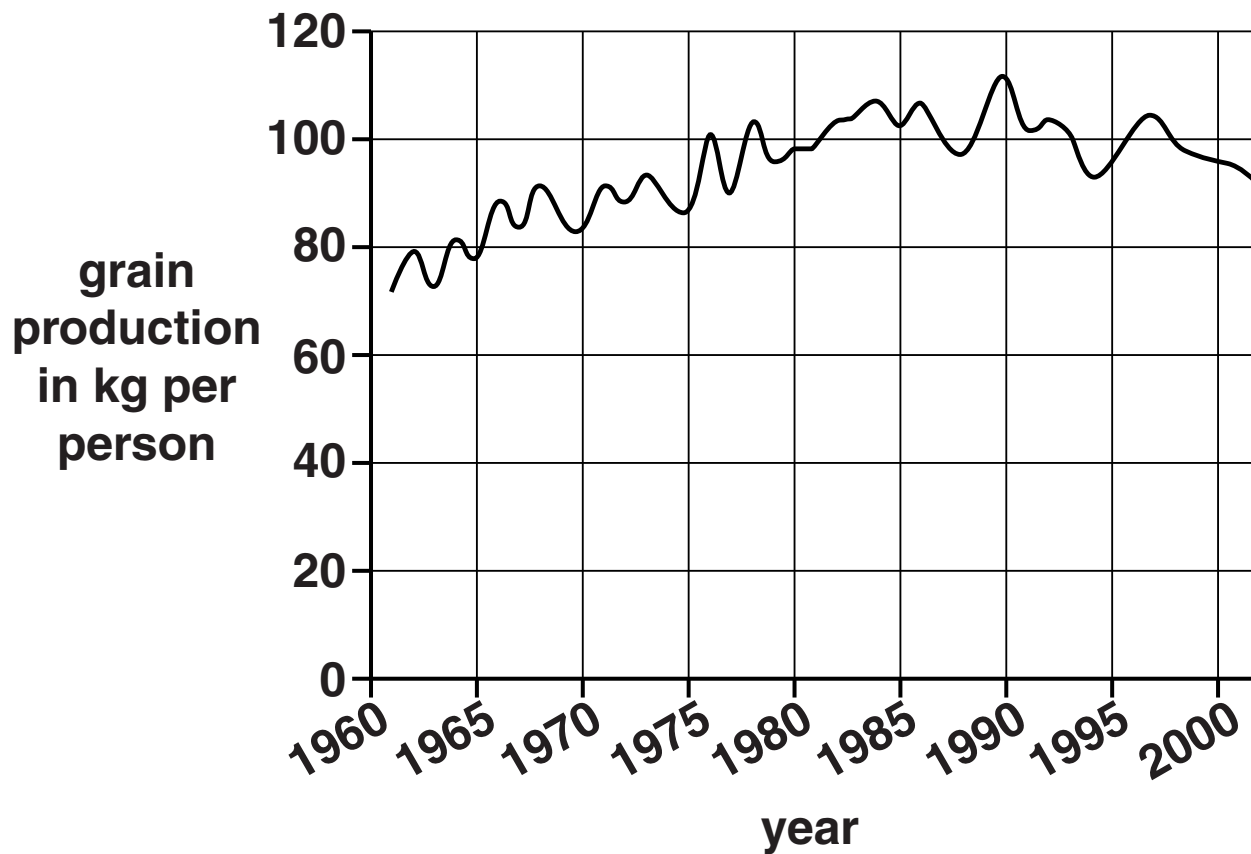
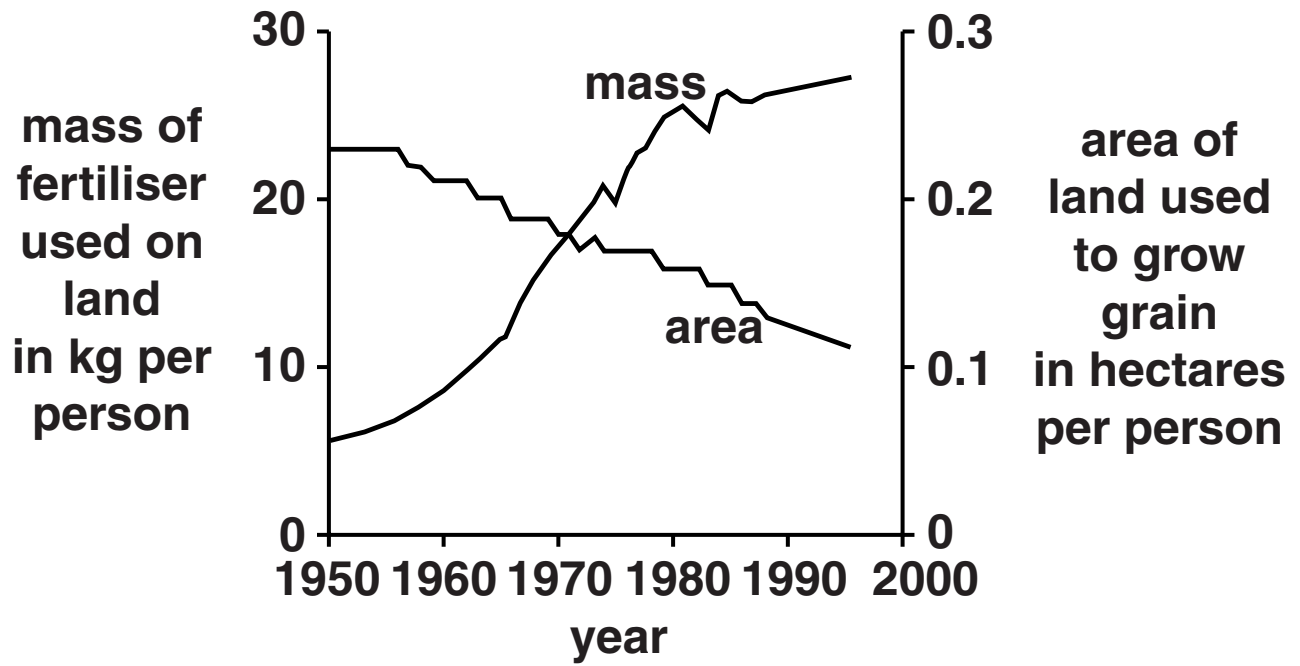
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**[6]**



**4 Different organisms have different roles in the decay process.**

**Bacteria and fungi which are saprophytes. They are less than 0.005 mm wide.**

**Woodlice which are about 4 mm wide.**

**Earthworms which are about 7 mm wide.**

**(a) Explain how saprophytes such as bacteria and fungi feed.**

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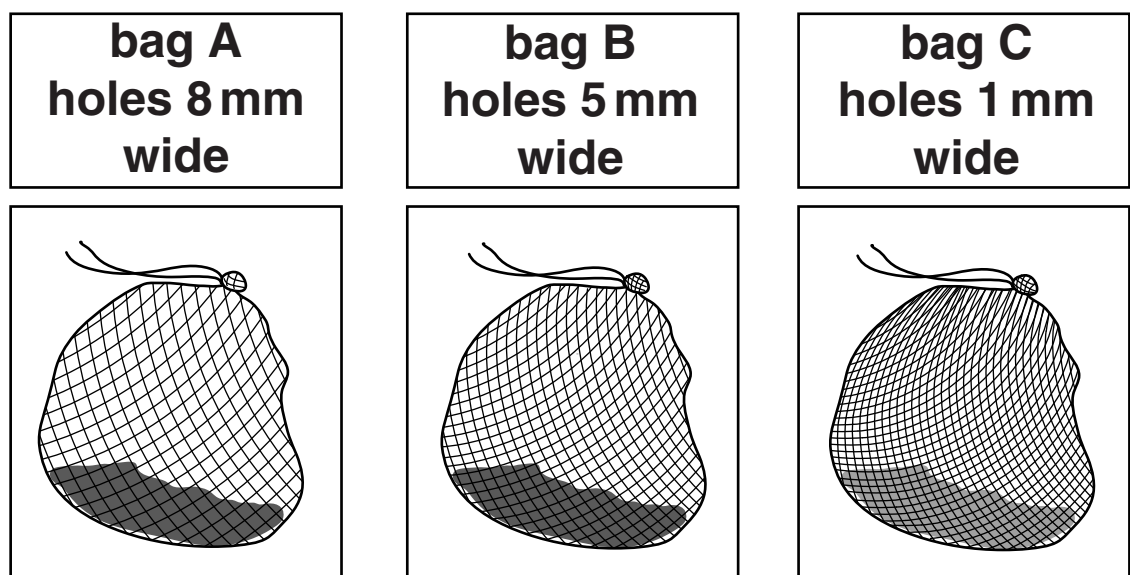
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[2]

**(b) Some students did an experiment to see how quickly leaves decay.**

**They measured the mass of some leaves and put them into three different bags, A, B and C.**

**Each bag was made of material that had different size holes.**



**The students buried the bags in the soil.**

**After two months they dug up the bags and reweighed the leaves.**

**Their results are shown in the table.**

	<b>Bag A</b>	<b>Bag B</b>	<b>Bag C</b>
<b>Mass at the start in grams</b>	<b>120</b>	<b>140</b>	<b>120</b>
<b>Mass after two months in grams</b>	<b>100</b>	<b>120</b>	<b>110</b>
<b>Percentage decrease in mass</b>		<b>14.3</b>	<b>8.3</b>

- (i) Calculate the percentage decrease in mass of leaves in bag A.**

**percentage decrease = \_\_\_\_\_ [1]**

**(ii) In which bag did leaves decay fastest?**

**Explain why decay was fastest in this bag.**

**Decay was fastest in bag \_\_\_\_\_**

**Explanation \_\_\_\_\_**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ **[3]**

**(iii) The students repeated this experiment in the winter.**

**They found that the decay of the leaves was slower.**

**Explain why decay is slower in colder weather.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ **[2]**

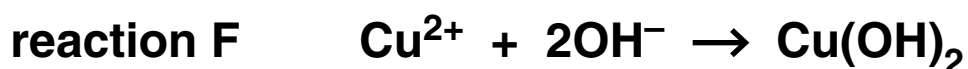
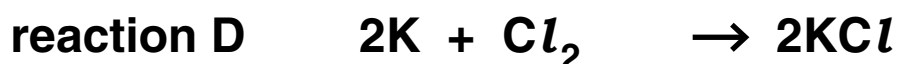
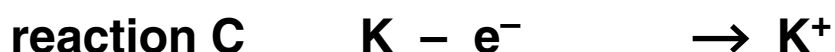
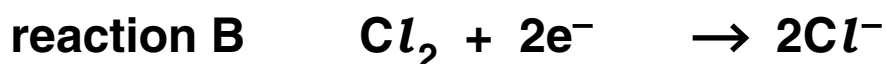


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## SECTION B – Module C4

### 5 Symbol equations are used to describe reactions.

Look at these symbol equations.



(a) One reaction is thermal decomposition.

Which one?

Choose from A, B, C, D, E or F.

answer \_\_\_\_\_

[1]

(b) One reaction makes a colourless gas and an alkaline solution.

Which one?

Choose from A, B, C, D, E or F.

answer \_\_\_\_\_

[1]

**(c) One reaction shows OXIDATION ONLY.**

**Which one?**

**Choose from A, B, C, D, E or F.**

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

**[1]**

**(d) One reaction makes a BLUE precipitate.**

**Which one?**

**Choose from A, B, C, D, E or F.**

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

**[1]**

**6 A factory makes iron(II) sulfate,  $\text{FeSO}_4$ .**

**The factory produces a lot of waste water.**

**The waste water is pumped into a local river.**

**Sarah thinks the water is polluted with small amounts of iron(II) ions,  $\text{Fe}^{2+}$ , and sulfate ions,  $\text{SO}_4^{2-}$ .**

**She tests samples of the river water.**

**Her results are shown in the table.**

<b>TEST</b>	<b>RESULT</b>
<b>flame test</b>	<b>yellow flame</b>
<b>barium chloride solution</b>	<b>white precipitate</b>
<b>silver nitrate solution</b>	<b>pale yellow precipitate</b>
<b>sodium hydroxide solution</b>	<b>orange brown precipitate</b>

**Describe how Sarah does the flame test.**

**Explain whether the results of each of her tests support the idea that the river water is polluted with  $\text{Fe}^{2+}$  and  $\text{SO}_4^{2-}$  ions.**



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

[illegible]

- 7 The United Kingdom uses many water resources such as seawater and water from lakes.**

**Look at the table.**

**It shows some information about water resources.**

<b>Region</b>	<b>Volume of water resources available each day in m<sup>3</sup></b>	<b>Volume of water needed each day in m<sup>3</sup></b>	<b>Water resource needed each day in %</b>
<b>A</b>	<b>1000</b>	<b>600</b>	<b>60</b>
<b>B</b>	<b>3000</b>	<b>1500</b>	
<b>C</b>	<b>2500</b>	<b>2400</b>	
<b>D</b>	<b>4000</b>	<b>2000</b>	<b>50</b>
<b>E</b>	<b>5000</b>	<b>1000</b>	<b>20</b>

- (a) Complete the table, by calculating the last column for the two remaining regions. [1]**
- (b) It is important that people living in region C conserve water.**

**Suggest why. Use information from the table.**

\_\_\_\_\_

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

**8 Metals such as iron are good conductors of electricity and have a high melting point.**

**(a) Use a labelled diagram to describe metallic bonding.**

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[2]

**(b) Iron has a high melting point and is a good conductor of electricity.**

**Explain BOTH of these properties of iron.**

**Use ideas about structure and bonding.**

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[2]

**9 Many scientists helped to develop the theory of atomic structure.**

**Dalton's theory stated that atoms could not be split.**

**Later, scientists such as Rutherford and Bohr developed theories that had particles smaller than an atom.**

**Now even more detailed theories of atomic structure are being developed.**

**(a) Explain why all theories of atomic structure are only provisional and keep changing.**

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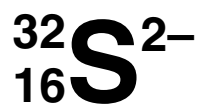
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**[2]**



**(b) Look at the symbol for a particle.**



**Deduce the number of protons, neutrons and electrons in this particle.**

**Explain your answer.**

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**[3]**

**10 Sodium chloride is an ionic compound.**

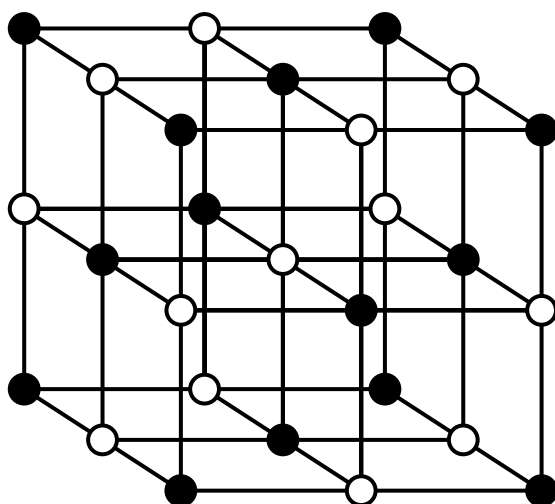
**Sodium chloride is made of sodium ions,  $\text{Na}^+$ , and chloride ions,  $\text{Cl}^-$ .**

**(a) Look at the diagram of part of the structure of sodium chloride.**

**KEY**

**○ =  $\text{Na}^+$  ion**

**● =  $\text{Cl}^-$  ion**



**How many  $\text{Cl}^-$  ions surround each  $\text{Na}^+$  ion?**

**Choose from 2, 4, 6 or 8.**

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

**[1]**

**(b) Magnesium oxide is an ionic compound.**

**It has a similar structure to sodium chloride.**

**Both sodium chloride and magnesium oxide have a high melting point.**

**(i) Explain why sodium chloride has a high melting point.**

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**[1]**

**(ii) The melting point of magnesium oxide is higher than that of sodium chloride.**

**Explain why.**

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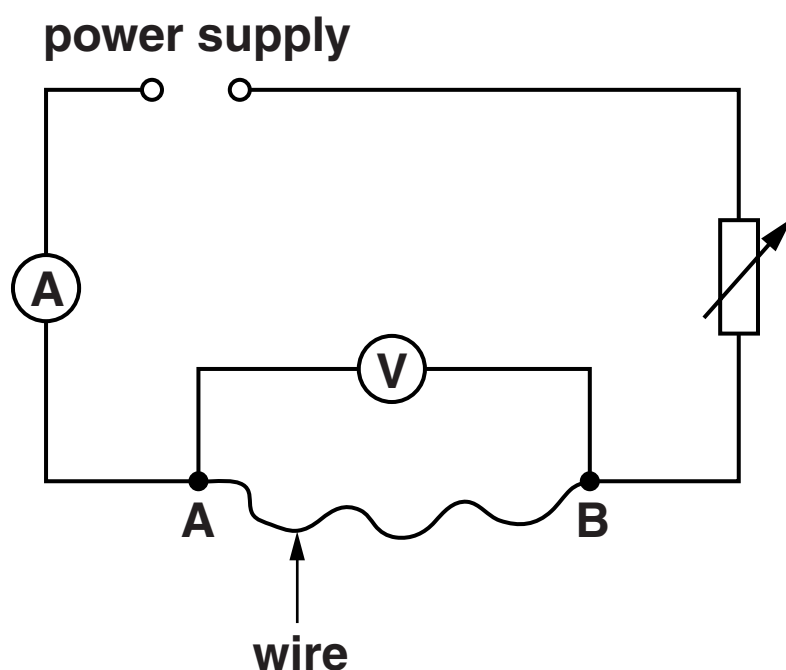
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**[2]**

## SECTION C – Module P4

11 This question is about circuits.

Chloe connects this circuit.



She investigates the relationship between current and voltage for different wires connected between A and B.

Look at her results.

Wire	Voltage across wire in volts	Current in amps	Resistance in ohms
W	12	3.0	4.0
X	6	3.0	2.0
Y	6	1.5	4.0
Z	8	0.5	

**(a) Calculate the resistance of wire Z.**

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**answer** \_\_\_\_\_ **ohms** [2]

**(b) Which TWO of these statements could explain the results for the resistance of the wires?**

- A Wire X is the same thickness but longer than wire W.**
- B Wire X is the same length but thicker than wire W.**
- C Wire Y is the same length but thicker than wire W.**
- D Wire Y is longer and thinner than wire X.**

**Choose from:    A            B            C            D**

**answer** \_\_\_\_\_ **and** \_\_\_\_\_ [2]

**12 Scientists are developing a new radioactive isotope to use as a tracer in patients.**

**Doctors will detect the radiation outside the patient's body.**

**Look at details of the detected count rate for the isotope.**

<b>Time in hours</b>	<b>0</b>	<b>12</b>	<b>24</b>	<b>36</b>	<b>48</b>
<b>Count rate in counts per minute</b>	<b>3200</b>	<b>1100</b>	<b>400</b>	<b>140</b>	<b>50</b>

**(a) What is meant by half-life?**

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[1]

**(b) Use the information in the table to calculate the half-life of the isotope.**

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answer \_\_\_\_\_ hours

[2]

- (c) The isotope is not poisonous to the patient and has a suitable half-life.

What **OTHER** information about the isotope would the scientists need to know before deciding if it were suitable to use as a tracer?

Explain your answer.

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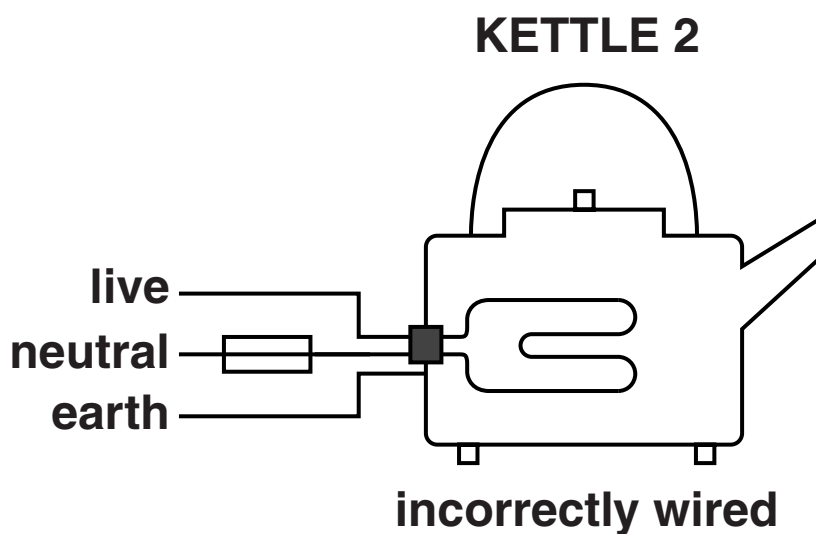
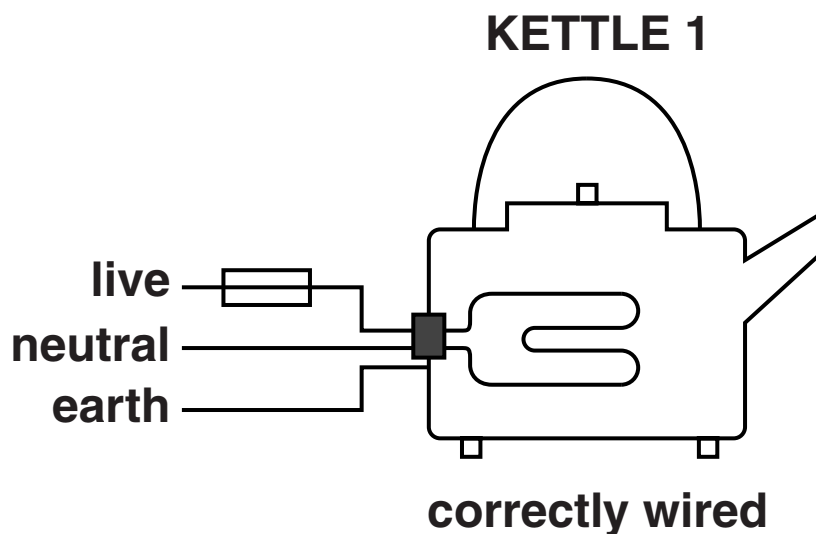
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[2]

- 13 (a) Metal electrical appliances need an earth wire and a fuse .

Look at the diagram.



It shows two metal kettles. Kettle 1 is correctly wired, kettle 2 is not.



**If there is a fault, explain how the fuse and earth wire protects the person who uses kettle 1, but not the person using kettle 2.**



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

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**[6]**

**(b) Kettle 1 has a power rating of 2500W and is connected to a 230V mains supply.**

**Fuses are available in 3 A, 7 A, 10 A and 13 A ratings.**

**Calculate the current in the kettle and select a suitable fuse for the plug.**

\_\_\_\_\_

\_\_\_\_\_

**current**                      \_\_\_\_\_ **A**

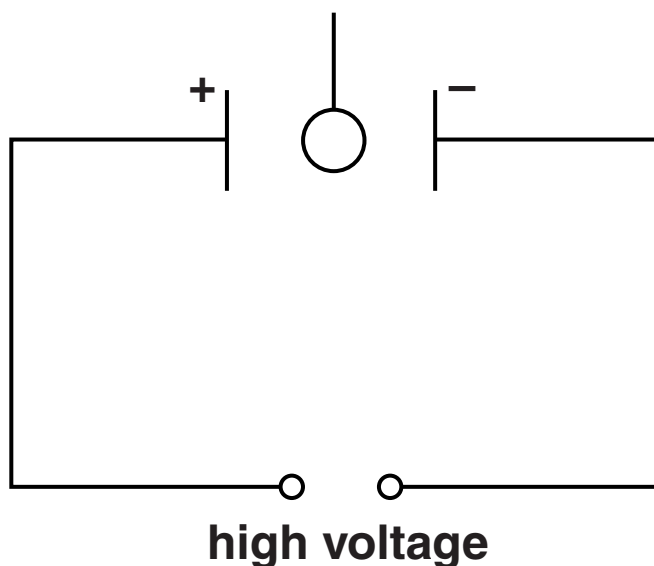
**fuse rating**                      \_\_\_\_\_ **A**

**[2]**

**14 This question is about electrostatics.**

- (a) Dan hangs a lightweight ball between two charged metal plates using nylon thread.**

**The ball has a metal coating.**



**The ball is moved so that it touches the positive plate.**

**When the ball is released, it swings and touches the negative plate.**

**It then continues to swing backwards and forwards between the plates touching each one in turn.**

**Explain why this happens.**

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**[3]**

**(b) Petrol is an insulator.**

**When it flows down a rubber pipe or a plastic pipe it can become electrostatically charged.**

**This could cause a spark and an explosion when filling a car with petrol.**

**Look at the diagram of a pipe which has a wire mesh as part of the pipe wall.**

**wire mesh connected to earth at the pump**



**Explain how this design of pipe prevents sparks when filling a car.**

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**[2]**

- 15 One model of a nuclear reaction involves a neutron hitting a uranium nucleus.



- (a) Describe how the model could be used to show a chain reaction. You may draw on the diagram.

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[2]

- (b) Describe how, in a nuclear reactor, the chain reaction is kept under control.

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[1]

## SECTION D

- 16 (a) Computer touch screens are made using the metal indium or using carbon fibre.

Table 1 shows the strength and the density (the mass of  $1\text{ cm}^3$ ) of these two materials.

**TABLE 1**

Material	Strength in MPa	Density in grams per $\text{cm}^3$
carbon fibre	1600	2.1
indium	262	7.3

Write about how suitable these two materials are for making the touch screens of tablet computers.

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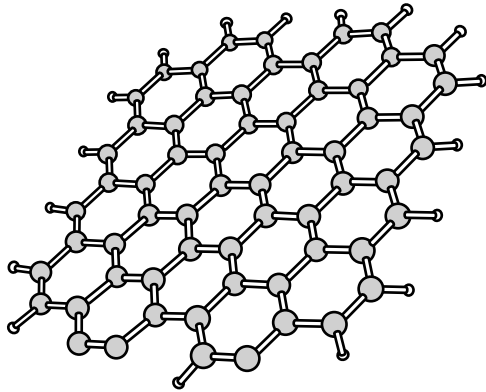
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[2]

**(b) In 2004 a new material called graphene was made.**

**It is made from graphite.**

**Graphene is a single sheet of carbon atoms that is one atom thick.**



**(i) A sheet of graphene is  $8.0 \times 10^{-8}$  cm thick.**

**What is the area of a sheet made with  $1 \text{ cm}^3$  of graphene?**

**Put a tick (✓) in the box next to the correct answer.**

$8.0 \times 10^8 \text{ cm}^2$

☐

$1.3 \times 10^7 \text{ cm}^2$

☐

$1.3 \times 10^{-7} \text{ cm}^2$

☐

$8.0 \times 10^{-8} \text{ cm}^2$

☐

**[1]**

- (ii) Table 2 contains some information about indium and graphite.

**TABLE 2**

	<b>World reserves in tonnes</b>	<b>World use in tonnes per year</b>
<b>indium</b>	<b>5 700</b>	<b>640</b>
<b>graphite</b>	<b>71 000 000</b>	<b>1 100 000</b>

If **INDIUM** is used at the present rate it will run out.

Use the data to work out how long it will last.

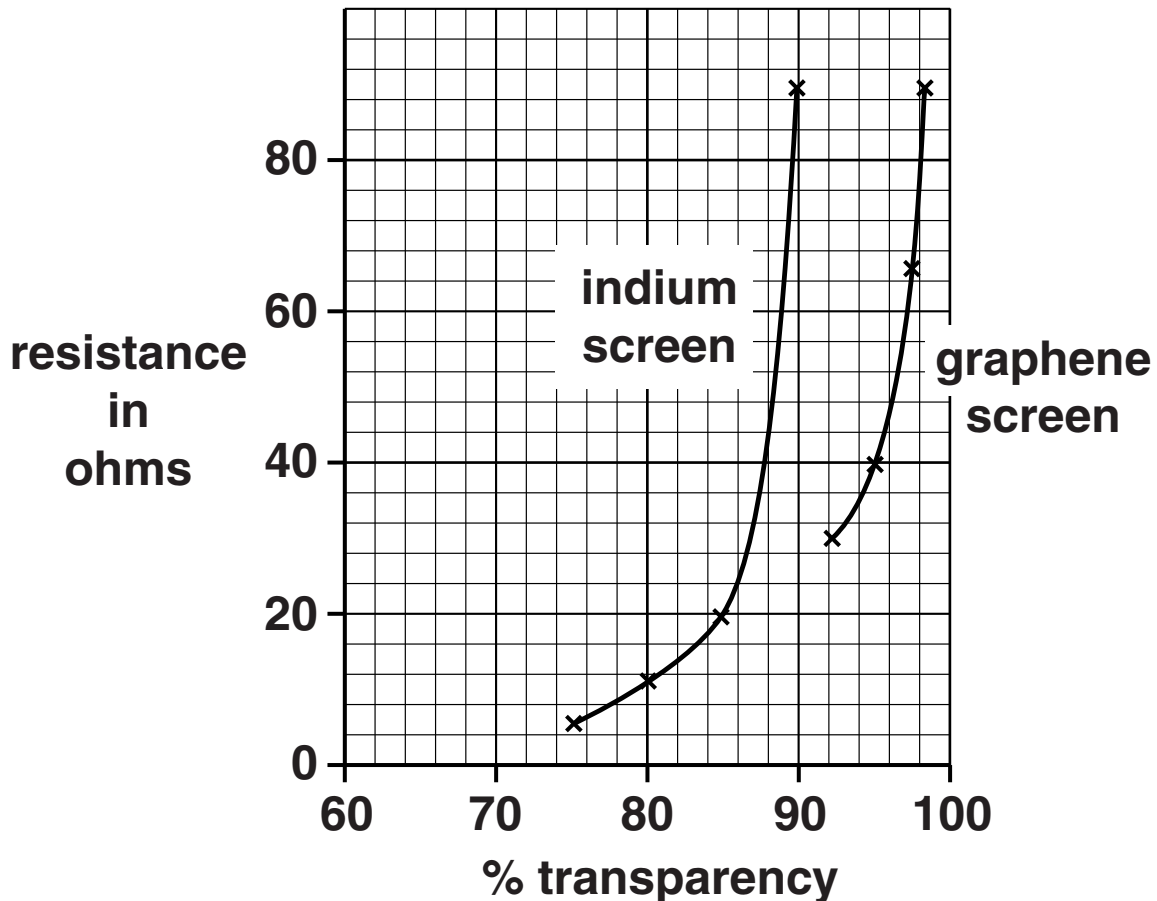
answer \_\_\_\_\_ years [1]



- (iii) Computer touch screens need to be transparent and have a low electrical resistance.

Look at the graph.

It shows the range of transparency and resistance for screens made using graphene and screens made using indium.



A screen will not work if it has a resistance greater than 30 ohms.

What does the graph tell you about the use of INDIUM for touch screens?

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[2]

- (c) Scientists think the discovery of graphene is important.

TABLE 3 shows some more information about graphene.

TABLE 3

Strength in MPa	Density in grams per cm <sup>3</sup>
5000	1.0

Evaluate the use of graphene for making touch screens.

Use Table 3 and information from all parts of Question 16 in your answer.

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[4]

END OF QUESTION PAPER

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