OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

ADDITIONAL SCIENCE B

B722/01

Unit B722: Additional Science modules B4, C4, P4 (Foundation 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

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your 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 for each question 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.

Examiner's Use Only:			
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8			
Total			

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

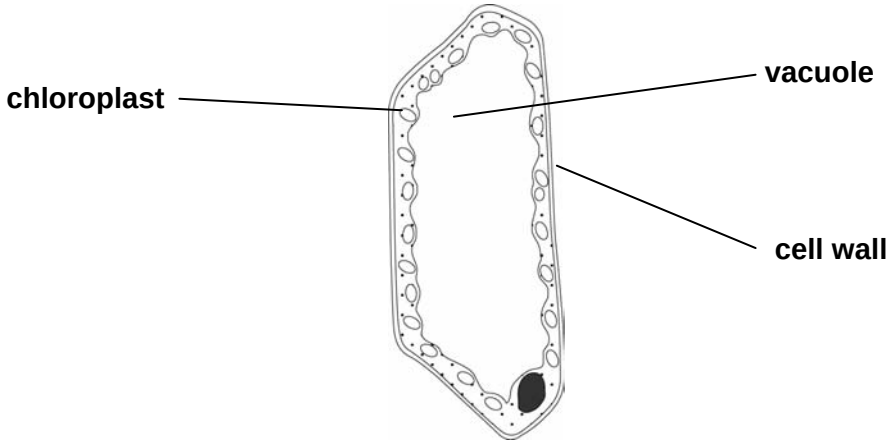
$mgh = \frac{1}{2} mv^2$

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

Answer **all** the questions.

Section A – Module B4

1 Look at the diagram of a plant leaf cell.



(a) A root hair cell does **not** contain chloroplasts.

Suggest why.

.....

.....

.....

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

(b) What are the jobs of a root hair cell?

.....

.....

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

[Total: 4]

2 Australia produces a lot of sugar cane.

(a) Look at the table showing climate information for Australia and the UK.

month	Australia		UK	
	average temperature in °C	average daily sunshine in hours	average temperature in °C	average daily sunshine in hours
January	31.4	6.8	7.0	1.9
February	31.2	6.1	7.4	2.5
March	30.6	6.5	10.2	3.6
April	29.2	6.7	12.6	4.9
May	27.6	6.7	16.5	6.3
June	26.0	7.2	19.4	6.0
July	25.7	7.3	22.2	6.4
August	26.6	7.9	22.3	6.2
September	28.1	8.6	18.9	4.7
October	29.5	8.8	14.6	3.8
November	30.6	8.5	9.9	2.3
December	31.4	7.8	7.8	1.6

Sugar cane grows better in Australia than in Britain.

Use the data in the table and your own knowledge to explain why.

.....

.....

.....

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

(b) Insect pests can eat the sugar cane. This reduces the crop yield.

Describe how farmers can prevent insects eating the sugar cane.

.....

.....

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

[Total: 5]

3 This question is about sewage.

(a) Jenny wants to show that decay is caused by microorganisms, such as bacteria.

Describe how Jenny could do an experiment to show that decay is caused by microorganisms.

.....

.....

.....

.....

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

(b) The microorganisms need a gas to help them break down the sewage.

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

carbon dioxide	☐
carbon monoxide	☐
nitrogen	☐
oxygen	☐

[1]

(ii) The presence of this gas is one factor that helps the microorganisms.

Write down **one other** factor that helps the microorganisms break down sewage.

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

(c) After sewage has been treated it can be used as fertiliser by farmers.

(i) Why does sewage need to be treated before it can be used as fertiliser by farmers?

.....

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

(ii) Fertilisers are used in intensive farming.

What is meant by intensive farming?

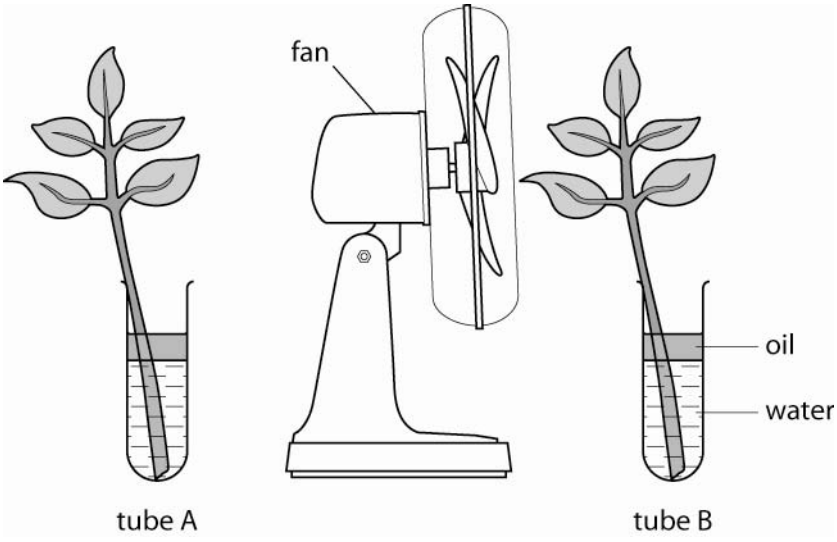
.....

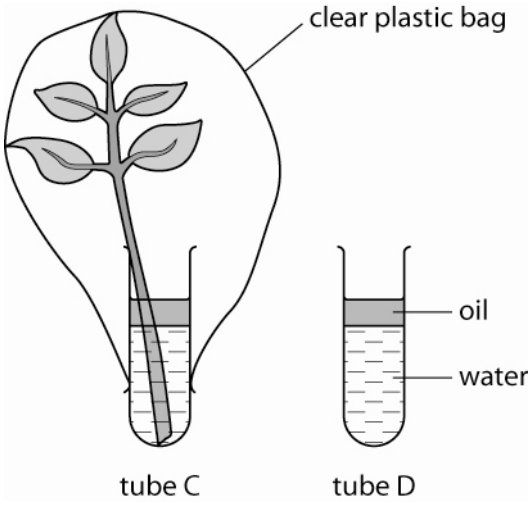
..... **[1]**

[Total: 7]

4 Jo is investigating the effect of some factors on transpiration in plants.

Look at the diagram. It shows the apparatus she uses.





Jo records the mass of each tube and its contents.

She leaves the apparatus for 5 days in the same room.

She then records the mass again.

The table shows Jo's results.

tube	**A** – left at room temperature	**B** – left in room with a moving fan next to it	**C** – left in room with a clear plastic bag over it	**D** – no plant left at room temperature
mass at start in g	42.4	47.3	39.2	31.9
mass at end in g	35.3	35.8	38.5	31.9

(a) Compare the effects of increasing air movement and increasing humidity on the rate of transpiration in Jo's plants.

Use information from the table, as well as your own calculations, to help you answer.

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

.....

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

(b) Explain why Jo set up tube **D**.

.....

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

(c) Jo left each tube in the same room for the same amount of time.

She did this to help make her experiment a fair test.

Suggest **one other** thing she could have done to help make it a fair test.

.....

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

(d) In Jo's experiment, water moves from the tubes to the leaves through transport vessels.

Write down the name of these vessels.

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

[Total: 9]

Section B – Module C4

5 This question is about the elements in the Periodic Table.

Look at the list of elements.

argon	**calcium**
hydrogen	**iodine**
magnesium	**neon**
nitrogen	**oxygen**
potassium	**sodium**

Answer the questions.

Choose your answers from the list.

Each element can be used **once**, **more than once** or **not at all**.

(a) Write down the **name** of the element which has the **atomic number of 12**.

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

(b) Write down the **name** of the element which is a **grey solid** non-metal at room temperature.

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

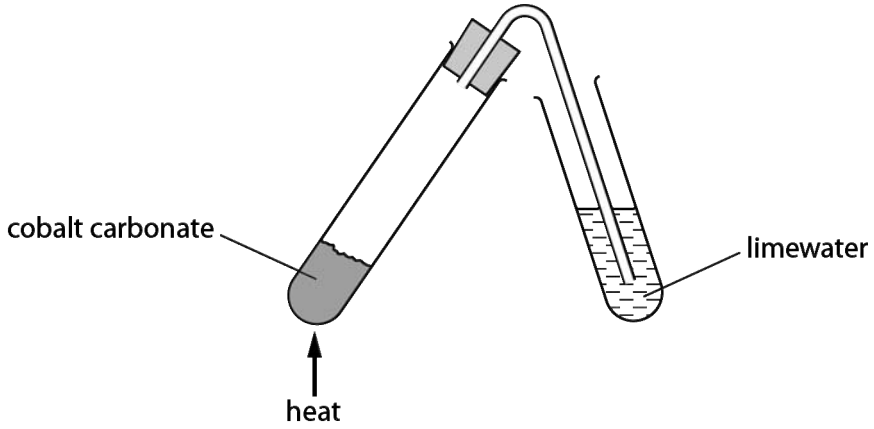
(c) Which element has an atom with only **five** electrons in its outer shell?

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

[Total: 3]

6 Beth investigates the thermal decomposition of cobalt carbonate.

Look at the diagram. It shows the apparatus she uses.



She measures the mass of the solid cobalt carbonate before heating.

She also measures the mass of the solid left after heating.

Look at her results.

	mass in grams
solid cobalt carbonate before heating	2.21
solid left after heating	1.39

During the heating the limewater turns milky.

(a) Explain why there is a change in mass of the solid cobalt carbonate during the heating.

.....

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

(b) Explain why the heating of cobalt carbonate is an example of thermal decomposition.

.....

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

(c) Construct the **word** equation for the thermal decomposition of cobalt carbonate.

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

(d) Beth uses the internet to find out about other metal carbonates.

She finds out the temperature needed to decompose different carbonates.

Look at the table. It shows these temperatures.

carbonate	temperature needed to decompose carbonate in °C
copper carbonate	375
iron(III) carbonate	–25
manganese carbonate	500
zinc carbonate	400

Most carbonates need to be heated before they will decompose.

Explain which carbonate will decompose **without** being heated by a Bunsen burner.

Choose from the carbonates in the table.

.....

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

[Total: 4]

7 Many scientists helped to develop the theory of atomic structure in the early 1900s.

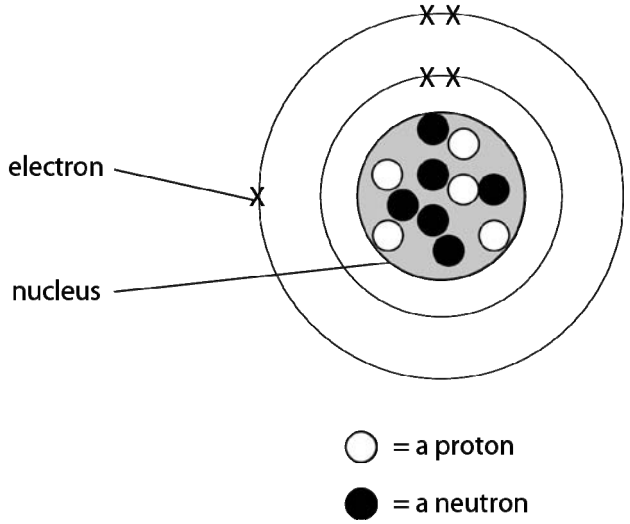
A scientist called Thomson discovered the electron.

Another scientist called Rutherford had the idea of atoms having a nucleus.

A third scientist called Bohr had the idea of electron shells.

Look at the diagram.

It shows the structure of an atom with a nucleus, electrons and electron shells.



(a) What is the electrical charge on an electron?

Choose from:

negative **neutral** **positive**

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

(b) Explain why the nucleus of an atom has a positive charge.

.....

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

(c) Explain why the **atomic** number of this atom is 5 and the **mass** number is 11.

.....

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.....

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

(d) The scientists Thomson, Rutherford and Bohr told other scientists about their ideas about atoms.

Suggest how and explain why they told other scientists.

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.....

.....

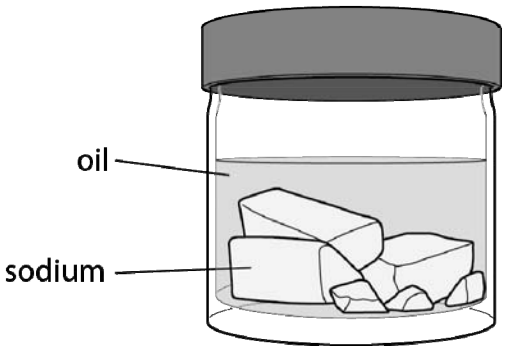
..... **[2]**

[Total: 6]

8 This question is about Group 1 elements such as sodium and rubidium.

(a) Look at the diagram.

It shows how sodium is stored.



The sodium is covered with oil.

Write down **two** reasons why sodium must be stored under oil.

.....

.....

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

(b) Group 1 elements, such as sodium, react with water.

Sodium hydroxide (NaOH) and hydrogen are made.

Construct the **balanced symbol** equation for the reaction between sodium and water.

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

(c) Look at the table. It shows some information about the elements in Group 1.

element	atomic symbol	atomic number	melting point in °C	density in g/cm^3	atomic radius in pm
lithium	Li	3	181	0.53	152
sodium	Na	11	98	0.97	182
potassium	K	19	64	0.86	227
rubidium	Rb	37			

The atomic number increases down the group.

It is difficult to predict the density of rubidium.

It is easier to predict the melting point and atomic radius of rubidium.

Explain why rubidium's melting point and atomic radius are easier to predict than its density.

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

[Total: 6]

9 Titanium, Ti, atomic number 22, is used to make the wings of some aeroplanes.

Predict four physical properties of titanium.

Explain why you make your predictions and relate the properties to the use of titanium in making aeroplane wings.

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

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

[Total: 6]

Section C – Module P4

10 This question is about electricity.

(a) Colin is wiring a plug connected to a fridge.

The earth wire is connected to the conducting metal casing of the fridge.

Colin thinks that the **brown** wire should be connected to the earth connection.

Is he correct?

answer .....

Explain what will happen as a result of Colin's wiring.

.....

.....

.....

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

(b) Sally's electric hairdryer is double insulated.

It has only two wires.

Which **two** wires are connected to the hairdryer?

Choose from

blue and brown

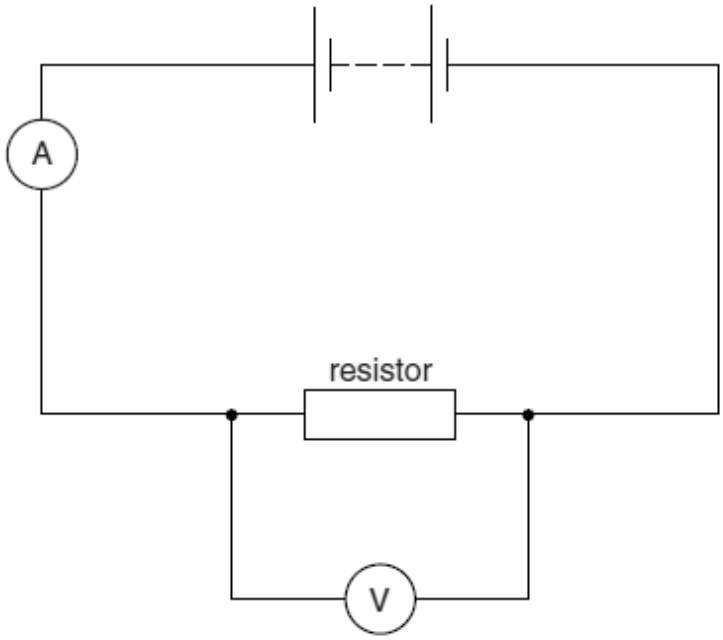
blue and green/yellow

brown and green/yellow

brown and red

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

(c) **(i)** Phil makes the following circuit.



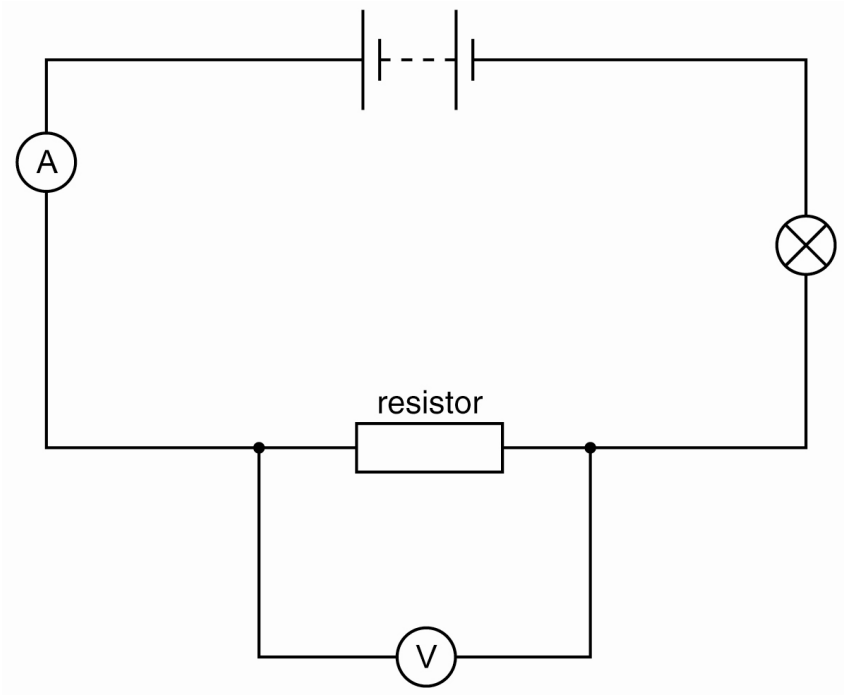
Phil adds a second resistor to the circuit. The resistance is doubled.

The voltage is kept constant.

What happens to the current?

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

(ii) Phil adds a bulb to his circuit.



He wants to change the brightness of the bulb but he needs to make sure the bulb is not damaged.

He could do this by changing or adding components.

Describe the components he could change or add. Explain how this makes a difference.

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.....

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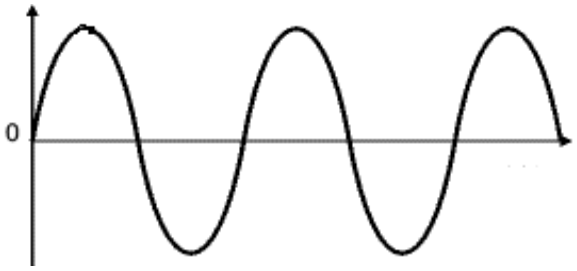
..... **[3]**

[Total: 7]

11 (a) Ultrasound is a longitudinal wave.

Look at the diagram of an ultrasound wave.



The wavelength of the wave is made shorter but the amplitude remains the same.

Draw a diagram of this wave.

[1]

(b) Ultrasound is used in **medicine**.

Write about **one** use for ultrasound and why it is used.

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

(c) Technetium-99 is a radioactive material. It is used as a medical tracer.

Technetium-99 emits gamma radiation and has a half-life of a few hours.

Give **two** reasons why technetium is a suitable medical tracer.

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.....

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

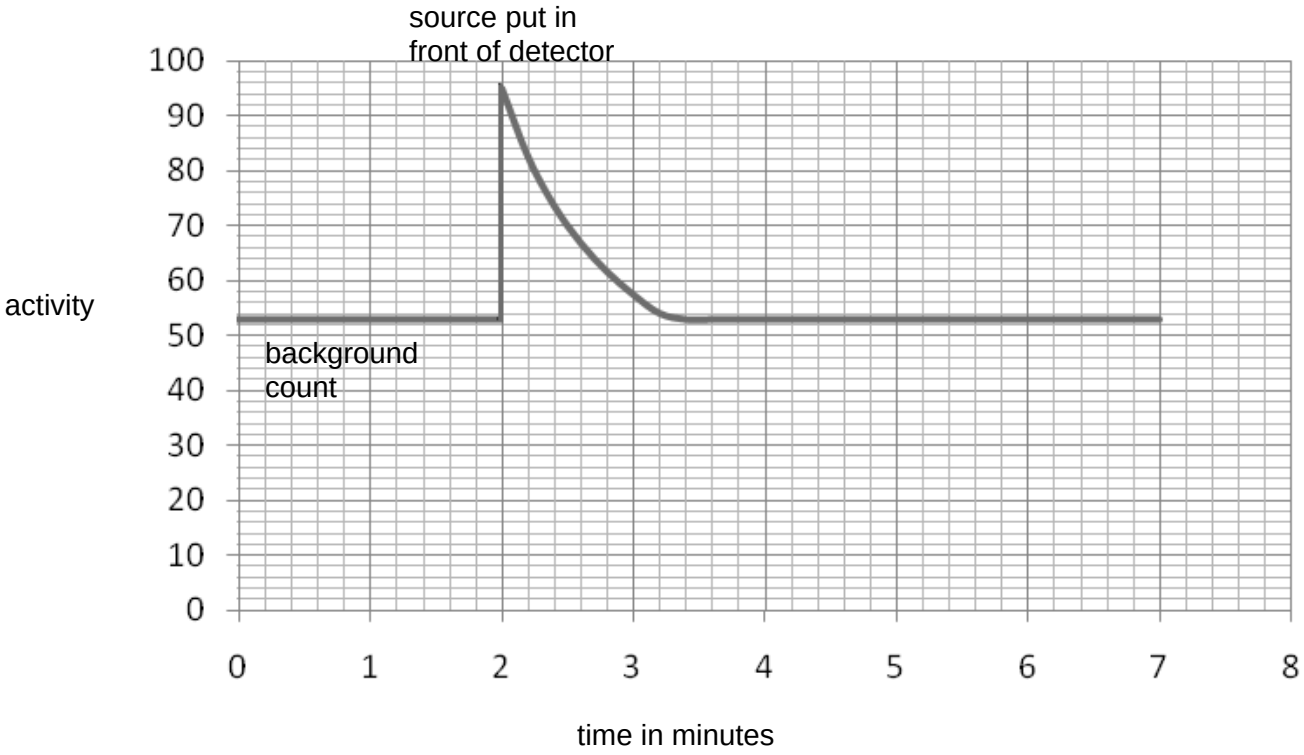
[Total: 5]

12 This question is about nuclear radiation and radioactivity.

Riswan is doing an experiment to see how the radioactivity of a source changes over time.

He wants to measure the half-life of the radioactive source.

Look at his data on the graph.



(a) What does the activity measure?

.....

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

(b) Write down **one** possible source of the background count on the graph.

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

(c) Riswan is trying to measure the half-life.

(i) What is meant by the half-life?

.....

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

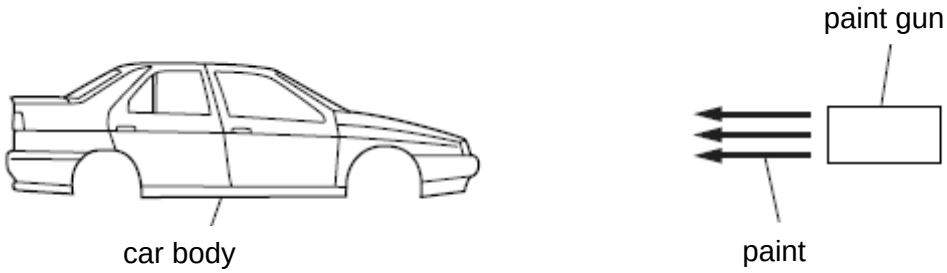
(ii) Can Riswan use this data to find out the half-life of the source? Explain your answer.

.....

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

[Total: 5]

13 Electrostatics is used in the car manufacturing industry to spray paint cars.



The paint travels to the car.

Explain how electrostatic charge is useful in spray painting **and** suggest how the manufacturers can reduce potential dangers to the workers doing the spray painting.

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

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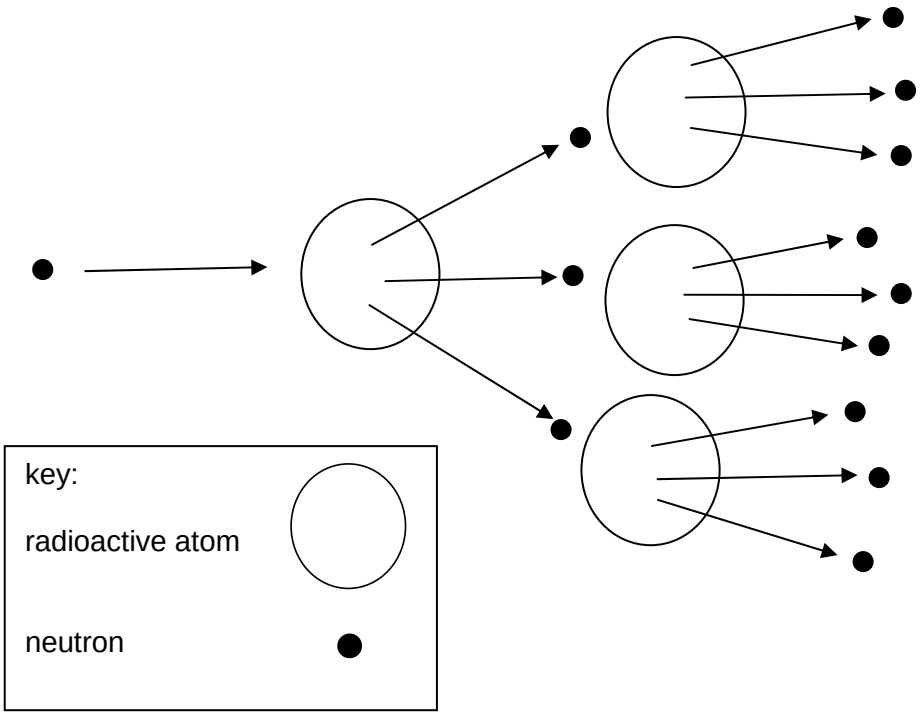
..... **[6]**

[Total: 6]

14 Nuclear power stations and nuclear bombs use a type of nuclear reaction.

Look at the diagram which represents a possible reaction.



Describe the type of reaction **and** explain how the reactions are different in a power station and a nuclear bomb.

.....

.....

.....

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

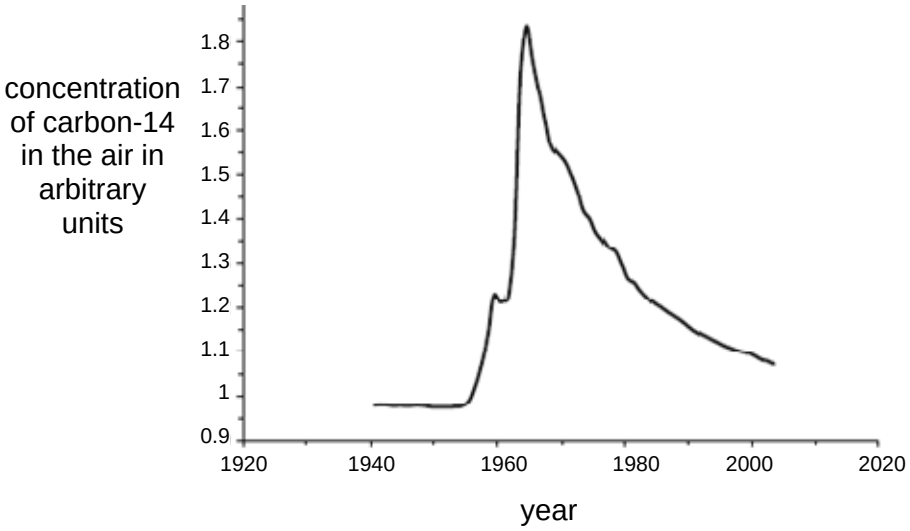
[Total: 2]

Section D

15 (a) Carbon-14 is a radioactive isotope of carbon.

It occurs naturally in small amounts.

Scientists have plotted the concentration of carbon-14 in the air since 1940.



Testing of nuclear bombs started in 1955. The testing was banned in 1963.

Scientists have used this graph to conclude that testing nuclear bombs increased the background radiation level.

How does the graph support this conclusion?

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.....

.....

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

(b) Teeth trap small amounts of carbon-14 when they are formed.

Scientists use the amount of carbon-14 trapped in a tooth to estimate when it was formed.

Ian's tooth contains the equivalent of 1.05 arbitrary units of carbon-14.

The graph in **(a)** suggests that the year Ian's tooth was formed was 1957.

Fred's tooth contains the equivalent of 1.22 arbitrary units of carbon-14.

Use the graph to suggest why it is harder to estimate when Fred's tooth was formed.

.....

.....

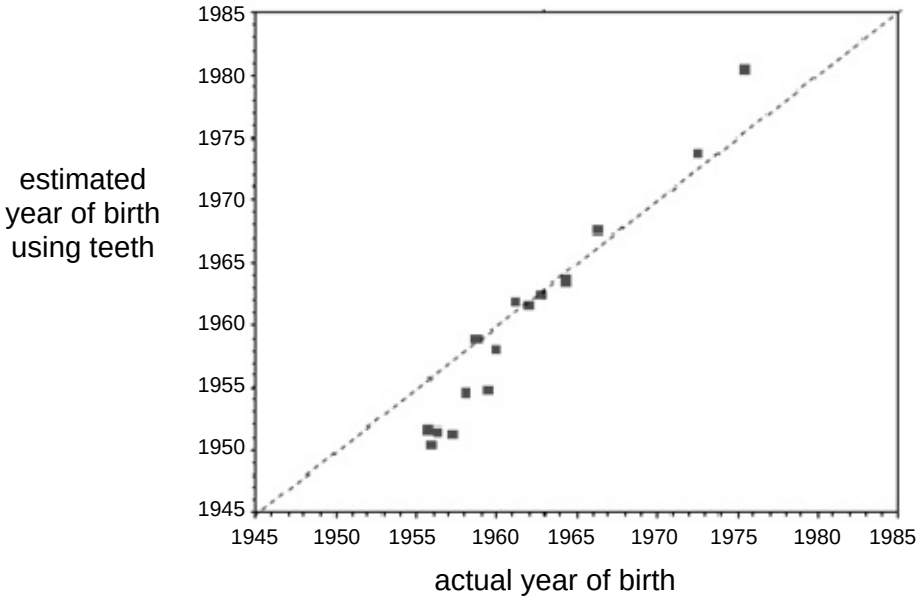
..... **[2]**

(c) The concentration of carbon-14 can be used to estimate the dates of birth of people.

Scientists have used this method on teeth from people of different ages.

They have plotted their results on a graph.

Look at the graph.



(i) How can you tell that more than 10 teeth were tested?

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

(ii) What does the graph show about the scientists' estimates?

.....

.....

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

(iii) How could the scientists improve their estimates?

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

test more teeth from older people	☐
test more teeth from people of different ages	☐
plot the dates in months not years	☐

Explain your answer.

.....

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

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

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PERIODIC TABLE

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						

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.

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RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

ADDITIONAL SCIENCE B

B722/01

Unit B722: Additional Science modules B4, C4, P4 (Foundation Tier)

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 20 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant – applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg mark scheme shows 'work done in lifting / change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his / her response, examiners should accept the alteration.

6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	(a)		because there is no light underground / AW (1) so no need for chloroplasts for photosynthesis (1)	2	
	(b)		absorb water (1) absorb minerals (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
2	(a)		because it is warmer and there is more sunlight (in Australia) (1) so more / faster photosynthesis (1) and the glucose / starch produced by photosynthesis can be used for growth (1)	3	**answers must link conditions to increased photosynthesis and to increased growth for full credit** **allow** reference to warmer temperature increasing the rate of chemical reactions (1)
	(b)		insecticides / pesticides (1) BUT use insecticides / pesticides to kill insects (2) predators / biological control / suitable example (1) BUT predators / biological control / suitable example to eat the insects (2) **max two**	2	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
3	(a)		idea of two samples set up one with bacteria killed and one sample untreated (1) samples left for specified time in a sealed container / in controlled conditions (1) method of identifying positive result for decay in untreated samples (1)	3	**allow** example of method to kill the bacteria in control sample eg heating (1) **allow** example of conditions under which sample kept eg in a tube with a bung in the top (1) **allow** examples of positive result eg can see mould growing / loss in mass due to decay (1)
	(b)	(i)	oxygen / tick in 4th box (1)	1	
		(ii)	moisture / warmth (1)	1	**allow** water / heat / temperature **allow** pH **allow** (coarse stone) filter
	(c)	(i)	to release minerals in the sewage (used by plants for growth) / AW (1)	1	**allow** prevent contamination of fields (1) **allow** to remove parts of sewage which will not decompose (1)
		(ii)	trying to produce as much food as possible from the land / plants / animals available (1)	1	
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
4	(a)		**Level 3** Answer applies knowledge of factors that affect transpiration to draw conclusions which correctly compare the effects of increased air movement **and** increased humidity on the rate of transpiration, supported by calculations of percentage loss. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Answer applies knowledge of transpiration to correctly describe the effects of increased air movement **and** increased humidity on the rate of transpiration shown in the experimental data, supported by calculations. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Answer applies knowledge of transpiration to correctly describe the effect of **either** increased air movement **or** increased humidity on the rate of transpiration, using some data from the table. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • reference to what each experiment is testing ie A = natural air movement + natural humidity therefore control, B = high air movement, C = high humidity • in **A**: mass of water lost = 7.1g, % mass lost = 16.7% • in **B**: mass of water lost = 10.6g, % mass lost = 24.3% • in **C**: mass of water lost = 0.8g, % mass lost = 1.8% • increased air movement increases rate of transpiration • increased humidity decreases rate of transpiration • reference to comparing result from B-A against C-A to compare the effects • positive effect of increased air movement (24.3 – 16.7 = 7.6) is less than negative effect of increased air humidity (1.8 - 16.7 = -14.9)

Question			Expected answers	Marks	Additional guidance
4	(b)		(control) to show loss in mass is due to plant alone / to show loss in mass is only due to transpiration (1)	1	
	(c)		same starting mass / controlled room temperature / controlled light intensity / same type of plant / same size plant (1)	1	**allow** same surface area of leaf
	(d)		xylem (1)	1	
			Total	**9**	

Question			Expected answers	Marks	Additional guidance
5	(a)		magnesium (1)	1	
	(b)		iodine (1)	1	
	(c)		nitrogen (1)	1	
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
6	(a)		because carbon dioxide is given off (1)	1	
	(b)		because when heated it breaks down / when heated one substance makes at least two substances / when heated changed into simpler substances (1)	1	
	(c)		cobalt carbonate → cobalt oxide + carbon dioxide (1)	1	**allow** $CoCO_3 \rightarrow CoO + CO_2$
	(d)		iron(III) carbonate because -25^{o}C is less than room temperature / AW (1)	1	**allow** iron(III) carbonate because you have to cool it to get to -25^{o}C (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
7	(a)		negative (1)	1	if answer line is blank allow correct answer circled, underlined or ticked
	(b)		because the protons are positive (and the neutrons are neutral) (1)	1	**allow** because there are no negatively charged electrons in the nucleus only positive protons and neutral neutrons (1)
	(c)		atomic number is 5 because nucleus has 5 protons (1) mass number is 11 because there are 11 particles in the nucleus (1)	2	**allow** mass number is 11 because there are 5 protons and 6 neutrons (1)
	(d)		they told others through: use of conferences / use of books / use of journals (1) telling others allowed: peer review by other scientists/ evaluation/ checking of their work/ repeating of their experiments by other scientists/other scientists to develop their work (1)	2	**allow** they publish their results (1) **ignore** telephone / internet / television / video
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
8	(a)		**any two from** stops reaction with water / stops reaction with moisture (1) stops reaction with air / oxygen (1) very reactive metal / stops it corroding (1)	2	**allow** stops reaction with moist air (2)
	(b)		$2Na + 2H_2O \rightarrow 2NaOH + H_2$ correct formulae (1) correct balancing (1)	2	**allow** = sign for arrow **not** and or & for +
	(c)		melting point and atomic radius have steady trends so you can predict the next value but, density does not have a steady trend so you cannot predict if next number is higher or lower (2) **OR** melting point decreases and atomic radius increases /density does not have a trend AW (1)	2	**allow** description of trends for melting point and atomic radius instead of general statements eg melting point decreases steadily and atomic radius increases steadily **allow** use of term pattern instead of trend **if answer does not compare melting point and atomic radius with density then limited to 1 mark**
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
9	✎		**Level 3** Four properties of titanium predicted with a clear rationale linked to titanium being a transition metal. Applies knowledge of properties to relate them to the use of titanium in aeroplane wings. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Some properties of titanium predicted with an attempt at an explanation for the choice of these properties or their relevance to use in an aeroplane. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Identification of titanium as a metal and at least two correct properties but no reasons given. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • identification of titanium as a metal • identification as a transition element using its position in the Periodic table • link that transition elements are metals • physical properties – hard, good thermal conductor, good electrical conductor, lustrous, sonorous, high density, high melting point, high boiling point, high tensile strength examples of relating properties to use in aeroplanes • idea of low density since it is used for an aeroplane and will require less force to lift • idea of strong to be able to be used as a wing so can withstand forces • idea of malleable so it can be made into sheets **allow** does not react with water / does not rust **ignore** solid / colour of metal / heavy / light **not** properties opposite to list above / magnetic
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
10	(a)		No (no mark) the brown is live wire so this would mean that the fridge will not work and the casing/fridge would become live if brown was connected (2) **OR** the brown is live wire / green yellow is the correct earth wire / AW (1)	2	if answer is 'yes' no marks **answer must link identification of brown wire to effect on the fridge to gain full credit** **allow** the green-yellow is the correct earth wire but if this is connected to the live connection the casing/fridge would become live (2)
	(b)		blue and brown (1)	1	if answer line is blank **allow** correct answer ticked circled or underlined
	(c)	(i)	(as resistor is in series the current) halves /1.5 (A) (1)	1	**ignore** just falls / AW
		(ii)	Protect bulb by: fuse / circuit breaker to protect the lamp **if** current gets too high (1) increase brightness by: add more cells / batteries which increases voltage / higher current flows (1) remove resistor already in circuit so higher current flows (1) use variable resistor **to** vary the brightness by varying the current (1)	3	**answers must link component to how this affects the current/voltage/bulb for each marking point** **allow** use lower (value) resistor (1) **allow** description of variable resistor eg decrease length of wire/increase thickness of wire / ora (1)
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
11	**(a)**		diagram correctly drawn to show shorter wavelength (1)	1	**not** any change in amplitude
	(b)		scans / pregnancy scan / AW (1) to check development of foetus / (unborn) baby (1) **OR** blood flow measurements (1) to check circulation system / heart is pumping correctly (1) **OR** breaking (kidney) stones (1) so they can pass out the body easily / avoids need for surgery or general anaesthetic (1)	2	**allow** examples of foetal development eg check heart or brain is normal (size) (1) **allow** look for tumours (1) to target treatment (1) **allow** cleaning (medical) equipment (1) so that idea that particles are removed (1) **allow** to treat muscle injury (1) so allows quicker healing process (1) **allow** cancer treatment or HIFU (1) as avoids need for surgery or general anaesthetic / chemotherapy or radiation (1)
	(c)		because it emits gamma, which penetrates the skin, it will be possible to trace it through the skin (1) because it has a short half-life it will, decay quickly / stop producing ionizing radiation quickly, so will minimise damage to tissues/risk (1)	2	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
12	(a)		the number of nuclear decays emitted (1)	1	**allow number of nuclear decays detected** (1) **ignore** idea of per second or per minute
	(b)		(background radiation from) rocks / cosmic rays (1)	1	**allow** reference to (waste from) hospitals / industry (1) **ignore** just nuclear power stations
	(c)	(i)	the time taken for the activity of the source to halve (1)	1	**not** just 'it halving' **allow** time for the activity to decrease by factor of 2 (1)
		(ii)	no (no mark) because it reaches the background radiation level before it halves (2) **but just** (activity) does not halve (1) **OR** idea of line levelling out (before it halves) (1)	2	**allow** higher level correct quantitative answers e.g. starts with an activity of 95 and never falls below 50 (1)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
13	✎		**Level 3** Detailed explanation of how charge is useful, in terms of paint droplets repelling and car attracting, and including the effect on the end result, and applies understanding of charges to explain how dangers could be reduced. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Limited explanation of how charge is useful, using the idea of opposite charges attracting. Applies understanding of charges to give some suggestion of how dangers could be reduced. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** An incomplete answer explaining few aspects of the process. Dangers identified in terms of risk of shock from electrical current. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • paint gun charged • car body earthed / opposite charge to paint • paint charged by paint gun • droplets all have same charge • (paint) droplets or particles repel/fine mist formed then • paint attracted to car/body/object • all of car painted including 'shadows' • even coat produced / no runs in paint and • risk of large charge flowing to earth through people • results in an electric shock • need to isolate charge • insulating footwear could reduce dangers • risk of inhaling vapour from paint • wearing a mask over the nose and mouth **allow** answers in terms of paint positive / car negative ORA **ignore** reference to nice finish **ignore** paint sticks to car
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
14			idea it is (a model of) a chain reaction (1) idea that the reaction is controlled in a nuclear power station **and** is out of control in a bomb (1)	2	**allow** fission
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
15	(a)		**any three from** idea that before testing started concentration levels of carbon-14 between 1940 and 1955 relatively constant showing that no other factor affected the levels (1) level increases (significantly/rapidly) between 1955 and 1963 which is during the testing of nuclear bombs (1) after 1963, levels start to decrease when testing stopped (1) makes link between more carbon-14 and increased background radiation level (1)	3	**allow** concentration of carbon-14 at 1 arbitrary unit between 1940 and 1955, which increases to 1.9 at its peak and then starts to decrease again after 1963 / AW (1)
	(b)		concentration level of carbon-14 'fluctuates' at 1.22 units / there is more than one year on the graph at 1.22 units (1) so cannot be certain which year 'value' to choose (1)	2	**allow** graph indicates two different years one in 1960 and one in 1985

Question			Expected answers	Marks	Additional guidance
	(c)	(i)	Because there are more than 10 points plotted on the graph (1)	1	
		(ii)	**any two from** quite accurate / reliable / close to actual date in middle of graph (1) older teeth are estimated as being too old (1) younger teeth are estimated as being too young (1)	2	**allow** idea that not all the estimates are accurate (1) **allow** worse when the teeth are older or younger (1) **allow** not so accurate / not reliable on older teeth or younger teeth (1)
		(iii)	test more teeth from people of different ages (1) Idea that estimates are better when based on more data (1)	2	**allow** because graph shows gaps in the data (1)
			Total	**10**	

Assessment Objectives Grid (AO)

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)		2		**2**
1(b)	2			**2**
2(a)		3		**3**
2(b)	2			**2**
3(a)	3			**3**
3(b)(i)	1			**1**
3(b)(ii)	1			**1**
3(c)(i)		1		**1**
3(c)(ii)	1			**1**
4(a) ✎		4	2	**6**
4(b)		1		**1**
4(c)		1		**1**
4(d)	1			**1**
5(a)		1		**1**
5(b)	1			**1**
5(c)		1		**1**
6(a)		1		**1**
6(b)	1			**1**
6(c)		1		**1**
6(d)		1		**1**
7(a)	1			**1**
7(b)		1		**1**
7(c)		2		**2**
7(d)	2			**2**
8(a)	2			**2**
8(b)	1	1		**2**
8(c)		1	1	**2**
9✎	3	2	1	**6**
10(a)	1	1		**2**
10(b)	1			**1**
10(c)(i)		1		**1**
10(c)(ii)	1	2		**3**
11(a)		1		**1**
11(b)	2			**2**
11(c)		2		**2**
12(a)	1			**1**
12(b)	1			**1**

Question	AO1	AO2	AO3	Total
12(c)(i)	1			**1**
12(c)(ii)			2	**2**
13	4	2		**6**
14		2		**2**
15(a)			3	**3**
15(b)			2	**2**
15(c)(i)			1	**1**
15(c)(ii)			2	**2**
15(c)(iii)			2	**2**
Totals	**34**	**35**	**16**	**85**

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