OCR

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Thursday 12 June 2014 – 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

B722/02

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.

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

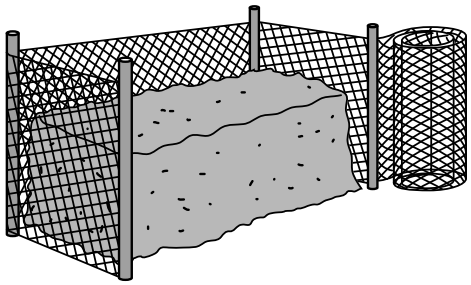
PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

SECTION A – Module B4

1 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 wire around the heap lets in air.

Explain why increasing the amount of air entering increases the rate of decay.

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

(b) Dead plant material contains elements.

These include carbon and nitrogen.

Explain why nitrogen is needed for plant growth.

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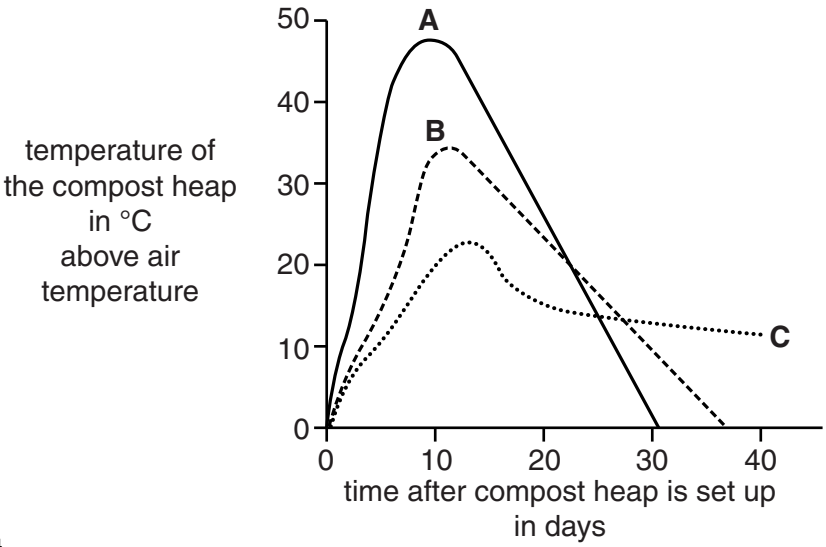
..... **[2]**

(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.

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: 7]

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

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

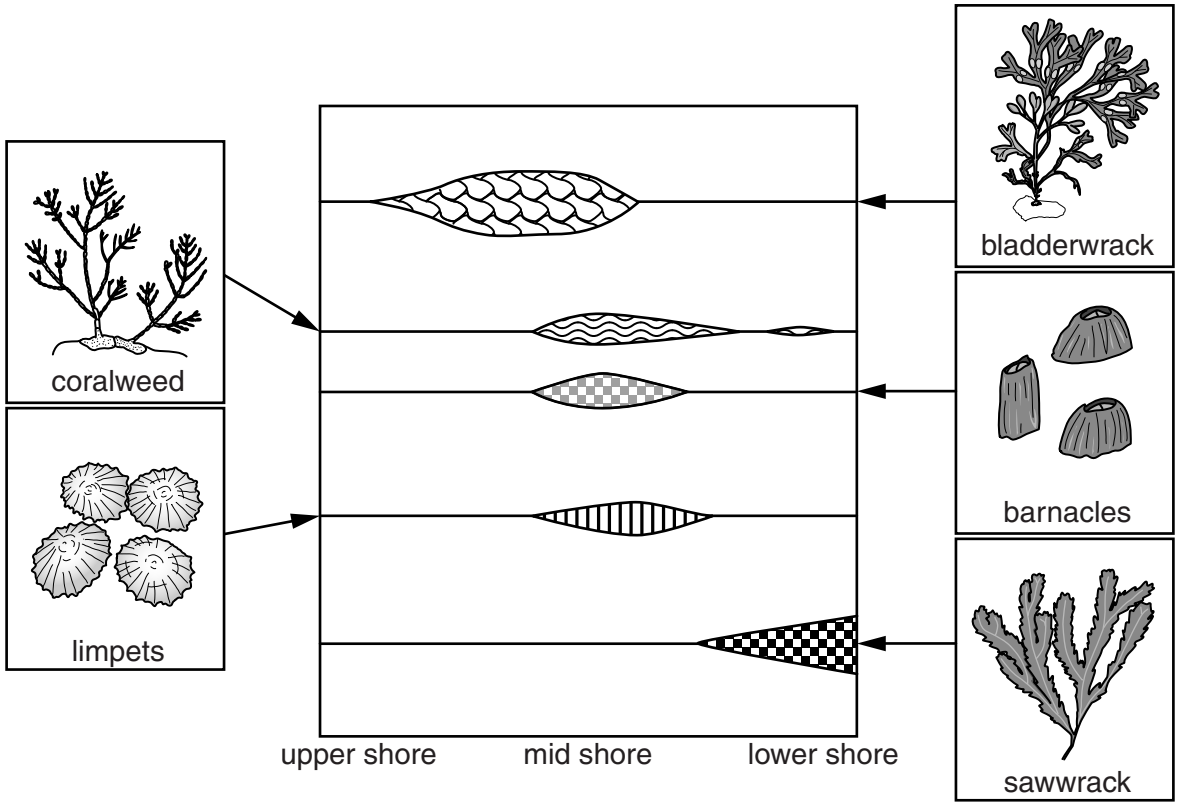
The tide causes the sea to cover the rocks several times a day.

The rocks higher up the shore are covered by water for less time.

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

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

The wider the lines, the more organisms are present.



Write about what the students can conclude from the data and how they could explain the distribution.

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

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

[Total: 6]

Question 3 begins on page 8

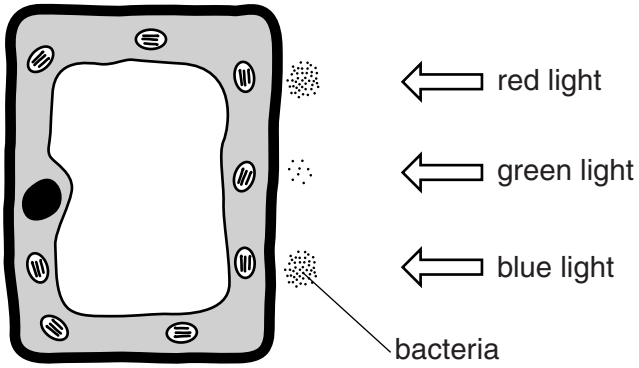
3 A cell from a green leaf is placed on a microscope slide.

On the slide, there is water containing bacteria.

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

Different colours of light are shone at different parts of the cell.

The diagram shows the cell viewed under a microscope.



(a) 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]**

(b) Explain why the bacteria have moved to the areas shown in the diagram.

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

[Total: 4]

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Question 4 begins on page 10

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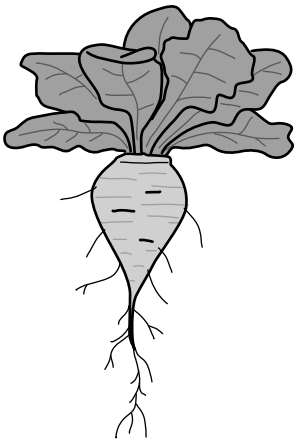
4 Some farmers grow sugar beet plants in their fields.

Sugar beet makes sugar by photosynthesis.

Sugar is stored in the swollen roots.



(a) Cells in the sugar beet plant need carbon dioxide for photosynthesis.

Leaves of plants are adapted to allow carbon dioxide to reach these cells.

Explain how.

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

(b) Farmers grow sugar beet plants in large fields.

They try and stop weeds growing in between the sugar beet plants.

One way to do this is by adding chemicals to kill the weeds.

Explain why removing weeds makes sugar beet plants grow bigger.

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

(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 size of the sugar beet crop depends on whether barley or soya beans were grown in the field the previous year.

They think that the effect on the sugar beet is **only** due to different chemicals used on the barley or soya beans.

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 chemical	22.1
barley	roneet	22.2
soya beans	no chemical	19.2
soya beans	treflan	17.4

Do the results back up the farmer's ideas?

Explain your answer.

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

[Total: 8]

SECTION B – Module C4

5 Astatine, At, is in Group 7 and Period 6 of the Periodic Table.

The atomic number of astatine is 85.

(a) An isotope of astatine has 125 neutrons in its nucleus.

Look at the table of information about this isotope.

Complete the table.

Information	
Number of electrons in **outer** shell	.....
Number of occupied shells	.....
Mass number	.....

[3]

(b) Look at the table of melting and boiling points of the elements in Group 7.

Element	**Melting point in °C**	**Boiling point in °C**
fluorine		
chlorine	–101	–35
bromine	–7	59
iodine	114	184
astatine	302	337

The values for fluorine are not in the table.

(i) Predict the melting point and boiling point of fluorine.

Melting point ..... °C Boiling point ..... °C **[1]**

(ii) Zaheer works in a laboratory.

The temperature inside the laboratory is 20 °C.

Predict the state of fluorine at 20 °C.

Choose from **solid**, **liquid** or **gas**.

Answer .....

Explain your answer .....

.....

[1]

(iii) All the elements in Group 7 have a simple molecular structure.

Which element has the **strongest** intermolecular forces?

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

(c) Zaheer predicts that chlorine will react with potassium astatide solution, KAt.

He predicts that potassium chloride solution and astatine, At_2, will be made.

Construct the **balanced symbol** equation for this reaction.

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

[Total: 8]

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/cm^3	Corrosion	Relative electrical conductivity (good = 10 and poor = 1)
A	1700	8	7.4	corrodes very slowly	7
B	232	3	9.4	corrodes rapidly	4
C	2010	9	3.2	corrodes very slowly	3

(a) Explain, with reasons, which metal, **A**, **B** or **C**, from the table would be best to make 'The Orbit'.

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

(b) Describe the metallic bonding in metals and use this to explain why most metals have a high melting point.

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

[Total: 5]

Question 7 begins on page 16

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

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

The electronic structure for sodium is 2.8.1.

The electronic structure for oxygen is 2.6.

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

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

(b) Use 'dot and cross' models to describe the bonding in both sodium oxide and in a molecule of oxygen, O_2.

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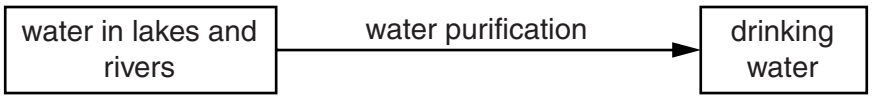
..... **[6]**

[Total: 7]

8 Water from lakes and rivers must be purified before it can be used as drinking water.



(a) There are **three** main stages in the purification of water.

Write about what happens at each stage.

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

(b) Some samples of drinking water may contain traces of nitrate fertiliser.

Suggest why the water purification process does not remove nitrate fertiliser.

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

(c) In some countries there is not enough water in lakes and rivers.

These countries distil sea water to make drinking water.

Explain one **disadvantage** of using distillation to make large quantities of drinking water.

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

[Total: 5]

SECTION C – Module P4

9 This question is about current and static electricity.

(a) Zara has a vacuum cleaner.

It has a power rating of 1200 W.

It is connected to the 230 V mains.

(i) Calculate the current to the vacuum cleaner when it is switched on.

Give your answer to two significant figures.

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answer ..... A **[2]**

(ii) Fuses are available in values of:

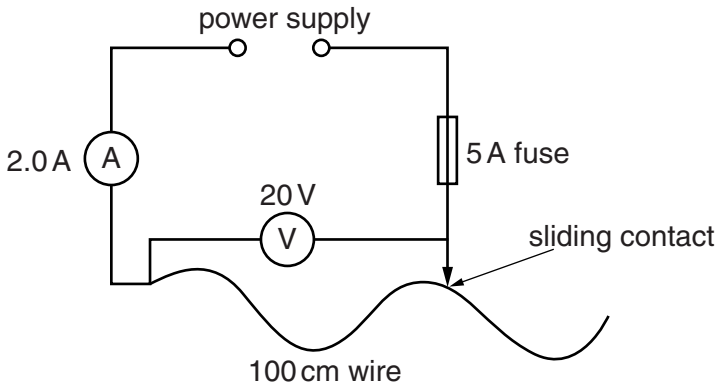
3 A **5 A** **10 A** **13 A**

Which fuse should be fitted in the plug of the vacuum cleaner?

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

(b) Zara investigates how the current through a wire changes as the length of the wire changes.

Look at the circuit she uses.



She starts with a wire 100 cm long. The potential difference across the wire is 20 V and the current in the wire is 2.0 A.

(i) Calculate the resistance of the 100 cm wire.

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

(ii) When the length of the wire is shorter than **40 cm**, the fuse will blow.

Use calculations to explain why.

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

(c) William is a television engineer. He unplugs the TV before he tries to mend it.

Even when the TV is unplugged, it can remain electrostatically charged.

He then earths the TV **and** stands on an insulating mat.

Explain how this reduces his chance of receiving a shock when mending the TV.

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

[Total: 8]

10 Ultrasound is used in medicine.

(a) What is ultrasound?

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

(b) Explain how ultrasound is used to produce images in body scans.

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

(c) Ultrasound can be used to measure blood flow in the body.

Write down one **other** use of ultrasound in medicine.

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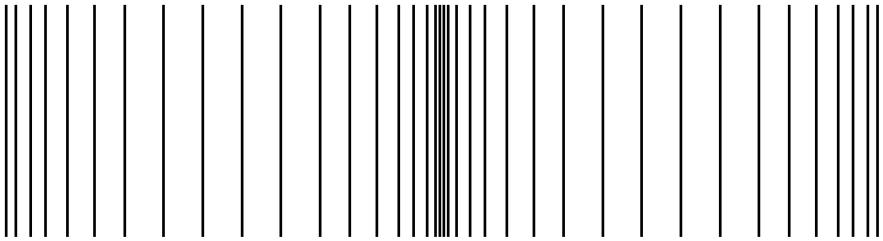
..... **[1]**

(d) The diagram represents a longitudinal wave.



Explain why the distance between **A** and **B** is one wavelength.

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

[Total: 6]

11 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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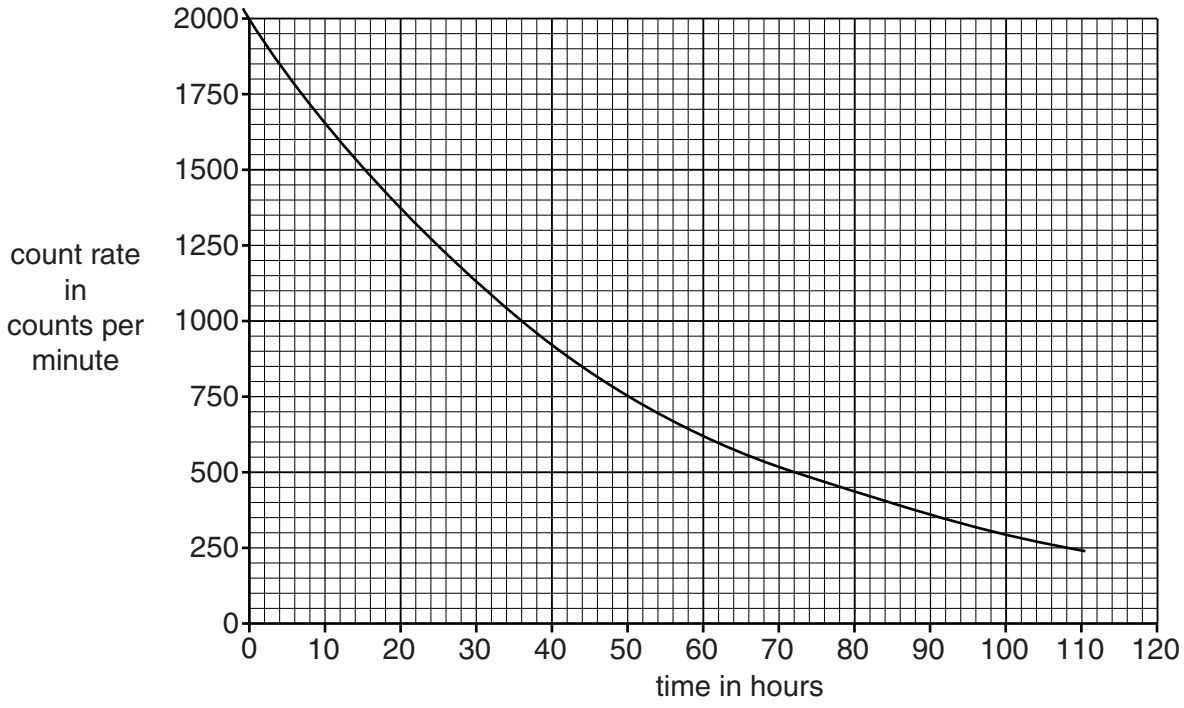
..... **[6]**

[Total: 6]

12 Vic is investigating a radioactive liquid.

He measures the count rate for a sample.

Look at the graph of his results.



(a) Use the graph to calculate the half life of the sample.

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.....

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

(b) The activity at the start of the measurements is 2000 counts per minute for this sample.

How long will it take for the count rate from this sample to reach 31 counts per minute?

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

[Total: 3]

13 **(a)** In one nuclear fusion reaction, two different isotopes of hydrogen fuse together to produce helium (He) and energy.

$$^{1}_{1}H + {}^{2}_{1}H \rightarrow {}^{.....}_{.....}He$$

Complete the equation by adding the correct mass number and atomic number to the helium nucleus. **[1]**

(b) Nuclear fusion could be a major energy source in the future.

Research on nuclear fusion is being done as a joint project between scientists in different countries.

Suggest **one** advantage of working together in this way on this project.

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

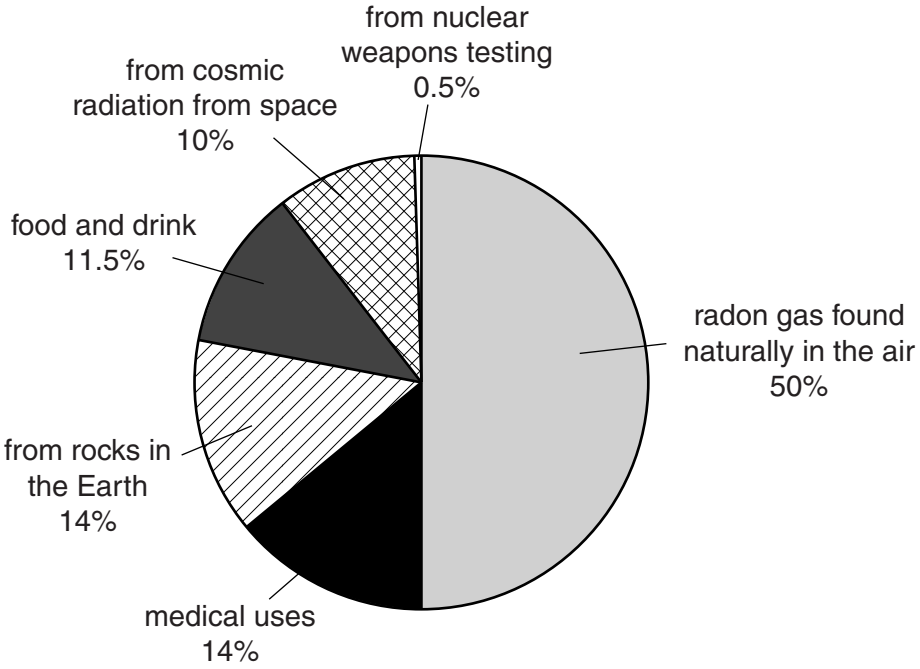
[Total: 2]

Question 14 begins on page 24

SECTION D

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

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



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.	3000
Highest dose that workers are allowed to be exposed to.	20000
Lowest dose of radiation that has been shown to increase the risk of cancer.	50000

Table 1

How much of an average person's radiation dose per year comes from their food and drink?

Use Table 1 and the pie chart to help you work out the answer.

answer ..... μSv **[2]**

(b) Jackson is concerned about how much radiation he is exposed to.

He finds a radiation calculator.

My radiation calculator

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**

(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** in part **(a)** to give reasons for your answer.

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

(c) Table 2 shows some data about the level of radon gas in the air.

It also shows deaths from lung cancer for both smokers and non-smokers.

	Deaths from lung cancer per 1000 people	
Level of radon in the air in arbitrary units	**Smokers**	**Non-smokers**
20	260	36
10	150	18
8	120	15
4	62	7
2	32	4
1.3	20	2

Table 2

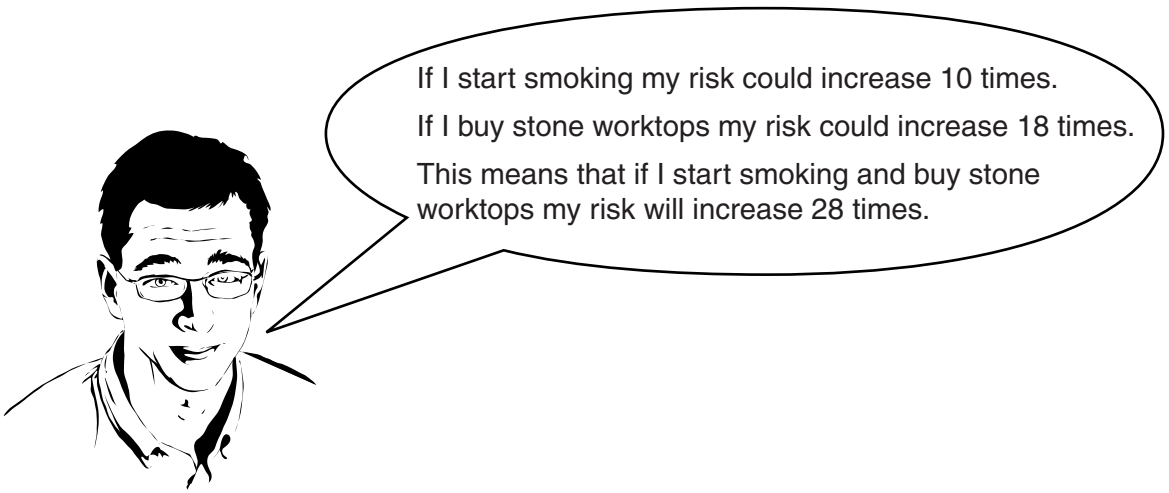
The normal level of radon gas in the air is **1.3** units.

It has been shown that stone worktops give off radon gas.

This can make the level of radon gas close to a worktop rise to **20** units.

(i) Peter is a non-smoker.

He is talking about the risk of dying from lung cancer.



Are Peter's comments correct?

Use the data in **Table 2** to explain your answer.

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

(ii) The risks from smoking and from radon gas from worktops would not be the same for all people.

For example one reason might be that people smoke different numbers of cigarettes per day.

Suggest **one** other reason why the risks would not be the same for all people.

.....

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

[Total: 10]

END OF QUESTION PAPER

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.