OCR
Oxford Cambridge and RSA

H

Friday 12 June 2015 – Afternoon

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

B722202

5069575198

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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- 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

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

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

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

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

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Question 1 begins on page 4

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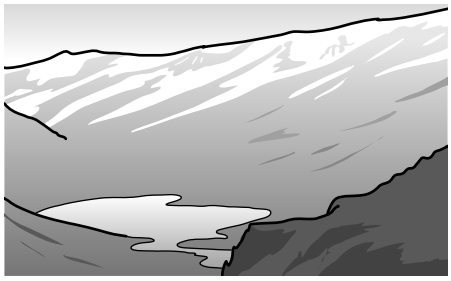
Answer **all** the questions.

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 °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.

$6CO_2$ + ... $\rightarrow$ $C_6H_{12}O_6$ + ... **[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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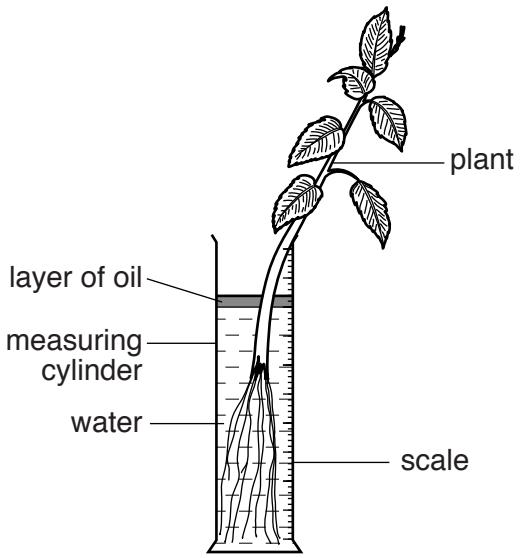
[3]

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^3
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.

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

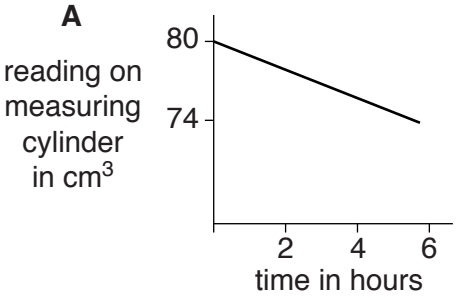
(c) Harold repeats his experiment but **turns off the lights** in the room.

He takes measurements on the measuring cylinder every two hours.

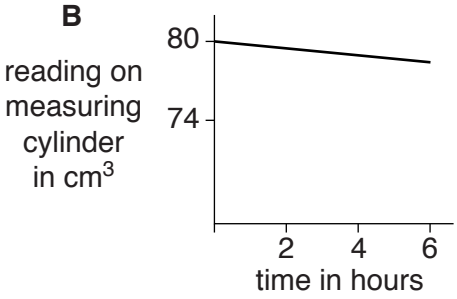
He is going to plot a graph of his results.

Look at the graphs.

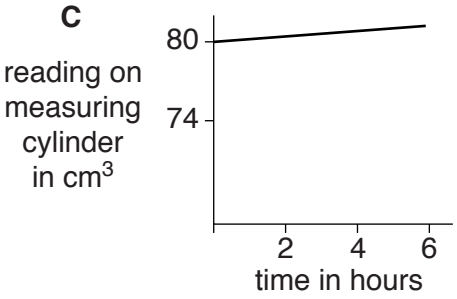
A



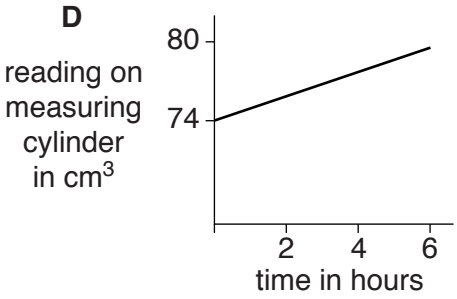
B



C



D



(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.

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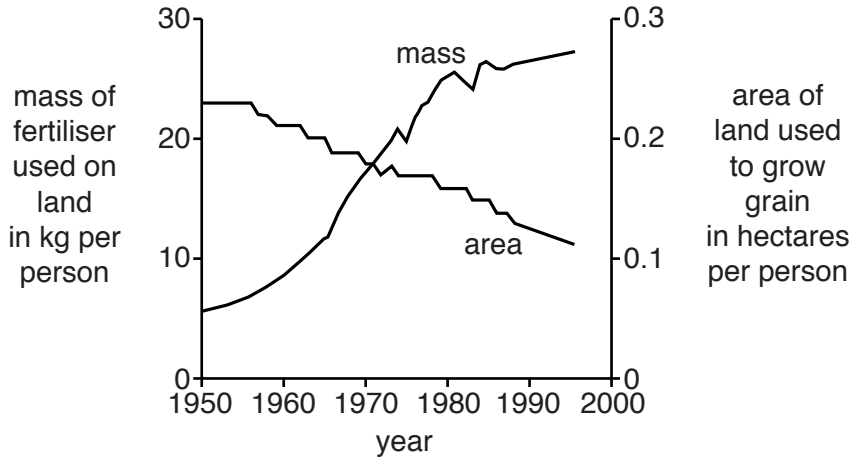
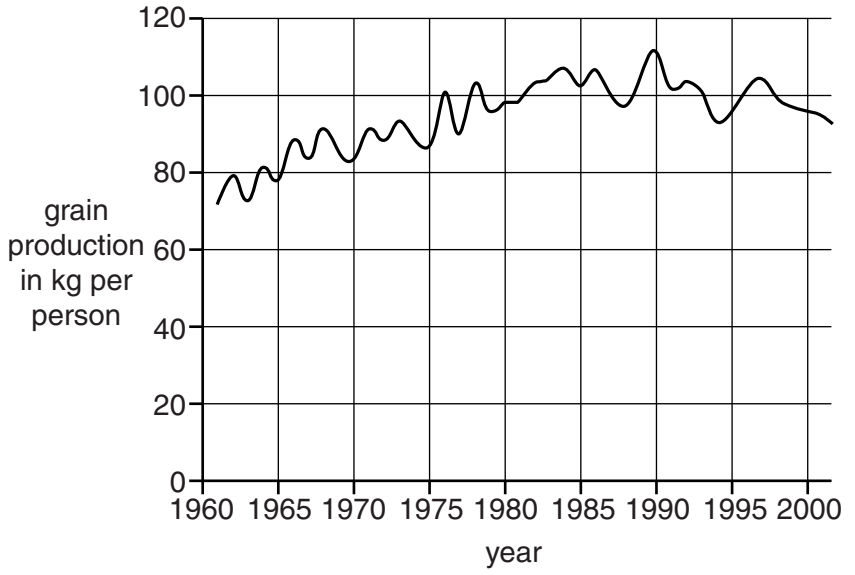
..... **[2]**

3 This question is about growing crops and fertiliser use.

The two graphs 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.





9

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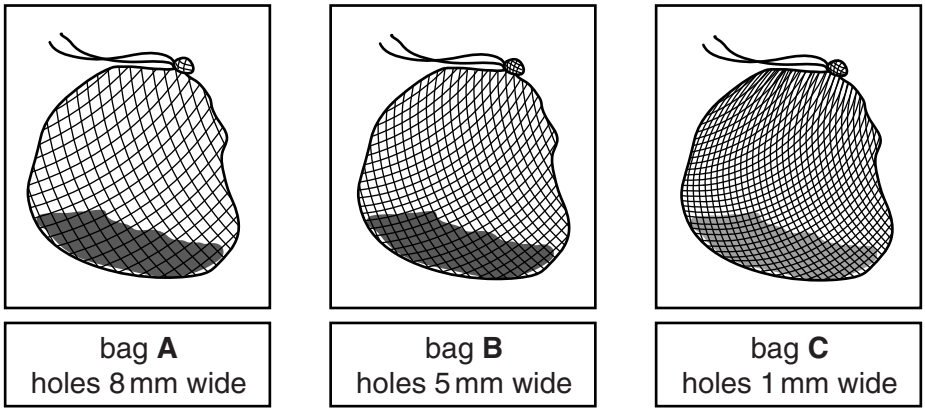
..... **[2]**

(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.



bag **A** holes 8 mm wide	bag **B** holes 5 mm wide	bag **C** holes 1 mm wide

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.

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

(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 .....

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..... **[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.

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

SECTION B – Module C4

5 Symbol equations are used to describe reactions.

Look at these symbol equations.

reaction **A** $CuCO_3 \rightarrow CuO + CO_2$

reaction **B** $Cl_2 + 2e^- \rightarrow 2Cl^-$

reaction **C** $K - e^- \rightarrow K^+$

reaction **D** $2K + Cl_2 \rightarrow 2KCl$

reaction **E** $2K + 2H_2O \rightarrow 2KOH + H_2$

reaction **F** $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$

(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, $FeSO_4$.

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, Fe^{2+}, and sulfate ions, SO_4^{2-}.

She tests samples of the river water.

Her results are shown in the table.

Test	Result
flame test	yellow flame
barium chloride solution	white precipitate
silver nitrate solution	pale yellow precipitate
sodium hydroxide solution	orange brown precipitate

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 Fe^{2+} and SO_4^{2-} ions.

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

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

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.

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

(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.

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

(b) Look at the symbol for a particle.

$$^{32}_{16}S^{2-}$$

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

Explain your answer.

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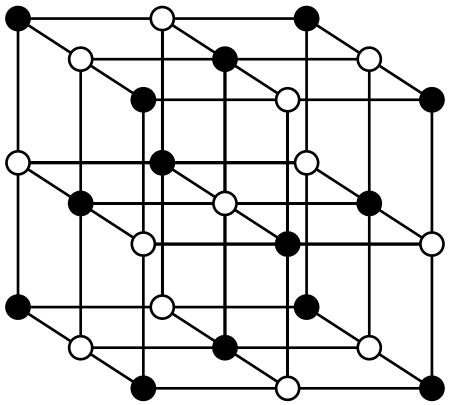
..... **[3]**

10 Sodium chloride is an ionic compound.

Sodium chloride is made of sodium ions, Na^+, and chloride ions, Cl^-.

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



How many Cl^- ions surround each 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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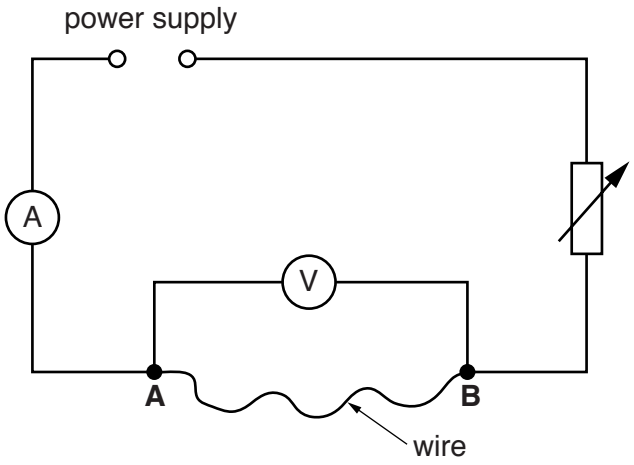
..... **[2]**

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.

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

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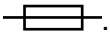
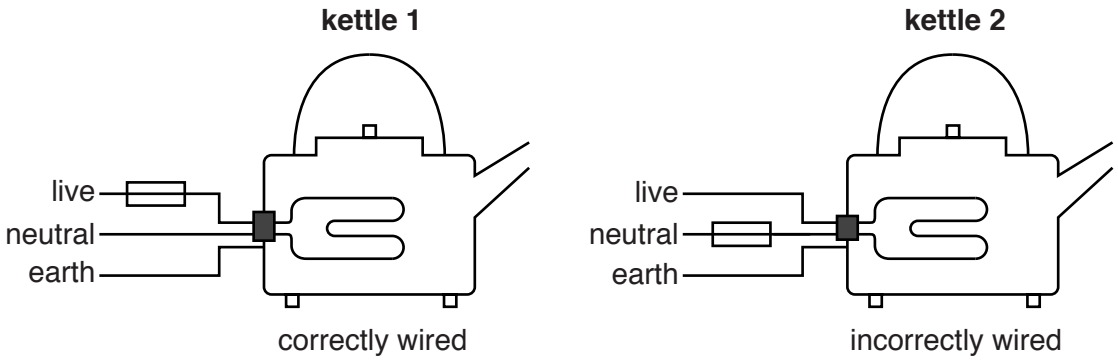
..... **[2]**

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 2500 W and is connected to a 230 V 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.

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.....

current ..... A

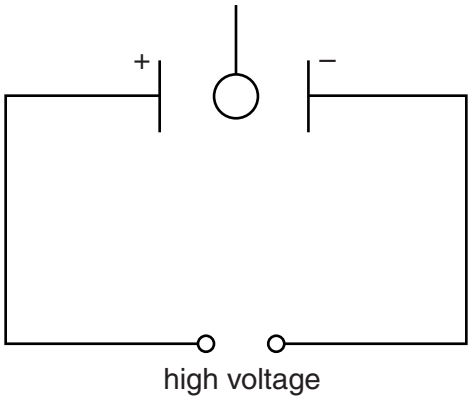
fuse rating ..... A

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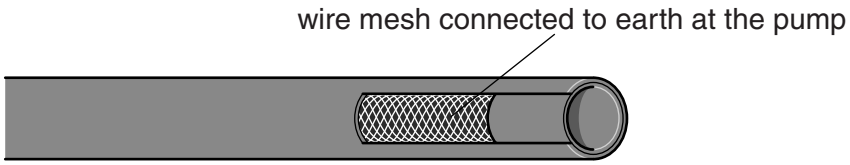
..... **[3]**

(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.



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.

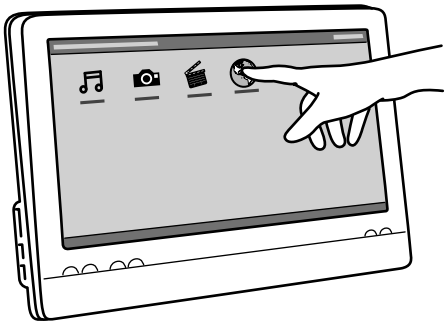

Table 1 shows the strength and the density (the mass of 1 cm^3) of these two materials.

Table 1

Material	Strength in MPa	Density in grams per 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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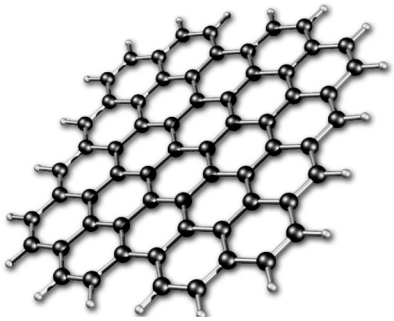
..... **[2]**

(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 8.0×10^{-8} cm thick.

What is the area of a sheet made with 1 cm^3 of graphene?

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

$8.0 \times 10^{8}\,cm^2$ ☐

$1.3 \times 10^{7}\,cm^2$ ☐

$1.3 \times 10^{-7}\,cm^2$ ☐

$8.0 \times 10^{-8}\,cm^2$ ☐

[1]

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

Table 2

	World reserves in tonnes	**World use in tonnes per year**
indium	5700	640
graphite	71 000 000	1 100 000

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

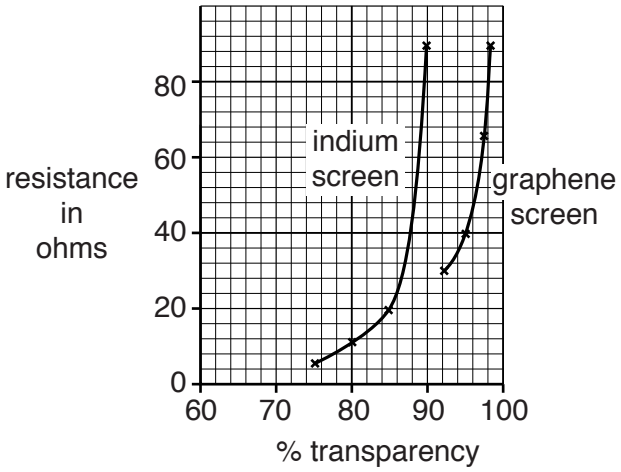
Use the data to work out how long it will last.

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^3
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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END OF QUESTION PAPER

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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.