OCR
Oxford Cambridge and RSA

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Friday 16 June 2017 – 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

* B 7 2 2 0 2 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

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 **24** 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

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

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

Answer **all** the questions.

SECTION A – Module B4

1 **(a)** Mites are small animals that are similar to spiders.

Some mites are pests that eat farmers' crop plants.

Some farmers use insects that are predators to kill the mites.

The table shows information about four species of predator insects, **A**, **B**, **C** and **D**.

Predator species	Temperature the predators are most active at in °C	Relative humidity the predators are most active at %	Number of mites eaten by predators each week, in ideal conditions	Which part of the predator life cycle eats the mites
A	21 – 27	> 60	300	larva and adult
B	18 – 26	40 – 80	500	larva only
C	5 – 16	> 50	425	larva and adult
D	26 – 35	40 – 50	350	adult only

Sue is a farmer. She grows crop plants inside a glasshouse.

There are mite pests living on her crop plants.

In her glasshouse

- the temperature is kept between 20 and 25 °C
- the relative humidity is kept between 50 and 60%.

Look at the table.

Which predator species will be the best one for Sue to use to kill the mites?

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

Explain your answer.

predator species .....

explanation .....

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

(b) Sue could also use chemical pesticides to kill the mites.

What are the **disadvantages** of using pesticides compared with using predator insects?

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

(c) Sue wants to estimate how many mites are in her glasshouse.

She has 320 plants in the glasshouse.

She counts how many mites are on five of the plants.

The table shows her results.

Plant	Number of mites on each plant
1st	62
2nd	108
3rd	85
4th	67
5th	168

(i) Estimate the total number of mites in the glasshouse.

You should show your working.

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

(ii) Why might this **not** be a very accurate estimate?

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

2 Sam is investigating diffusion.

He uses cubes of agar jelly that contain an alkali.

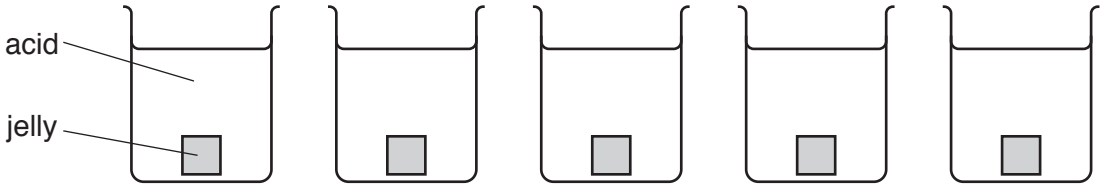
The jelly also contains an indicator.

The indicator is a pink colour when alkaline but goes colourless when neutral or acidic.

Sam puts a cube of jelly in each of five different concentrations of acid.

He times how long it takes each cube to completely change from pink to colourless.

Each cube is identical to begin with.



concentration of acid:	1.0 M	0.8 M	0.6 M	0.4 M	0.2 M

Explain why the cubes eventually go completely colourless.

Predict which cube goes colourless first and explain why.

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

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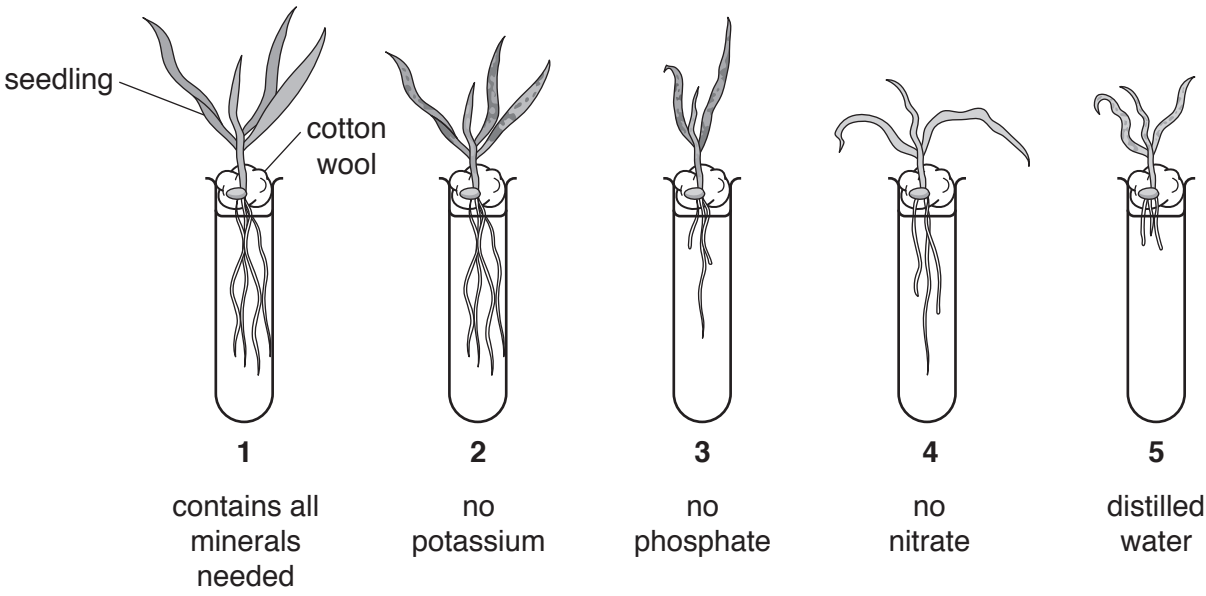
..... **[6]**

3 Liz is investigating why plants need different minerals.
She puts some seedlings in different solutions to grow.

Test tube **1** contains all the minerals the seedlings need.
Test tubes **2**, **3** and **4** are each missing a different mineral.
The distilled water in test tube **5** contains no minerals.
Liz makes sure that the seedlings all get the same amount of light and are kept at the same temperature.

The diagram shows the seedlings after four weeks.



(a) Explain the results for test tube **3**.

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

(b) If oxygen is bubbled through the solution in test tube **1**, this will speed up the rate of growth.

Explain why.

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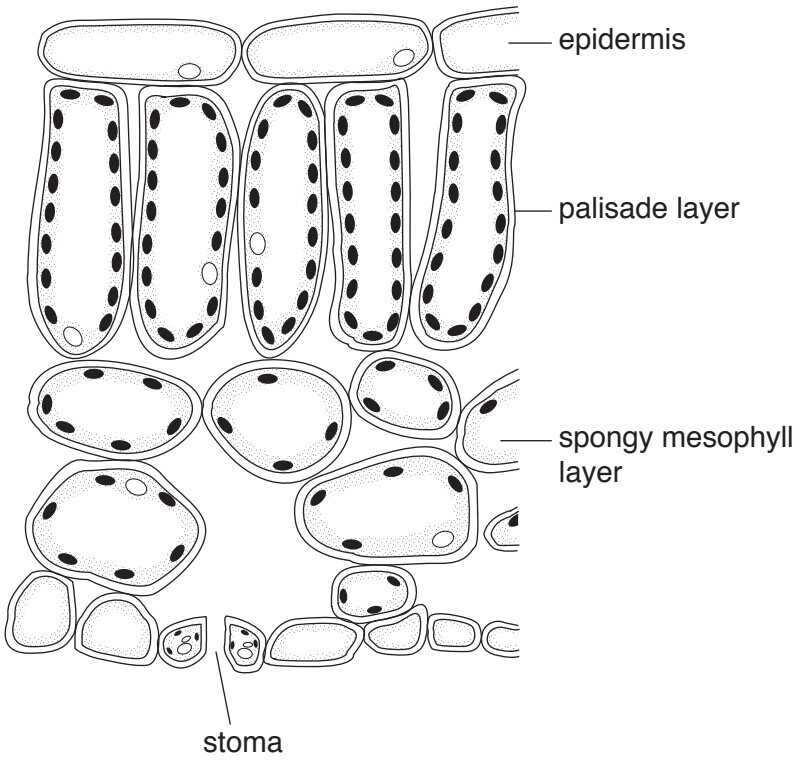
..... **[3]**

4 The diagram shows a section through a leaf.



(a) The epidermis is transparent.

Explain how this is an adaptation to the job of the leaf.

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

(b) Palisade cells and spongy mesophyll cells convert sugar into starch and store it as starch grains.

Explain why they store food as starch and **not** as sugar.

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(c) Most stomata are on the bottom surface and **not** on the top surface.

Explain why.

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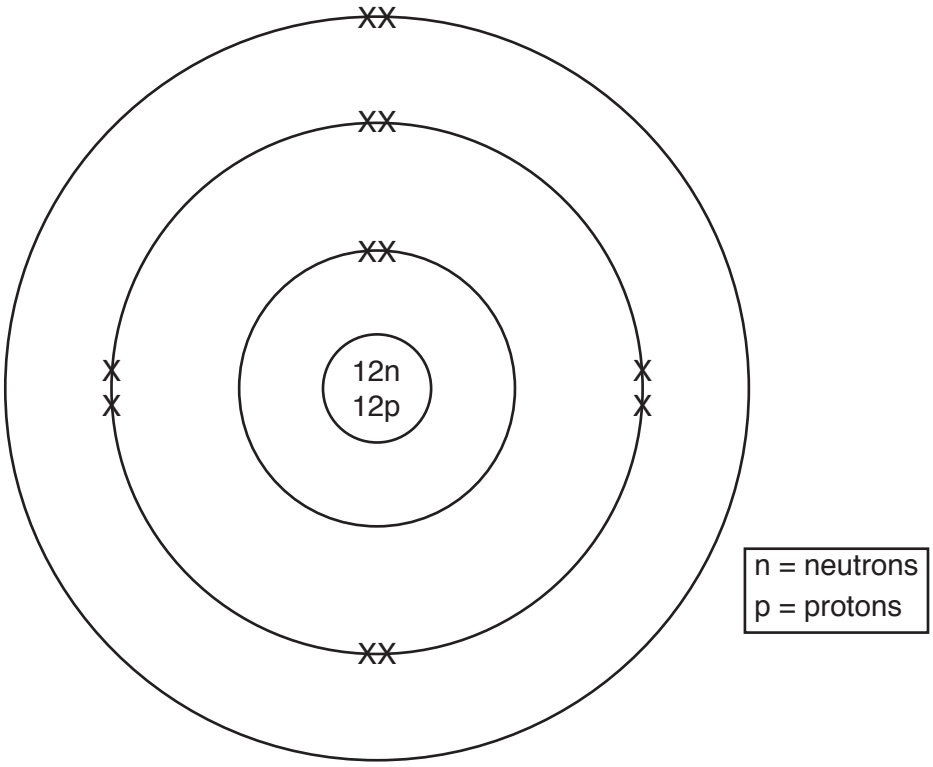
SECTION B – Module C4

5 Look at the diagram of the structure of an atom of an element.



(a) To which **group** of the Periodic Table does the element belong?

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

(b) To which **period** of the Periodic Table does the element belong?

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

(c) The element has several **isotopes**. This atom is one of these isotopes.

What is meant by the word isotopes?

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

6 Phil tests two unknown solutions, **A** and **B**, with

- silver nitrate solution
- sodium hydroxide solution.

Look at his table of results.

Solution	Effect of silver nitrate solution	Effect of sodium hydroxide solution
A	white solid	blue solid
B	stays the same	grey/green solid

Phil makes two conclusions.

- Solution **A** contains chloride ions.
- Solution **B** contains iron(III) ions.

Do Phil's results support each of these conclusions?

Explain your answer.

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

7 Chlorine has the electronic structure 2.8.7.

Chlorine reacts with non-metals and metals.

(a) Chlorine, Cl_2, reacts with hydrogen, H_2, to make hydrogen chloride, HCl.

(i) Write the **balanced symbol** equation for this reaction.

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

(ii) Hydrogen chloride is a **covalent** molecule.

Use the 'dot and cross' model to show the covalent bonding in hydrogen chloride.

Hydrogen has the electronic structure 1.

You only need to show the outer shell electrons.

[1]

(b) Chlorine has the electronic structure 2.8.7 and sodium the electronic structure 2.8.1.

Chlorine reacts with sodium to make sodium chloride, NaC*l*.

Sodium chloride is an **ionic** compound.

Use the 'dot and cross' model to show the ionic bonding in sodium chloride.

Include the charges on the ions.

You only need to show the outer shell electrons.

[2]

(c) Sodium chloride has a high melting point.

Explain why.

Use ideas about structure and bonding.

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

8 Water in rivers, lakes and reservoirs contains many impurities.

These impurities include insoluble materials, microbes, pesticides and fertilisers.

Water in rivers, lakes and reservoirs needs to be purified before it can be used as drinking water.

Describe the three processes involved in water purification.

Explain why some soluble substances are not removed by these processes.

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

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

9 The Group 7 elements are called the halogens.

Look at the table. It shows some of the physical properties of the halogens.

Halogen	Atomic number	Atomic radius in pm	Melting point in °C
fluorine	9	64	.....
chlorine	17	99	–101
bromine	35	114	–7
iodine	53	133	114
astatine	85	.....	.....

(a) The physical properties of the halogens show a trend as the atomic number increases.

Complete the table by predicting the missing atomic radius and melting points. **[3]**

(b) The halogens have similar chemical properties.

Explain why.

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

(c) Bromine will react with potassium iodide in a displacement reaction.

The ionic equation for this reaction is

$$Br_2 + 2I^- \longrightarrow 2Br^- + I_2$$

The reaction involves both oxidation and reduction.

Explain why the reaction involves both oxidation and reduction.

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

SECTION C – Module P4

10 Ultrasound is used in hospitals.

(a) Ultrasound is used to scan unborn babies in the womb.

(i) Explain how ultrasound waves produce an image showing different depths of tissue.

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(ii) X-rays are **not** used to scan unborn babies in the womb.

Explain reasons why.

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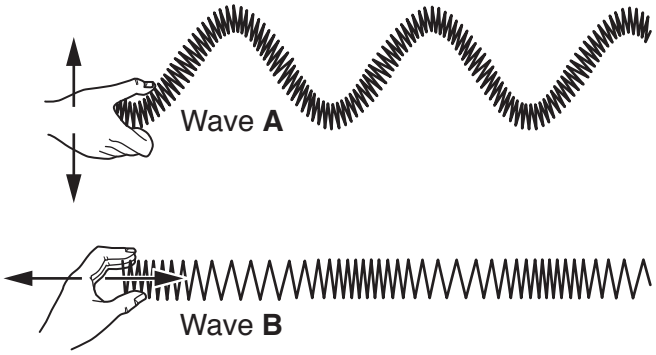
(b) Ultrasound and water waves are different types of waves.

Look at the diagrams of slinky springs being used to model the different types of waves.



Explain how wave **A** and wave **B** model the particles in the two different types of waves.

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

(c) What are the **differences** between sound waves and ultrasound waves?

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

11 An engineer tests underground pipes to see if they have a fault.

She uses a gamma radioactive tracer to find the faults.

(a) Why are alpha and beta tracers **not** used to check pipes?

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

(b) She measures the radioactivity above ground every 10 m along the pipe.

Look at her results.

Distance along the pipe in m	Radiations in one minute
0	110
10	108
20	112
30	109
40	190
50	150
60	12
70	11
80	13
90	12

What can you conclude about the fault in the pipe?

Use the data to explain your answer.

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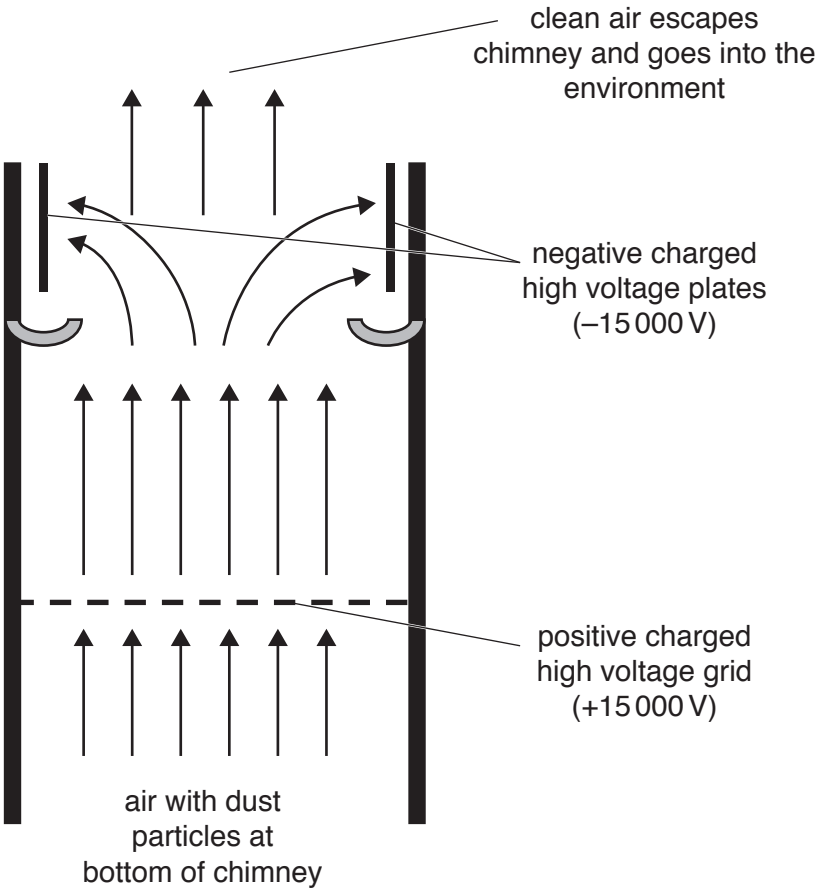
..... **[3]**

12 Electrostatic precipitators remove dust particles in chimneys.

Look at the diagram.



The dust particles have a neutral charge at the bottom of the chimney.
The dust particles rise through the charged grids and are removed from the air.

Explain how electron transfer helps remove dust particles from the air.

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

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13 Bill has electrical appliances in his home.

One of the appliances stops working.

(a) He fits a new fuse in the plug.

Explain how a fuse can help prevent electrical fires.

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(b) This appliance has only two wires.

Explain how the appliance can remain safe without an earth wire.

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(c) The appliance uses 230 V to supply a maximum current of 3 A.

Calculate the maximum power of the appliance.

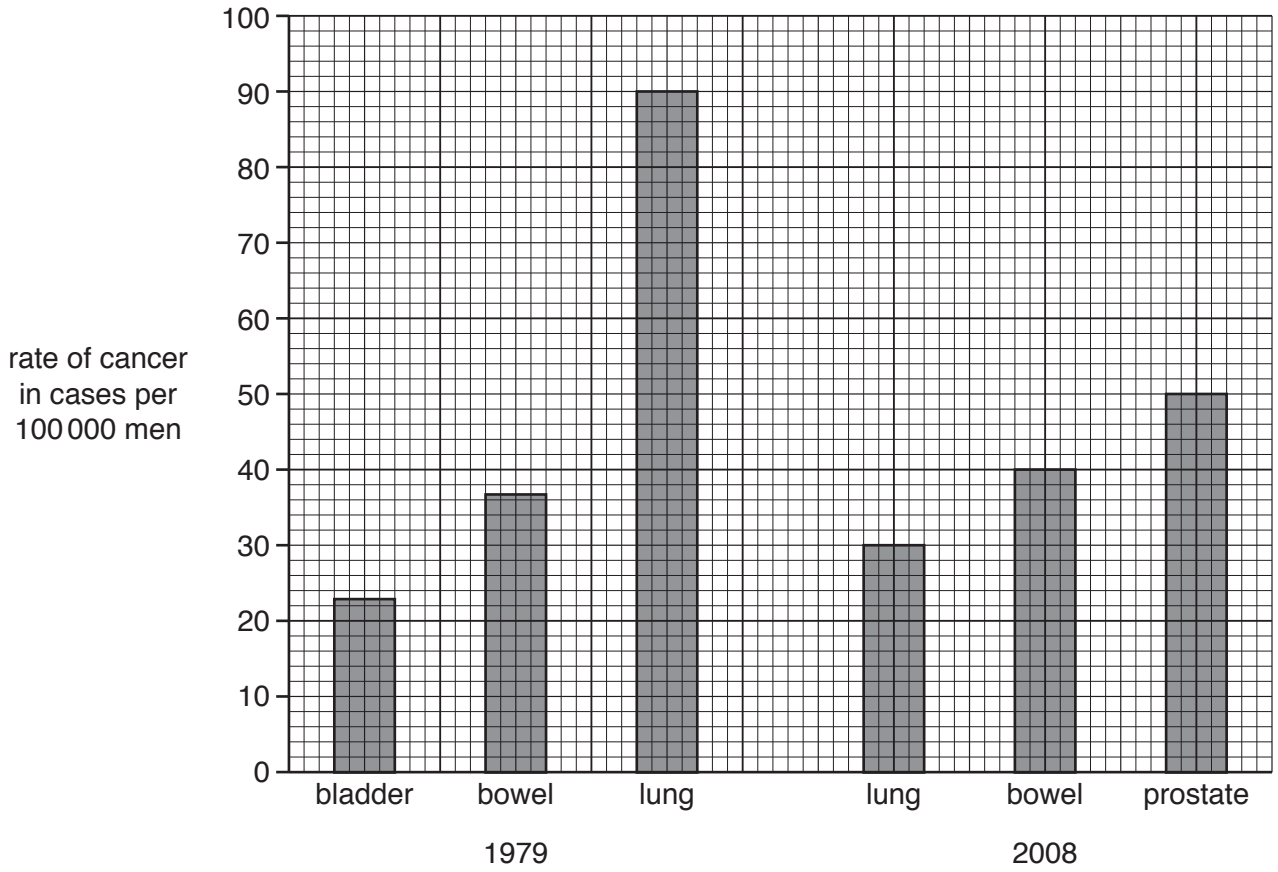
answer ..... unit ..... **[2]**

SECTION D

14 Radioactive isotopes are used to treat different types of cancer.

(a) The graph shows the rates of cancer in men aged 40–50 in Great Britain.

It shows the rates for the three most common types of cancer in these men in 1979 and the three most common types of cancer in these men in 2008.



(i) What can you conclude about the rate of bladder cancer in 2008?

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

(ii) In 2008 there were 4 million men aged between 40 and 50 in Great Britain.

Calculate how many of these men would be expected to have prostate cancer.

You should show your working.

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

(iii) The data about cancers in each year is given as a **rate per 100 000 men**.

The rate is often used rather than giving the **actual number** of cancer cases.

Suggest a reason why the rate is used.

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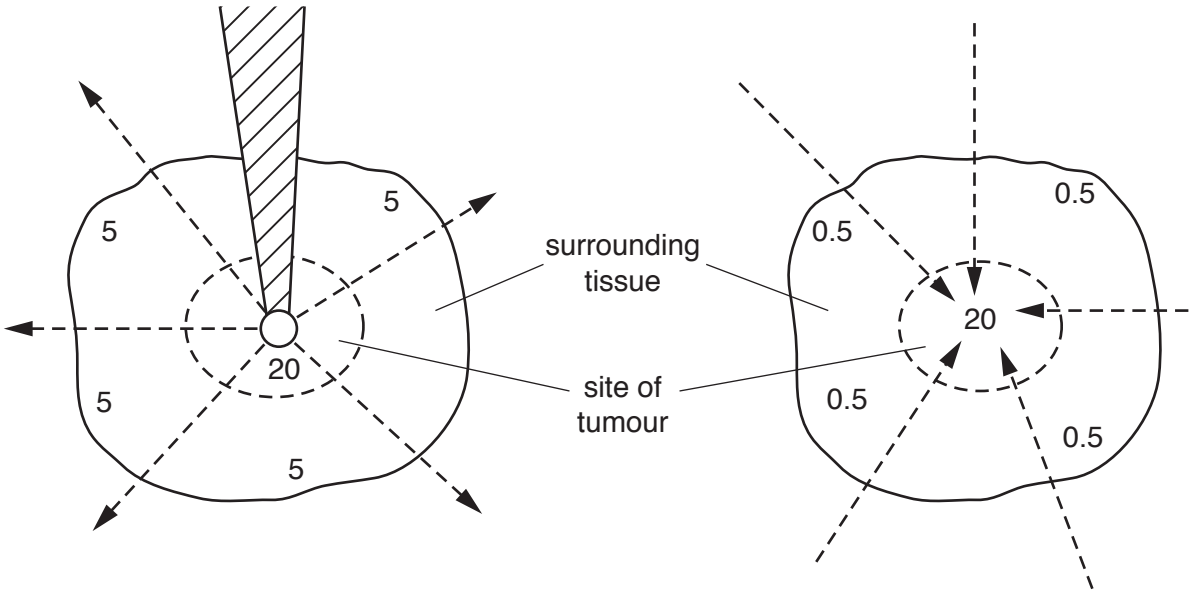
..... **[1]**

(b) Patients with cancer often have the cancer tissue (tumour) removed.
They are then treated with radioactive isotopes to

- stop the tumour growing back
- stop any cancer cells in the surrounding tissue spreading to somewhere else in the body.

The diagram shows two ways of using radioactive isotopes.

The numbers show the amount of radiation received in different areas.



Method A
The radiation is supplied by putting the isotope inside the tissue

Method B
The radiation is supplied from the isotope outside the body

Compare the amount of radiation received by the cells in different parts of the tissue using method **A** and method **B**.

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

(c) Doctors designed a trial to compare the two methods of giving radiation.

They used 3000 patients in 11 different countries in the trial.

The patients were randomly divided into two groups.

One group was treated with method **A** and the other with method **B**.

(i) Suggest a reason why they chose patients in 11 different countries.

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

(ii) Here are some results from the trial.

	Method A	**Method B**
deaths from the tumour growing back in the next five years	17	15
deaths from diseases such as cancers elsewhere in the body in the next five years	12	27

Compare the success of the two treatments and suggest reasons for any differences.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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.