OCR

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Thursday 12 June 2014 – Morning

**GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B**

B722/01   Additional Science modules B4, C4, P4 (Foundation Tier)

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 **28** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over

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

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

$$GPE = mgh$$

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

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

Answer **all** the questions.

SECTION A – Module B4

1 Some farmers grow sugar beet plants in their fields.

Sugar beet makes sugar by photosynthesis.

Sugar is stored in the swollen roots.
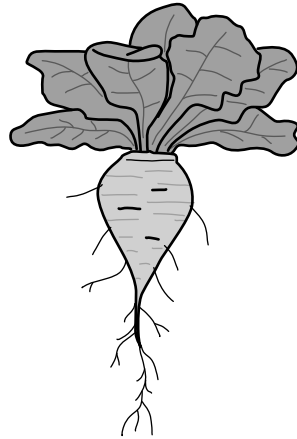
(a) Sugar beet plants need carbon dioxide for photosynthesis.

Write about **where** and **how** carbon dioxide gets into the sugar beet plant.

....

....

.... **[2]**

(b) Farmers try to kill weeds growing between the sugar beet plants.

Write down the name of a type of chemical they can use to kill weeds.

Choose your answer from this list.

      fertiliser   **fungicide**   **herbicide**   **insecticide**

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

(c) On some types of farm, sugar beet is only grown every other year.

Barley or soya beans are grown one year, followed by sugar beet the next year.

Put a tick (✓) in the box next to the name of this type of farming method.

battery farming ☐

biological control ☐

crop rotation ☐

hydroponics ☐

[1]

(d) Some farmers think that the crop grown in the field the year before sugar beet affects the size of the sugar beet crop.

They think that the different chemicals used on the barley or soya beans might affect the sugar beet.

The farmers look at some data to investigate this.

Crop grown the year before	Chemical used on the fields the year before	Size of sugar beet crop in arbitrary units
barley	no	22.1
barley	yes	22.2
soya beans	no	19.2
soya beans	yes	17.4

Put ticks (✓) in the boxes next to **two** conclusions that the scientists can make from this data.

Sugar beet grows better after barley than after soya beans. ☐

The chemical used on barley plants reduces the size of the sugar beet crop. ☐

Sugar beet grows better after soya beans than after barley. ☐

The growth of sugar beet is affected by both soya beans and the chemical used. ☐

Sugar beet grows just as well after soya beans as after barley. ☐

[2]

(e) These results had been published in a scientific journal.

Explain why it is important that scientists publish their work in scientific journals.

....

....

.... **[2]**

[Total: 8]

Question 2 begins on page 6

Turn over

2 A gardener builds a compost heap from posts and wire.

He is going to use it to recycle dead plant material from his garden.

(a) The gardener forks the compost to let in air.

Why is this important for the decay of the plant material?

.... **[1]**

(b) Dead plant material contains elements.

Plants get many of these elements from minerals.

Write about how plants take up minerals.

....

....

.... **[2]**

(c) When dead plants decay, the compost heap gets warmer than the surrounding air.

This is because decay organisms are giving off heat.

The graph shows the temperature of three different compost heaps, **A**, **B** and **C**.
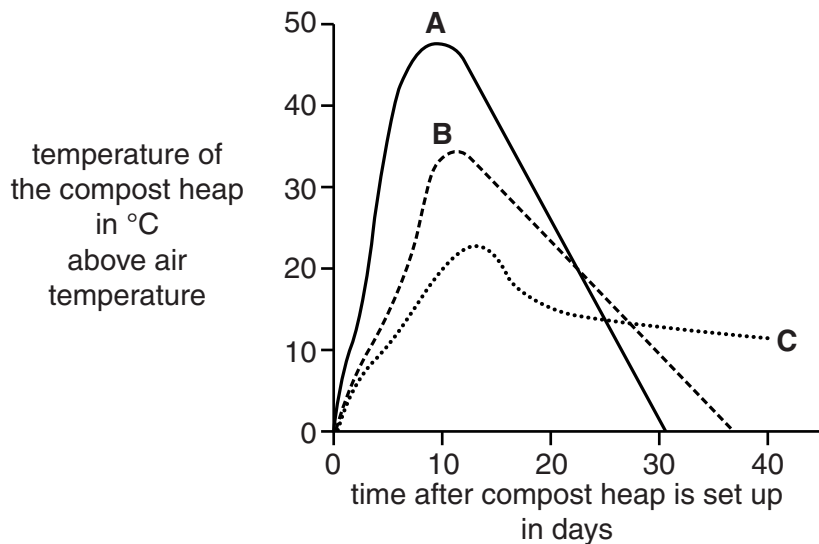
(i) Using the graph, compare the decay in compost heap **A** with compost heap **C**.

....

....

.... **[2]**

(ii) Scientists have found that plant material decays **slower** if it contains much more carbon than nitrogen.

They can measure the ratio of carbon to nitrogen (C:N).

Here are some ratios for different materials.

Material	C:N ratio
grass clippings	19:1
sawdust	134:1
straw	80:1

Compost heaps **A**, **B** and **C** contained different plant material.

Write **A**, **B** or **C** in the correct box to show which material was in each heap.

grass clippings	
sawdust	
straw	

[1]

[Total: 6]

3 A group of students visit an area of sea shore.

The shore is covered by rocks and different organisms live on the rocks.

The students want to find out if different organisms live in different parts of the shore.

They use a quadrat, a long tape measure and a biological key.

This is the kite diagram that they draw from their data.

The wider the lines, the more organisms are present.

Write about how the students collected the data to draw the kite diagram and what their conclusions should be.

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

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.... **[6]**

[Total: 6]

Question 4 begins on page 10

Turn over
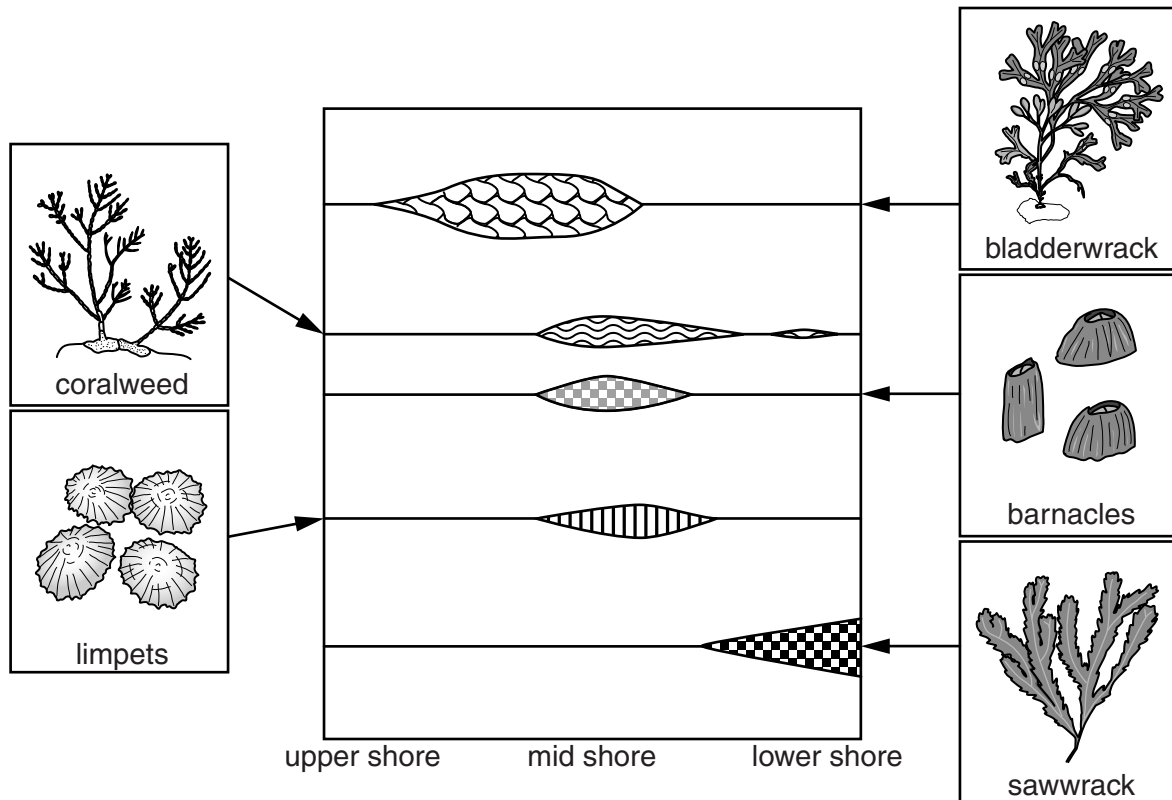
4 A cell from a green leaf is placed on a microscope slide.

On the slide, there is water containing bacteria.

The bacteria move to the areas where there is the most oxygen.

Light is shone at the cell and the diagram shows the cell viewed under a microscope.

Look at the diagram.
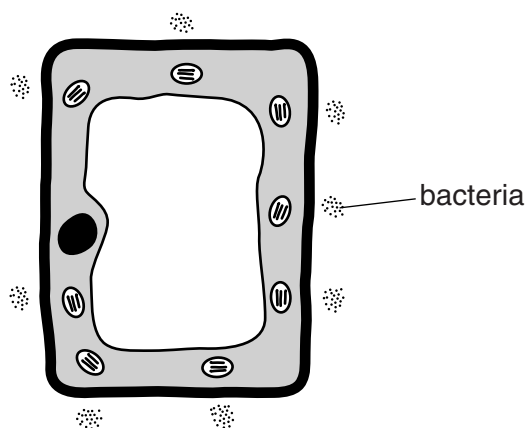
bacteria

(a) The bacteria have moved close to the cell wall next to certain parts inside the plant cell.

Write down the name of these parts.

.... [1]

(b) Explain why the bacteria have moved close to these parts.

Use the equation for photosynthesis to help you.

$$\text{carbon dioxide } + \text{ water } \xrightarrow{\text{chlorophyll}} \text{glucose } + \text{ oxygen}$$

....

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....
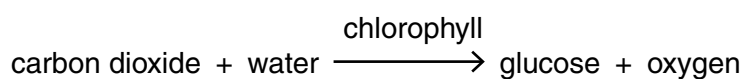
.... [3]

(c) What type of leaf cell was used in the experiment?

Choose your answer from this list.

palisade mesophyll   **upper epidermis**   **spongy mesophyll**   **guard cell**

answer .... [1]

[Total: 5]

SECTION B – Module C4

5 Boron, B, is in Group 3 of the Periodic Table.

(a) Write down the name of one **other** element in Group 3.

.... **[1]**

(b) Look at the diagram of an atom of boron.

electron

proton
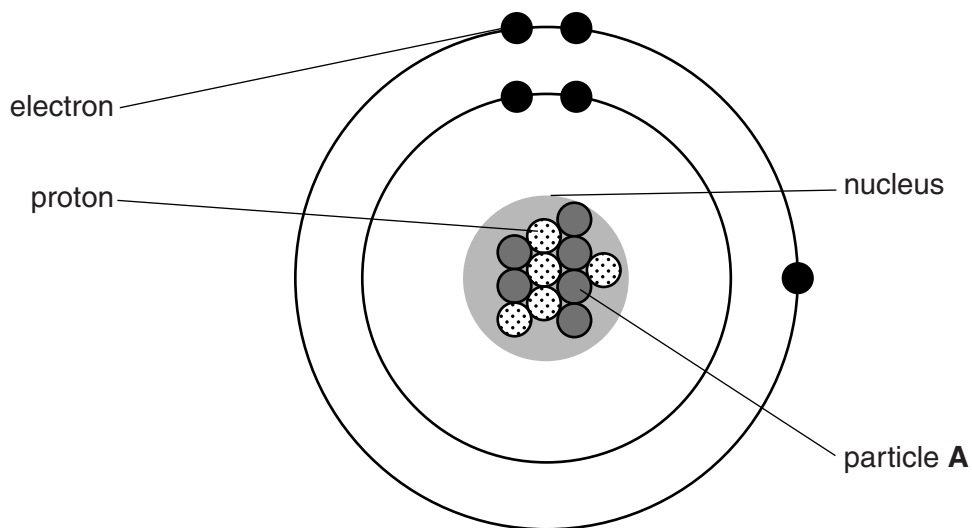
nucleus

particle **A**

(i) What is the name of particle **A**?

.... **[1]**

(ii) The relative electric charge of each electron is –1.

What is the total relative electric charge of the **nucleus** of a boron atom?

.... **[1]**

(iii) What is the electric charge of a boron atom?

Choose from

negative

neutral

positive

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

[Total: 4]

Turn over

6 A very large metal structure called 'The Orbit' was built for the London Olympics.

Look at the picture of 'The Orbit'.

The table shows information about some metals that could be used to make 'The Orbit'.

Metal	Melting point in °C	Relative strength (very strong = 10 and weak = 1)	Density in g/cm³	Corrosion	Relative electrical conductivity (good = 10 and poor = 1)
A	1700	8	7.4	corrodes quite rapidly	7
B	232	3	9.4	corrodes rapidly	4
C	2010	9	3.2	corrodes very slowly	3

Suggest the properties needed for the metal used to make 'The Orbit'.

Explain, with reasons, which metal, **A**, **B** or **C**, from the table would be best.

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

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.... **[6]**

[Total: 6]

7 Sodium, Na, reacts with oxygen, O_2, to make sodium oxide.

Sodium oxide contains the ions, Na^+ and O^{2-}.

(a) Explain how you can tell that O_2 is a **molecule** but O^{2-} is an **ion**.

....

....

....

.... **[2]**

(b) Explain **how** and **why** a sodium atom forms a positive sodium ion, Na^+.

....

....

....

.... **[2]**

(c) Use the charges of the ions in sodium oxide to work out the formula of sodium oxide.

.... **[1]**

[Total: 5]

Question 8 begins on page 14

8 Water is an important resource in the United Kingdom.

An aquifer is one type of water resource.

(a) Write down the name of one **other** type of water resource.

.... **[1]**

(b) Look at the bar chart. It shows the use of water by different industries during one year.
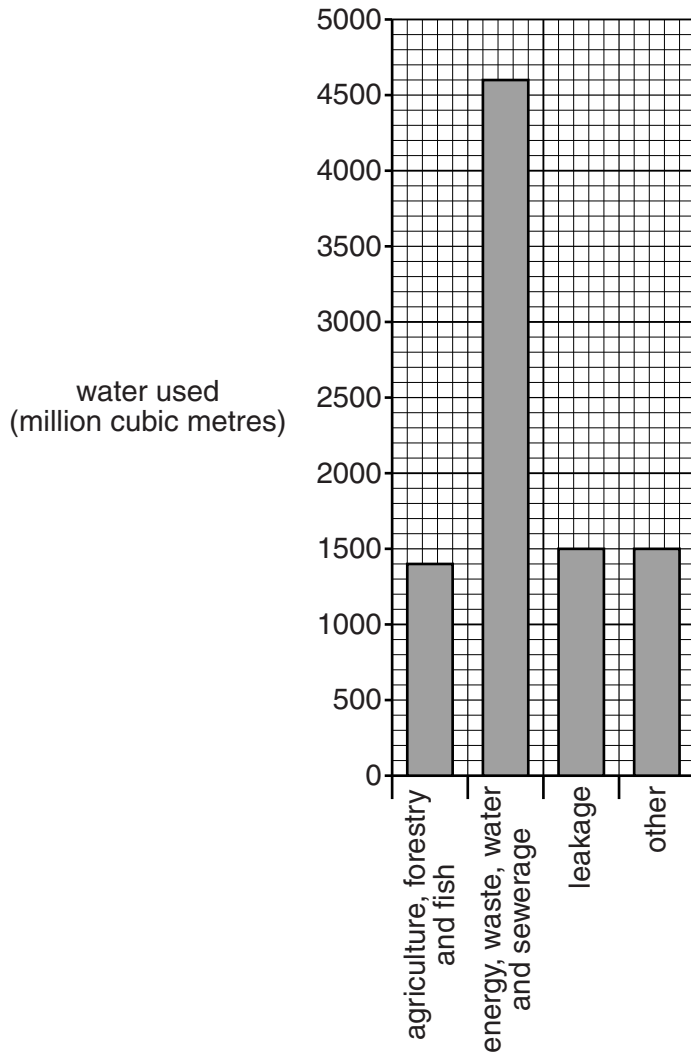
The total volume of water used by industry in this year was 9000 million cubic metres.

What is the volume of water wasted by leakage? ....

Calculate the percentage of water used that was wasted by leakage.

answer .... % **[2]**

(c) Drinking water sometimes contains small amounts of pollutants.

Write down the name of one of these pollutants and describe how it gets into drinking water.

....

....

.... **[2]**

[Total: 5]

Question 9 begins on page 16

Turn over

9 Chlorine and iodine are two elements in Group 7 of the Periodic Table.

(a) Both chlorine and iodine have many uses.

Write about some of the uses of chlorine and iodine.

....

....

....

.... **[3]**

(b) Chlorine reacts with calcium iodide.

It makes iodine and calcium chloride.

Write down the **word** equation for this reaction.

.... **[1]**

(c) The diagram shows the part of the Periodic Table that includes the elements in Group 7.

F **fluorine**
Cl **chlorine**
Br **bromine**
I **iodine**
At **astatine**

Which element in Group 7 is the **most** reactive?

....   **[1]**

[Total: 5]

SECTION C – Module P4

10 This question is about electric circuits.

(a) Circuits **A**, **B**, **C** and **D** all have the same components and the same type of resistance wire.

The lengths and thicknesses of the resistance wire are different.

Look at the circuit diagrams.

100 cm of thick resistance wire
A

50 cm of thick resistance wire
B

50 cm of thin resistance wire
C

100 cm of thin resistance wire
D
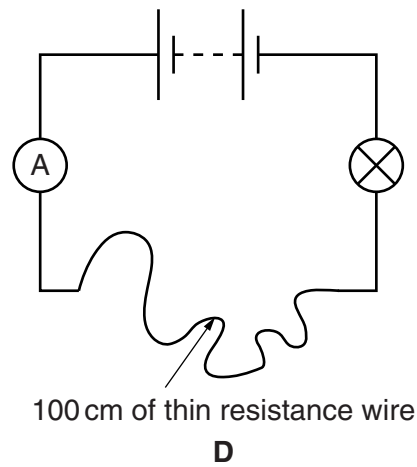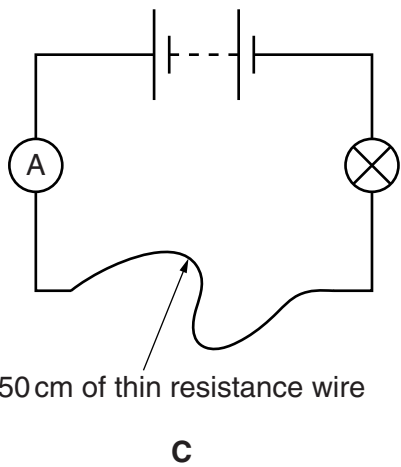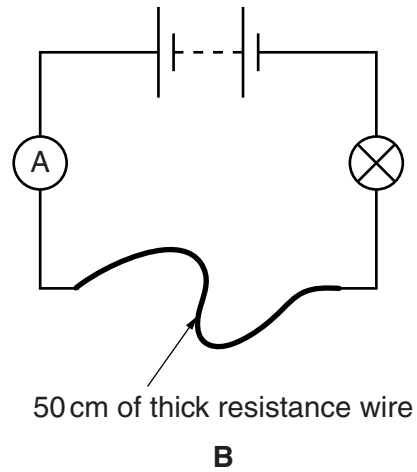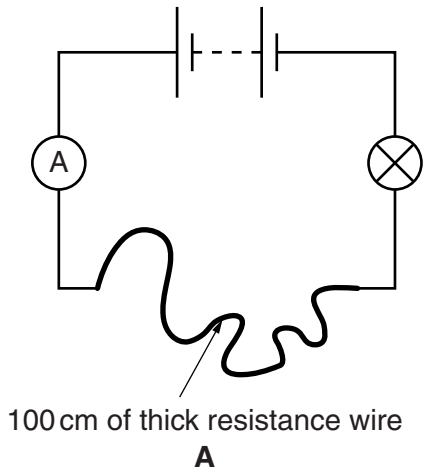
(i) Which circuit gives the **highest** reading on the ammeter?

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

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

 (ii) In circuit **A** the current is 1.5 amps.

 The voltage (potential difference) across the wire is 6V.

 Calculate the resistance of the wire.

 Write down your answer and the unit of resistance.

 ....

 ....

 answer .... unit .... **[3]**

(b) Look at the two circuits containing identical bulbs.
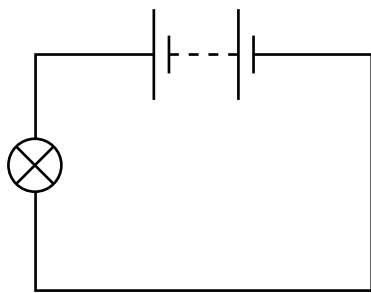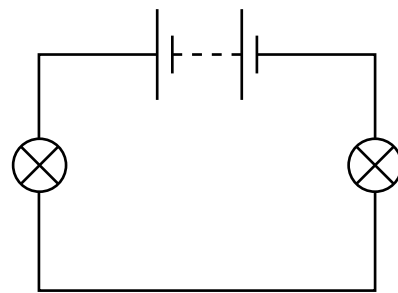
 circuit **E**   circuit **F**

 The bulb in circuit **E** is bright.

 The bulbs in circuit **F** are equally dim.

 Explain why.

 Use ideas about current and resistance.

 ....

 ....

 ....

 .... **[2]**

(c) Look at the diagram of a mains plug.
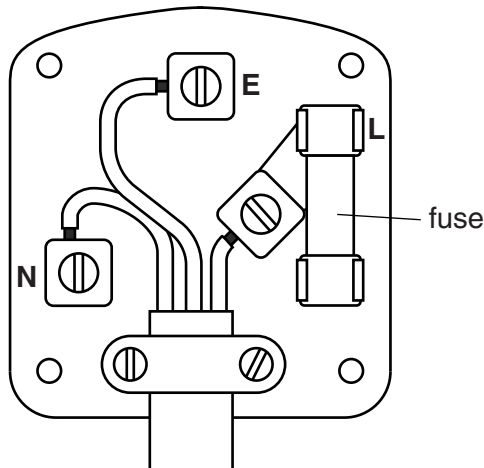
The electrical cable connected to the plug has three colour coded wires.

(i) Which line of the table shows correctly how the plug should be wired?

	Live	**Neutral**	**Earth**
A	green/yellow	blue	brown
B	blue	green/yellow	brown
C	brown	blue	green/yellow
D	blue	brown	green/yellow

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

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

(ii) There is a fuse in the plug.

Explain why.

....

.... **[1]**

[Total: 8]

11 This question is about static electricity.

(a) Sophie plays hockey on an artificial grass surface.

She gets a shock when she touches the metal goal posts.

When she plays hockey on a natural grass surface she does not get a shock.

Explain why she only gets a shock on the artificial grass.

....

....

....

.... **[2]**

(b) Sophie is investigating the use of static electricity to pick up pieces of paper.

Sophie rubs 5 rods with different cloth materials.

Look at her results.

Rod material	Cloth material	Result
copper	nylon	does not pick up paper
nylon	silk	picks up paper
glass	steel wool	does not pick up paper
polythene	wool	picks up paper
aluminium	steel wool	does not pick up paper

Explain her results.

....

....

....

.... **[2]**

(c) Static electricity can be useful.

It is used to remove smoke from chimneys.

Write down one **other** use of static electricity.

....

.... **[1]**

[Total: 5]

Question 12 begins on page 22

Turn over

12 An engineer thinks that a water pipe in a field is partly blocked.

The pipe is underground.

She can use a tracer to investigate the problem.

Look at the information about the tracers that she could use.

Tracer	Radiation	Half life	Penetrating power
A	alpha	2 hours	stopped by paper
B	beta	48 hours	stopped by 3 mm aluminium
C	beta	12 hours	stopped by 3 mm aluminium
D	gamma	3 minutes	can penetrate lead and concrete
E	gamma	24 hours	can penetrate lead and concrete

The engineer chooses which tracer to use.

She puts this tracer in the water pipe.

Explain which tracer she should use and describe how she finds the position of the partial blockage.

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

....

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....

....

.... **[6]**

[Total: 6]

13 Energy is produced during nuclear fusion and nuclear fission.

(a) Describe the difference between **fusion** and **fission**.

....

....

....

.... **[2]**

(b) It is accepted that fusion happens at very high temperatures.

Some scientists claim that this also happens at lower temperatures.

This is called 'cold fusion'.

Why do other scientists **not** believe that this can happen?

....

.... **[1]**

(c) (i) Doctors treat cancer cells with nuclear radiation.

They check the activity of the radioactive source each morning.

As the source gets older, the patients generally need to be exposed to the radiation for longer.

Explain why.

....

....

....

.... **[2]**

(ii) Which type of radiation is usually used for the treatment of cancer?

.... **[1]**
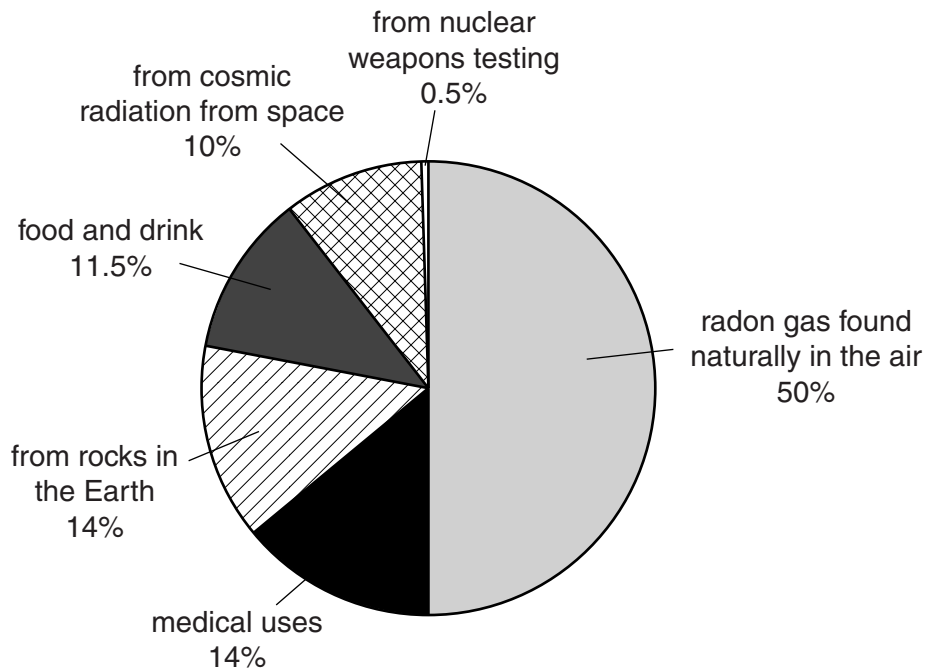
[Total: 6]

SECTION D

14 Everybody is exposed to some nuclear radiation (radioactivity) all the time.

(a) The pie chart shows the sources of this radiation.

Complete the sentence.

There are natural sources of radiation, one is food and drink, the other three are....................

....

Calculate the **total** percentage of the radiation from **all** these natural sources.

....

answer .... %

[2]

(b) Different people are exposed to different amounts of radiation.

Table 1 shows some information about different doses of radiation.

	Radiation dose in µSv per year
An average person's dose of radiation.	3 000
Highest dose that workers are allowed to be exposed to.	20 000
Lowest dose of radiation that has been shown to increase the risk of cancer.	50 000

Table 1

Jackson is concerned about how much radiation he is exposed to.

He finds a radiation calculator.

<div style="border:1px solid">

<u>My radiation calculator</u>

1. Radiation from air (radon), food and water and weapons testing   = **2410**

2. Cosmic radiation at sea level (from outer space)   = **260**

    If you live above sea level,
    add a number depending on the height you live
up to 300 m	**add 20**	
301–600 m	**add 50**	
601–1200 m	**add 90**	
1201–2000 m	**add 290**	= ....

3. Radiation from the ground:
If you live on basalt rock	**add 230**	
If you live on granite rock	**add 900**	
If you live on other types of rock	**add 460**	= ....

4. If you have had an X-ray   **add 400**   = ...

5. If you travel by aeroplane
    for each 1000 miles you travel   **add 10**   = ...

My total annual radiation dose: **answer = ... µSv**

</div>

(i) Jackson's house is on granite and is 500 metres above sea level.

He has had an X ray.

He has travelled 10 000 miles by aeroplane this year.

Work out Jackson's annual radiation dose.

Write your answer in the radiation calculator. **[2]**

(ii) Should Jackson be worried about his annual radiation dose?

Use **Table 1** to give reasons for your answer.

....

....

.... **[2]**

(c) Background radiation is around us all the time.

Some people are concerned that radiation from stone worktops may increase the risk of lung cancer.

The worktops may give out radon gas which may build up in the air in kitchens.

Three different worktops were tested to see if they were safe to use.

Look at the relative radiation readings.

Type of stone	Radiation detected around worktop per day	Background radiation reading per day	Radiation coming from the worktop per day	Radiation coming from the worktop per year (365 days)
blackstone	10.0	5.4	4.6	1 679
bluestone	35.0	5.0	30.0	10 950
greystone	45.0	5.0	....	....

  (i) The radiation reading around the blackstone worktop was 10.0 but the radiation actually coming from the worktop was 4.6.

Explain this difference.

....

.... **[1]**

  (ii) Complete the table for the greystone worktop.

[2]

(iii) Megan is having a new kitchen with stone worktops.

Put a tick (✓) next to **two** ways that would reduce her concern about getting lung cancer.

Choose a worktop made of blackstone rather than bluestone. ☐

Put an extractor fan in her kitchen. ☐

Choose a worktop made of greystone rather than blackstone. ☐

Always use gloves when she is preparing food. ☐

Wear an apron in the kitchen. ☐

[1]

[Total: 10]

END OF QUESTION PAPER

The Periodic Table of the Elements

Key

| relative atomic mass |
| **atomic symbol** |
| name |
| atomic (proton) number |

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 **A***l* aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C***l* 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 **T***l* 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

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.

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