OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

ADDITIONAL SCIENCE B

B722/02

Unit B722: 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

Duration: 1 hour 30 minutes

Other Materials Required:
- Pencil
- Ruler (cm/mm)

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.

For Examiner's Use

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

$KE = ½ mv^2$

momentum = mass × velocity

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

GPE = mgh

$mgh = ½ mv^2$

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

Answer **all** questions.

Section A – Module B4

1 Look at the photograph.

It shows two palm trees.

(a) During photosynthesis, the trees make glucose.

The trees change the glucose into other substances, such as starch for storage.

(i) Describe **one other** substance into which trees change glucose and what the new substance is used for.

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

(ii) Give **two** reasons why soluble glucose is turned into insoluble **starch** for storage.

.....

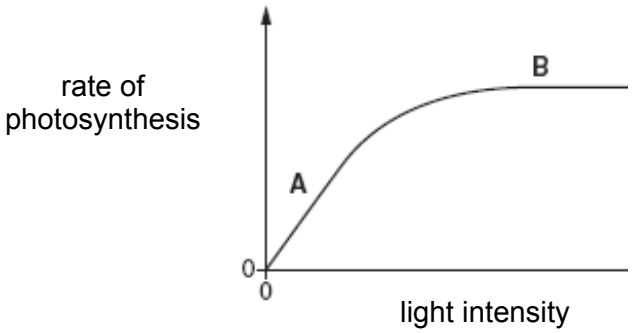
.....

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

(b) Look at the graph.

It shows the effect of increasing light intensity on the rate of photosynthesis.

The concentration of CO_2 is kept at 0.04% throughout the experiment.



(i) Explain the shape of the graph.

.....

.....

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

(ii) Julie says that if the CO_2 concentration is increased, the graph will be steeper at **A** and level off at the same value at **B**.

Niall says that if the CO_2 concentration is increased, the graph will be the same at **A** but will level off at a higher value at **B**.

Who is correct? Explain your answer.

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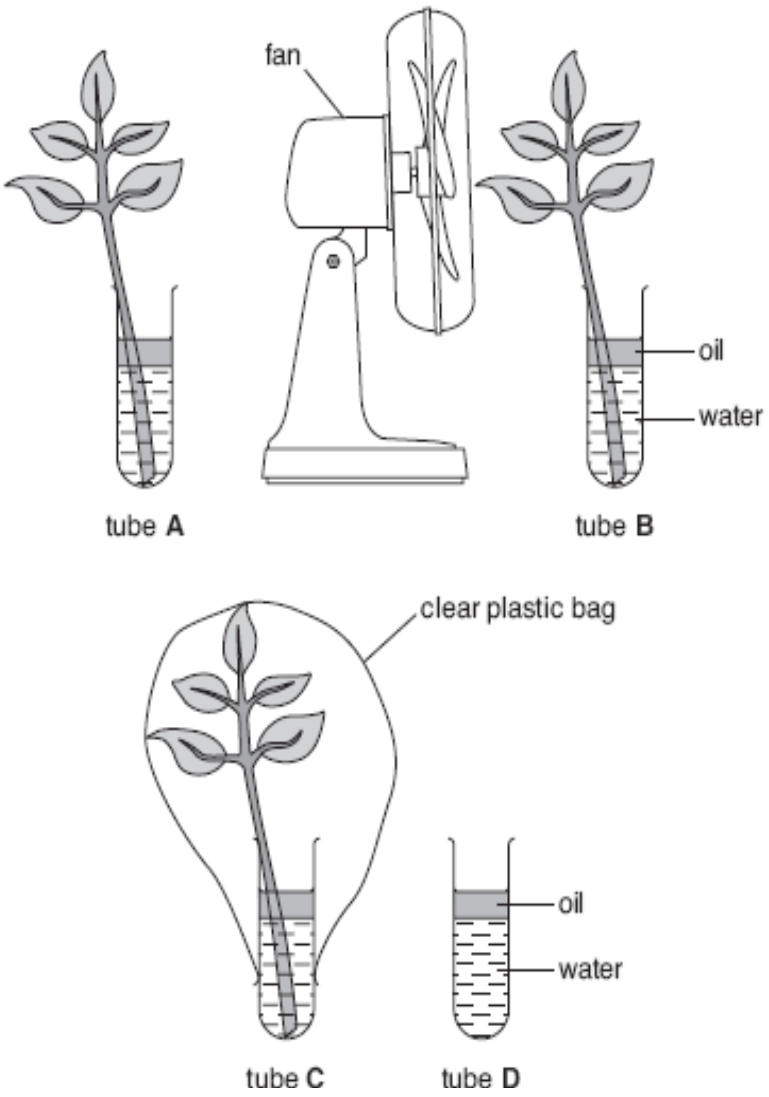
..... **[2]**

[Total: 8]

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

Write down the name of these vessels.

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

[Total: 7]

3 Australia produces a lot of sugar cane.

Insects eating the sugar cane affect the production of the crop.

(a) Farmers use pesticides to kill the insects.

The pesticides cause the death of some animals higher in the food chain.

Explain why this happens.

.....

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

(b) Cane toads were introduced to feed on the insects.

Cane toads are much bigger than the native Australian toads. Cane toads are also poisonous.

The introduction of cane toads was **not** a success.

Suggest **two** reasons why.

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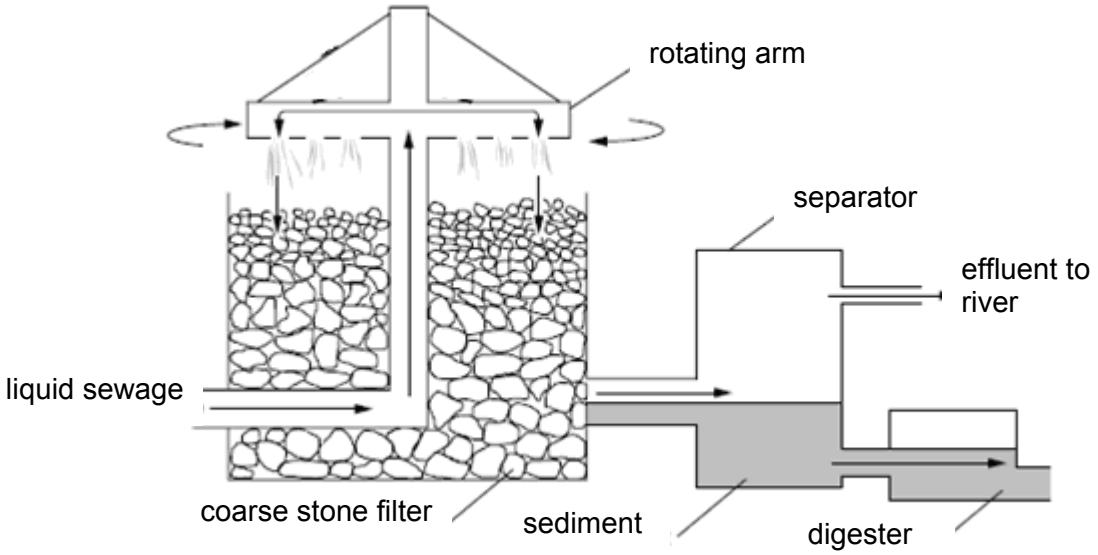
..... **[2]**

[Total: 4]

4 Look at the diagram. It shows part of a sewage works.



(a) Sewage is broken down (decayed) by microbes such as bacteria.

Sewage is broken down more quickly in the summer than in the winter.

Give **two** reasons why.

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.....

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

(b) After sewage has been treated it can be used as a fertiliser.

(i) Fertilisers provide minerals containing elements that are needed for healthy plant growth.

Two of these elements are nitrogen and magnesium.

Explain why plants need each element.

nitrogen .....

.....

magnesium .....

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

(ii) Explain how minerals are taken into the root hairs of plants.

.....

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

[Total: 6]

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**.

The Periodic Table on the back page may help you.

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

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

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

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

(c) Write down the **name** of the element which has the electronic structure 2.8.8.2.

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

[Total: 3]

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

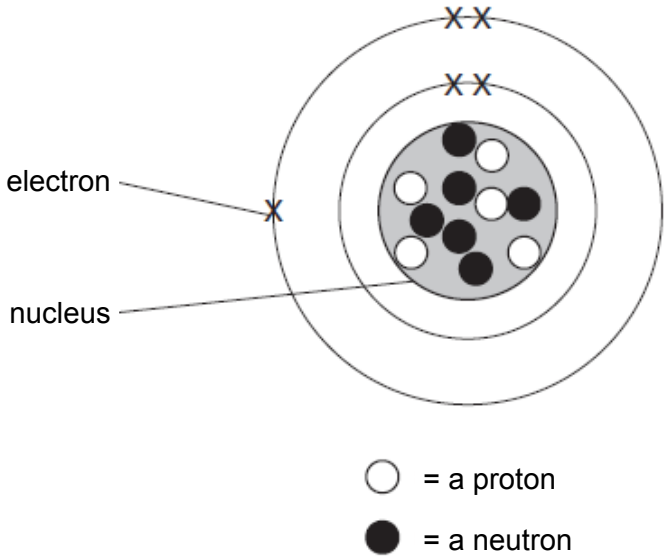
A scientist called Thomson discovered the electron.

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

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

(b) 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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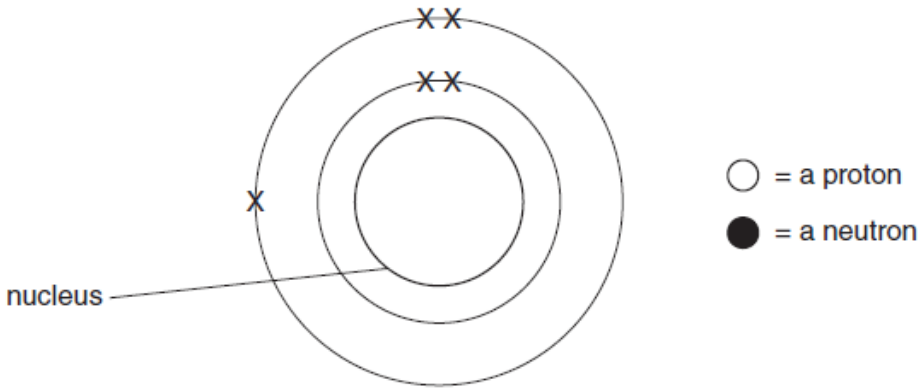
..... **[2]**

(c) Finish the diagram to show an isotope of the element above.



[1]

[Total: 4]

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

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

element	atomic symbol	atomic number	melting point in ^{o}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		1.53	

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

Sodium hydroxide, NaOH, and hydrogen are made.

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

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

(b) The reaction of rubidium with water is more violent than the reaction of sodium with water.

Rubidium is more reactive than sodium.

Explain why.

Use ideas about electrons.

.....

.....

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

(c) Describe and explain the relationship between atomic radii and melting points of the elements in Group 1. Include in your answer predictions for the atomic radius and melting point of rubidium.

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

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

[Total: 10]

8 This question is about the reaction of halogens with alkali metals.

(a) Astatine reacts with potassium.

Construct the **word** equation for this reaction.

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

(b) Chlorine reacts with sodium to make sodium chloride.

The electronic structure for chlorine is 2.8.7.

Use the 'dot and cross model' to describe the bonding in sodium chloride and in a molecule of chlorine.

You only need to include the outer shell electrons.

(i) sodium chloride

[2]

(ii) chlorine

[1]

[Total: 4]

9 River water needs to be purified before it can be used as drinking water.

Look at the table. It shows the mass of different ions in 1000g of river water.

ion	mass in g
Ca^{2+}	0.00201
Br^-	0.00197
$C\ell^-$	0.00180
K^+	0.00291
NO_3^-	0.00159
Pb^{2+}	0.00522
SO_4^{2-}	0.00481

(a) Kritica, a research chemist in a water purification factory, needs to know the percentage of lead ions in the water sample.

(i) What is the percentage by mass of lead ions, Pb^{2+}, in the river water?

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.....

percentage =..... % **[1]**

(ii) The river water is treated in the water purification factory.

Suggest why the tap water the factory makes may still contain lead ions.

.....

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

(b) Kritica tests a sample of the polluted river water with barium chloride solution.

Predict what Kritica would observe and explain why.

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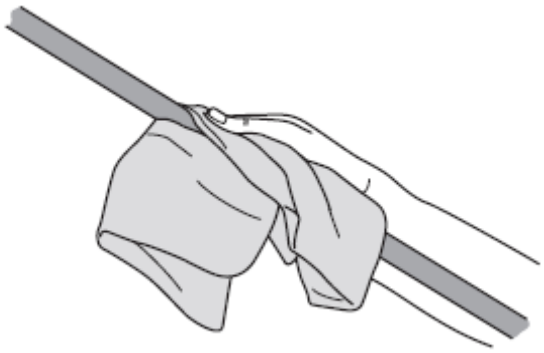
..... **[2]**

[Total: 4]

Section C – Module P4

10 (a) Nita rubs a rod with a duster.



The rod is made from an **insulating** material.

The rod becomes **negatively** charged.

Which statement is true?

A The rod has **gained neutrons** from the cloth.

B The rod has **gained electrons** from the cloth.

C The rod has **gained protons** from the cloth.

D The rod has **lost neutrons** to the cloth.

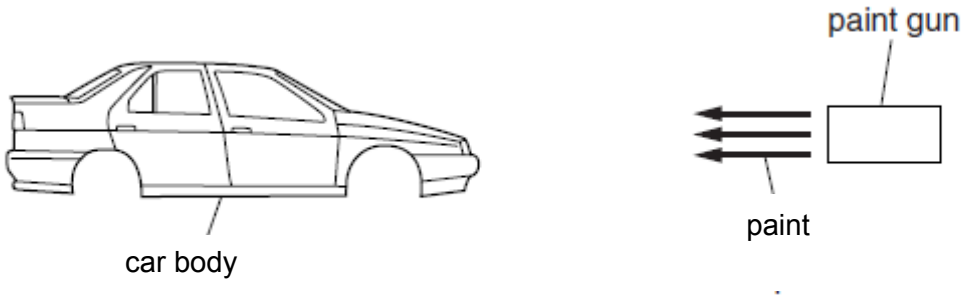
E The rod has **lost electrons** to the cloth.

F The rod has **lost protons** to the cloth.

Choose **A**, **B**, **C**, **D**, **E** or **F**.

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

(b) Electrostatics is used in the car manufacturing industry to spray paint cars.



The paint travels towards the car body.

Kevin connects the car body to the negative terminal of the power supply. He forgets to connect the paint gun to the positive terminal.

The paint does not spray evenly over the car.

Explain why.

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..... **[4]**

[Total: 5]

11 (a) Phil has a desktop computer.

It has a 5 A wire fuse in the plug.

What could be the consequence of replacing the 5 A fuse with a 13 A fuse?

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

(b) Phil also has a kettle and a hairdryer.

The kettle has three wires connecting it to the mains supply.

The hairdryer only has **two** wires connecting it to the mains supply.

The two wires are brown and blue.

Appliances with only two wires are **double insulated**.

This symbol is shown on the appliance.

Explain why a double insulated appliance does **not** need the third wire.

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

[Total: 4]

12 (a) Ultrasound is a longitudinal wave.

P is a particle in a longitudinal wave.

Look at the diagram.

How does the particle **P move** in the longitudinal wave?

Put a (ring) around the correct answer.

[1]

(b) Doctors use ultrasound for some medical scans rather than X-rays.

Give **two** reasons why ultrasound is used rather than X-rays.

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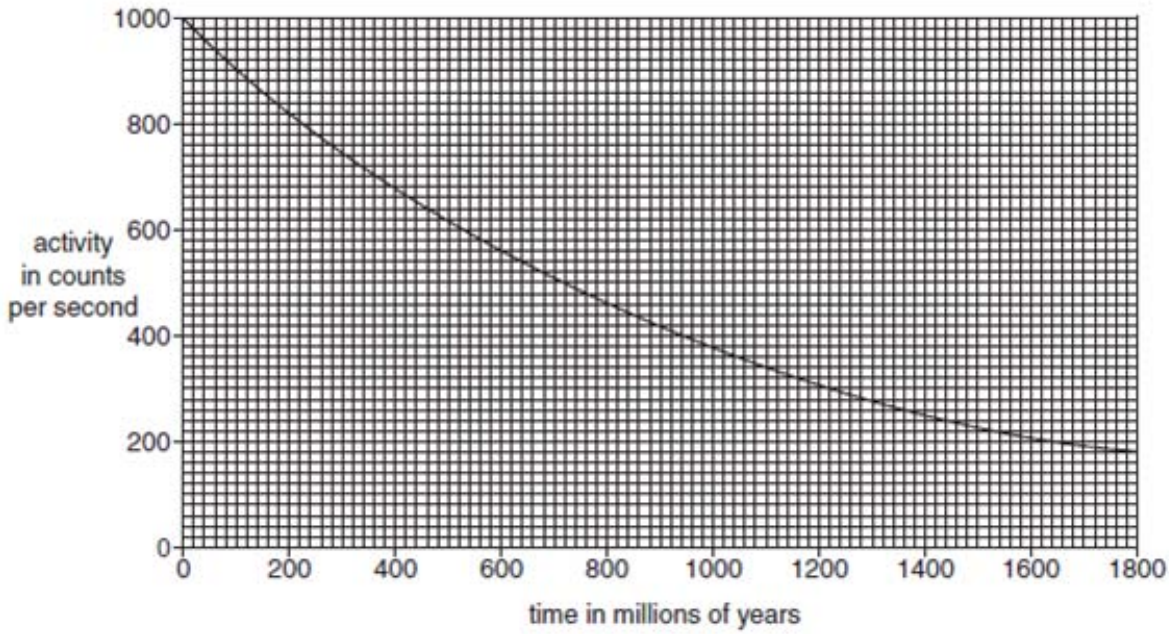
..... **[2]**

[Total: 3]

13 (a) (i) Some nuclear powers stations use uranium-235.

The graph shows how the activity of uranium-235 decreases with time.



Use the graph to work out the half-life of uranium-235.

You must draw lines on the graph to show how you calculated your answer.

.....

.....

Half-life of uranium-235 = ... million years **[2]**

(ii) Uranium is not used as a medical tracer because it is an alpha (α) emitter.

Explain one **other** reason why uranium-235 is unsuitable for use as a tracer.

.....

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

(b) The activity of a nuclear material decreases when radioactive particles are emitted.

This can be caused by the emission of an alpha (α) particle.

Complete the nuclear equation below to represent the **alpha** decay of uranium -235 (U) into thorium (Th)**.**

Put your answers on the dotted lines.

$$^{235}_{92}U \longrightarrow {}^{\text{-------}}_{\text{-------}}Th + {}^{\text{-------}}_{\text{-------}}\alpha$$

[2]

(c) Look at the data showing the sources that contribute to the average UK radiation dose.

source	contribution
rocks	50%
cosmic rays	25%
medical	15%
from inside the human body	9.5%
work-related	0.2%
other	0.3%

Stephen uses the data to conclude that rocks and cosmic rays are the only significant contributors to his radiation dose.

Is this an appropriate conclusion? Explain why.

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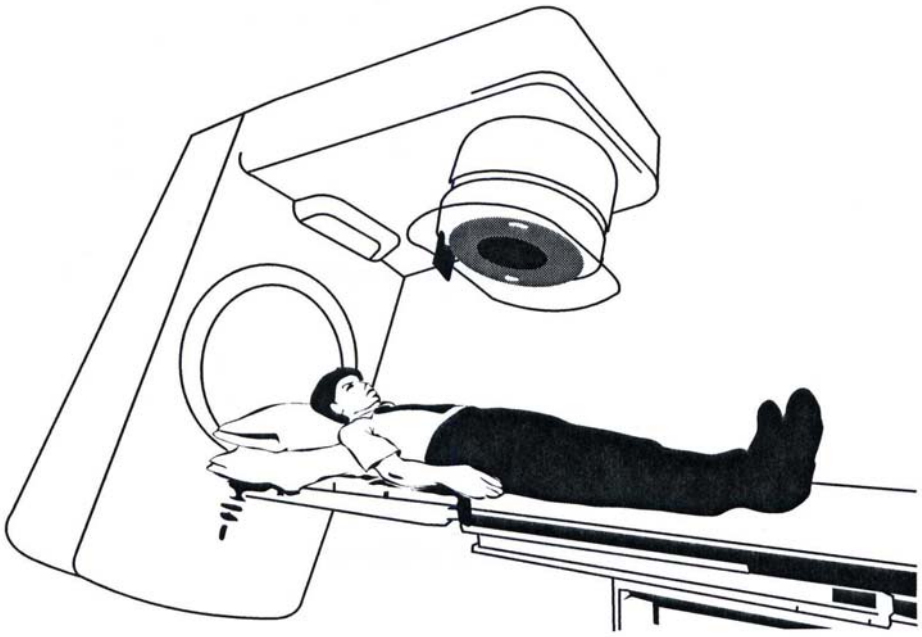
..... **[2]**

[Total: 7]

14 Doctors use gamma rays to treat cancer.

They rotate a gamma source around the patient.

Look at the picture.



Explain how the treatment works **and** the potential risks and benefits that the patient must consider before deciding whether to have the treatment.

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

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

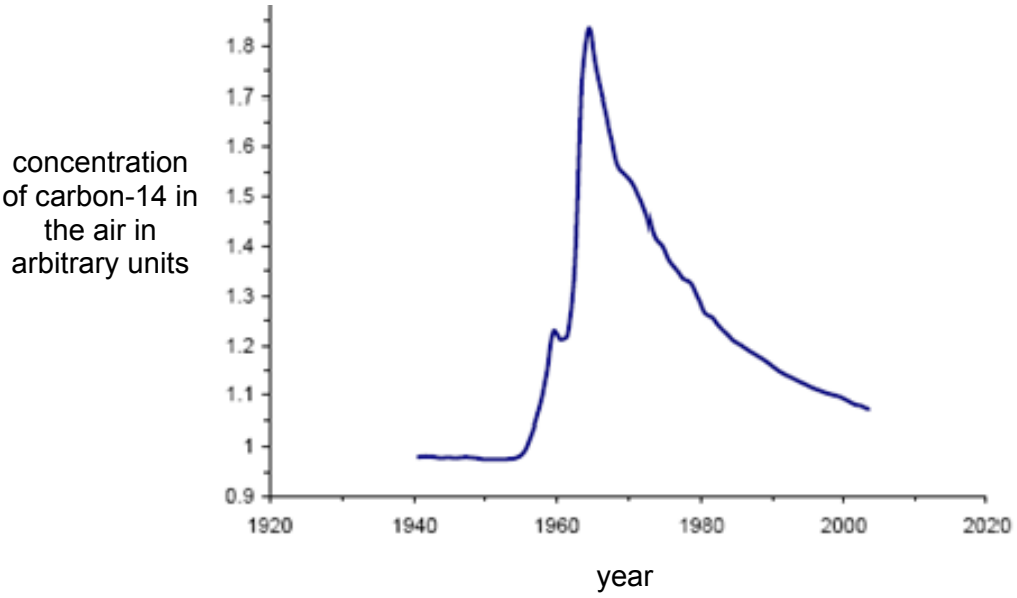
[Total: 6]

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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.....

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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.

The table shows the age of a person when different types of teeth are formed.

type of tooth	1st incisor	1st premolar	1st molar	3rd molar
age in years when tooth formed	3	7	3	14

Ian's 1st premolar tooth contains the equivalent of 1.22 arbitrary units of carbon-14.

The scientists used this information and the graph to estimate that Ian was born in 1953.

The scientists were not confident in the accuracy of this estimate.

Suggest why they were not confident and how they could improve their level of confidence.

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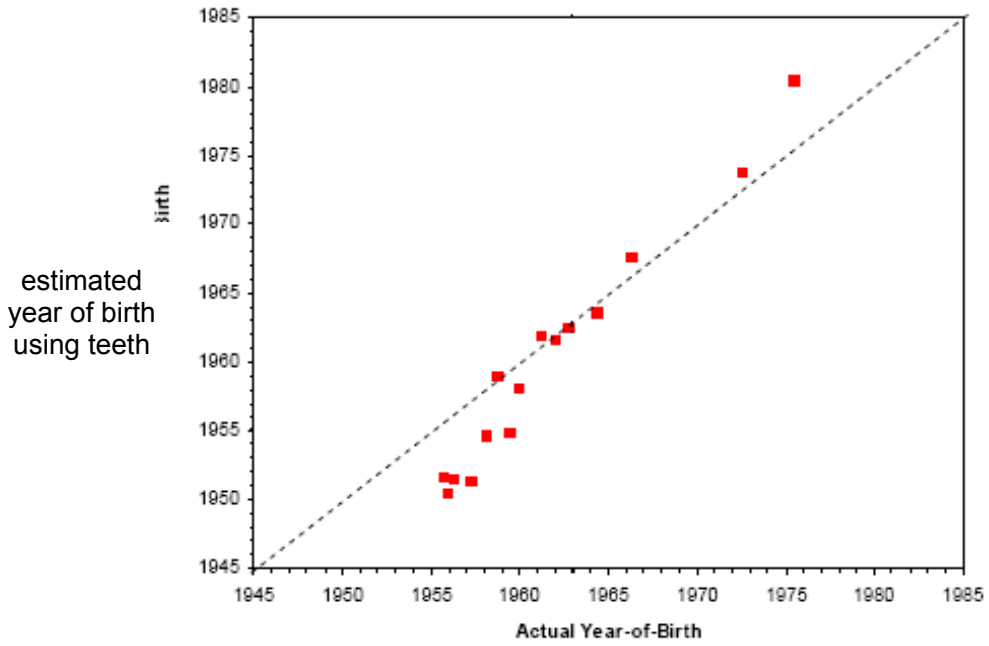
.....

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

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

They have plotted their results on a graph.

Look at the graph.



What does the graph show about the scientists' estimates?

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

(d) Carbon-14 is radioactive so it will decay.

Its half life is 5700 years.

Explain if this is likely to significantly affect the estimate of year of birth made by the scientists.

.....

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

(e) Forensic scientists use another method to find out approximately how old a person was when they died.

They look at how worn the teeth are.

Both the carbon-14 test and the 'teeth wear test' have limitations.

Put a tick (✓) or a cross (✗) in each of these boxes to show if each test works in each of these situations.

	carbon-14 test	**teeth wear test**
could be used to find out in which year a person was born		
could be used to find out where a person was born		
provides useful information on a person born before 1930		

[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 **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.

OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

ADDITIONAL SCIENCE B

B722/02

Unit B722: Additional Science modules B4, C4, P4 (Higher 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)	(i)	cellulose (1) for cell walls (1) OR fats / oils (1) for storage / water proofing / buoyancy (1) OR protein (1) for growth / repair (1)	2	**allow** other molecules eg chlorophyll / amino acids / vitamins / water / carbon dioxide plus correct use **allow** sucrose **but not** sugar use must match named molecule to award second mark but always **allow** energy / respiration / make ATP (1) **allow** makes leaves / makes new roots etc as alternative to growth **ignore** transport
		(ii)	because it does not move away to other cells (1) because it does not affect water concentration (1)	2	
	(b)	(i)	A – photosynthesis increases with increasing light because light is the limiting factor / limits rate B – light is not the limiting factor / does not limit the rate as increasing light has no effect OR CO_2 / temperature is limiting rate as increasing light has no effect (1)	2	**ignore** water

		(ii)	(Niall is correct) (no mark): at **A** CO_2 is not the limiting factor so an increase will not cause any change (1) at **B** CO_2 is the limiting factor so an increase in CO_2 will cause the rate to continue to increase until something else becomes the limiting factor (1)	**2**	
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
2	(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)
2	(b)		xylem (1)	1	
			Total	7	

Question			Expected answers	Marks	Additional guidance
3	(a)		because pesticides / animals / insects containing the pesticide are eaten by animals higher in the food chain (1) pesticides accumulate / build up / concentration increases in these animals causing death (1)	2	**allow** pesticide passes up the food chain **allow** bioaccumulation **allow** pesticides do not breakdown / are not excreted / are stored / are persistent **ignore** just 'pesticide gets stronger' **allow** if insects are killed their predators have no / less food (1) **ignore** just the statement that pesticide kills animals (in question) **BUT allow** pesticides may be directly toxic to animals other than pests eg pesticides get into lakes and kill small animals there (1)
	(b)		**any two from:** cane toads had no (natural) predators (1) cane toads did not eat the pests (1) cane toads reproduced rapidly and outcompeted native toads (1)	2	**allow** organisms that ate the cane toads died which disrupted food chains/webs (1)
			Total	4	

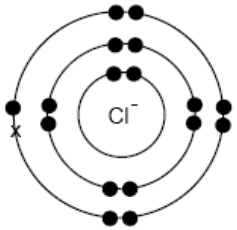
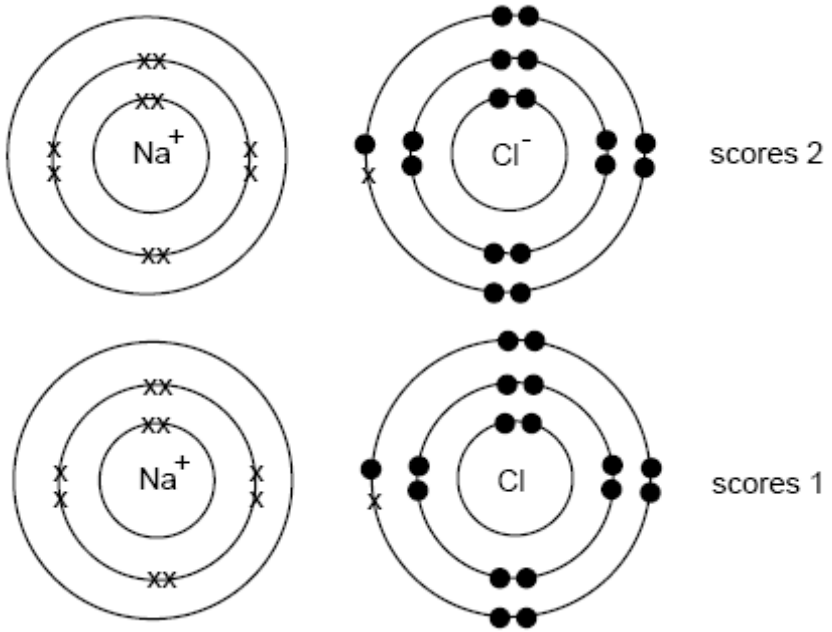
Question			Expected answers	Marks	Additional guidance
4	(a)		because microbes / bacteria reproduce more quickly at higher temperatures (1) and microbes / bacteria respire more quickly at higher temperatures (1)	2	**allow** reactions within bacteria occur at higher rates at higher temperatures
	(b)	(i)	nitrogen: (make) amino acids / proteins (1) magnesium: (make) chlorophyll (1)	2	**allow** (make) enzymes / DNA / RNA (1)
		(ii)	active transport / active uptake / uptake using energy (1) against concentration gradient / up the concentration gradient / from lower concentration / to higher concentration (1)	2	**not** osmosis **ignore** diffusion **ignore** just 'against the gradient'
			Total	6	

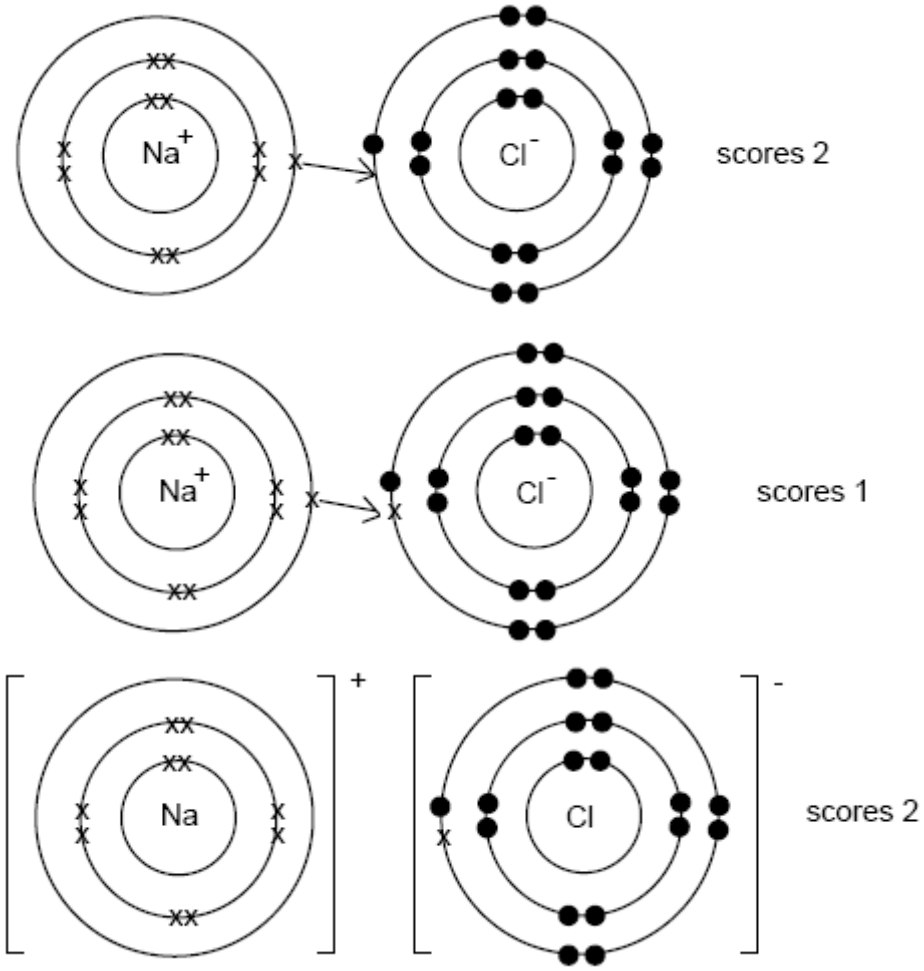
Question			Expected answers	Marks	Additional guidance
5	(a)		iodine (1)	1	
	(b)		nitrogen (1)	1	allow Mg
	(c)		calcium	1	allow Ca
			Total	3	

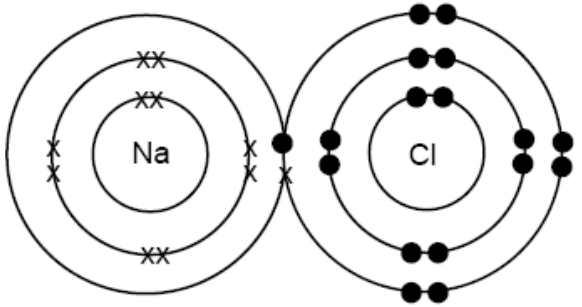
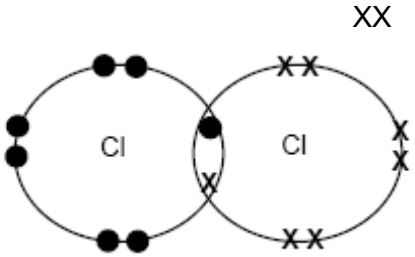
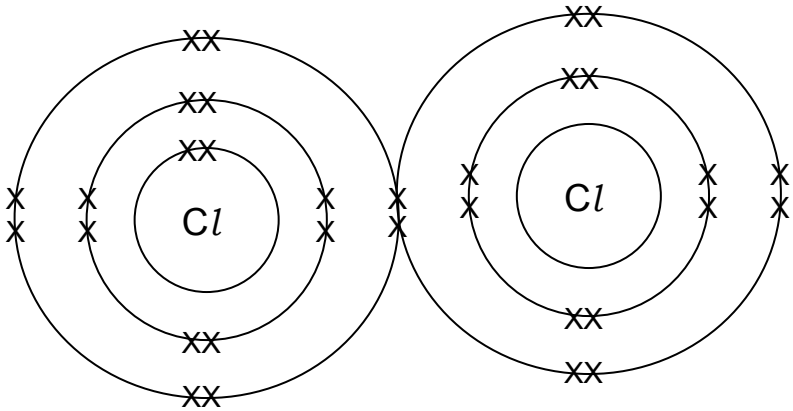
Question			Expected answers	Marks	Additional guidance
6	(a)		because in the nucleus the protons are positive and the neutrons are neutral (1)	1	**allow** because there are no negatively charged electrons in the nucleus only positive protons and neutral neutrons (1)
	(b)		they told others through: use 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
	(c)		a diagram with 5 protons and any number other than 6 neutrons (1)	1	**allow** writing in the nucleus rather than circles eg 5 protons and 5 neutrons
			Total	4	

Question			Expected answers	Marks	Additional guidance
7	(a)		$2Na + 2H_2O \rightarrow 2NaOH + H_2$ correct formulae (1) correct balancing (1)	2	**allow=** sign or arrow **not** and or & for +
	(b)		it is easier for rubidium to lose electrons when it reacts than for sodium to lose electrons because rubidium has a larger atomic radius (2) OR idea that both lose electrons when they react (1)	2	electon loss must be linked to larger atomic radius in order to gain 2 marks

Question			Expected answers	Marks	Additional guidance
	(c)		**Level 3** Description of relationships and comprehensive explanation about how atomic radii, the strength of the metallic bonding and the melting point are related. Predictions made based on evidence in table are accurate. 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** Relationship described and explanation applies understanding that melting point depends on the strength of the metallic bond. Correct predictions made based on evidence in table. 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** Limited description of the link between atomic radii and melting point and two predictions made. 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: • melting point decreases as atomic radius increases • melting point decreases because it is easier to overcome the metallic bond • because strength of metallic bond decreases as atomic radius increases • idea that metallic bond is the attraction between delocalised electrons and (closely packed) metal ions • idea that atoms lose electrons more easily down Group 1 because the attraction is weaker • melting point of rubidium is any value between 30 to 50 ^{o}C • atomic radius of rubidium 272 to 295 pm **allow** at lower levels answers that just refer to bonds between particles in a metal **ignore** anything related to the reactivity of the metals including loss of electrons and electronic structure **not** reference to covalent, ionic bonds or intermolecular forces
			Total	**10**	

Question			Expected answers	Marks	Additional guidance
8	(a)		potassium + astatine → potassium astatide (1)	1	**allow** K + At_2 → KAt
	(b)	(i)	correct charges on ions Na^+ and Cl (1) correct electronic structures 2,8 for sodium ion and 2.8.8. for chloride ion (1)  $[Na]^+$	2	alternatively mark sodium ion for charge and electronic structure (1) and chloride ion and electronic structure (1) whichever gives most marks **allow** just $[Na]^+$ for sodium ion and its electronic structure. **not** covalent NaCl extra advice is shown on the next page. 

Question			Expected answers	Marks	Additional guidance
					

Question			Expected answers	Marks	Additional guidance
					 scores 0
		(ii)	correct structure for chlorine (1) 	1	diagram shown is complete answer but can **ignore** missing inner shells, or atomic symbols. as in diagram **allow** all crosses or all dots 
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
9	(a)	(i)	% = 0.000522 (1)	1	**allow** 5.22 x 10^{-4} %
		(ii)	Purification methods do not remove soluble impurities and the lead ions may be in solution / lead ions may come from old lead pipes (1)	1	
	(b)		white precipitate (1) of barium sulfate produced which is insoluble / due to presence of sulfate ions (1)	2	
			Total	4	

Question			Expected answers	Marks	Additional guidance
10	(a)		**B** (1)	1	if answer line is blank **allow** correct answer ticked circled or underlined
	(b)		because the droplets have no charge they do not repel (1) this means that the paint does not produce mist / fine spray (1) because the paint is not charged opposite to car, the car does not attract paint (1) this means that the paint is not attracted into the shadows / not an even coat of paint (1)	4	**answers must link no charge to effect on paint to gain full credit in this question** **not** paint does not stick to car
			Total	5	

Question			Expected answers	Marks	Additional guidance
11	(a)		when current is too high for the computer, the 13A fuse will not melts / blow (1) this could result in overheating / damage / possible fire in the computer (1)	2	**both** needed **allow** power (1) **ignore** energy **not** voltage (1st answer) **not** fuse blows up / burns / snaps / leaks (2nd answer)
	(b)		third wire is for earthing or earth(ing)wire not needed (1) (because) case made of insulator or plastic so that it cannot become live (1)	2	 **allow** case does not conduct (1) OR **allow** cannot normally give shock / prevents electrocution (1)
			Total	4	

Question			Expected answers	Marks	Additional guidance
12	(a)		ring around second diagram (side to side) (1)	1	**allow** two rings around 4th + 6th arrow (1)
	(b)		because ultrasound can give image of soft tissue which x-rays cannot (1) because ultrasound does not damage cells (1)	2	**allow** ORA **allow** non ionising (1) **allow** ORA **not** just less damaging / less harmful / safer
			Total	3	

Question			Expected answers	Marks	Additional guidance
13	(a)	(i)	720 (1) **second mark for how the half-life was calculated** two acceptable horizontal lines/indications eg 1000 and 500 / 800 and 400 etc with corresponding values on the time axis indicated (1)	2	**allow** +/- 1 small square ie answer in the range 700-740
		(ii)	idea that uranium has a long half-life and so remains active in the body for too long (1)	1	
	(b)		$^{231}_{90}U \longrightarrow {}^{231}_{90}Th + {}^{4}_{2}\alpha$ both Th mass and atomic numbers correct (1) both α mass and atomic numbers correct (1)	2	
	(c)		no because medical and / or from inside the human body are not that much smaller (1) no because the data is an average and Stephen could have a particular medical condition / job (1)	2	**answers must support candidates choice to gain credit** **allow** yes because these values together make up 75% of the total (1) **allow** references to particular job eg radiographer or conditions eg cancer
			Total	7	

Question			Expected answers	Marks	Additional guidance
14	✎		**Level 3** Answer thoroughly explains how gamma is used safely and the effect of the gamma radiation on the tumour and healthy tissue. Applies understanding of the risks of radiation and the benefits of treatment to explain in detail what the patient should consider including balancing risks against benefits of the treatment and the consequences of remaining untreated. 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 explains some aspects of how gamma radiation is used and recognises the need to limit dose. Applies understanding of risks of radiation and benefits of treatments to address some risks and benefits in limited detail. 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 explanation including gamma killing cancer cells. Identifies risks or benefits of treatment. 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: • beam is fairly wide and / or relatively weak • idea that γ can penetrate body to reach the tumour • idea that γ can kill cancer(ous) cells • idea that healthy cells can be damaged • rotation with tumour at the centre • gamma rays are focussed on the tumour • tumour receives dose from all angles • gamma does not penetrate through the same healthy cells due to change of angle with rotation • dose is limited to healthy tissues/cells risks and benefits • idea that a relatively small exposure a number of times • risk of damage to healthy cells/tissue • risk of side effects from treatment • benefit of treatment curing the cancer • risk that treatment may be ineffective • risk of cancer spreading/causing death if not treated • benefit of not suffering side effects / having to spend time in hospital if not treated **allow** answers in terms of tumour / cells / tissue **reject** references to chemotherapy
			Total	6	

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)		**any one from** concentration level of carbon-14 'fluctuates' at 1.22 units / there is more than one year on the graph at 1.22 units so cannot be certain which year 'value' to choose (1) **and** idea of repeating process using concentration levels of carbon-14 in other teeth to check for consistency in predictions (1)	2	**allow** graph indicates two different years one in 1960 and one in 1985 **allow** repeating with other teeth where the value does not fluctuate (1)

Question			Expected answers	Marks	Additional guidance
	(c)		**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)
	(d)		no (no mark) because the carbon-14 will not have decayed much / AW (1)	1	
	(e)		**carbon 14 test** **teeth wear test** ✓ ✗ ✗ ✗ ✗ ✓	2	six correct = (2) four or five correct = (1)
			Total	**10**	

Assessment Objectives Grid (AO)

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)(i)	2			**2**
1(a)(ii)	2			**2**
1(b)(i)		2		**2**
1(b)(ii)		2		**2**
2(a) ✎		4	2	**6**
2(b)	1			**1**
3(a)	2			**2**
3(b)		2		**2**
4(a)	2			**2**
4(b)(i)	2			**2**
4(b)(ii)	2			**2**
5(a)	1			**1**
5(b)		1		**1**
5(c)		1		**1**
6(a)		1		**1**
6(b)	2			**2**
6(c)		1		**1**
7(a)	1	1		**2**
7(b)	2			**2**
7(c) ✎	2	2	2	**6**
8(a)		1		**1**
8(b)		3		**3**
9(a)(i)		1		**1**
9(a)(ii)	1			**1**
9(b)	1	1		**2**
10(a)	1			**1**
10(b)		4		**4**
11(a)		12		**21**
11(b)	1	1		**12**
11(c)	1	1		**2**
12(b)	2			**2**
13(a)(i)		2		**2**
13(a)(ii)		1		**1**
13(b)	1	1		**2**
13(c)			2	**2**
14 ✎	4	2		**6**

Question	AO1	AO2	AO3	Total
15(a)			3	3
15(b)			2	2
15(c)			2	2
15(d)			1	1
15(e)			2	2
Totals	3533	364	16	85

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