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EDEXCEL COMBINED SCIENCE PHYSICS: QUESTIONS BY TOPIC

Radioactivity (6)

Combined Science Physics (Foundation) Topic 6

5 questions · 55 marks · Mark schemes included

Pearson Edexcel Combined Science (9-1) Physics 1SC0, Foundation Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
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QUESTIONS

5 questions · 55 marks · lowest tariff first



9-MARK QUESTIONS

1 question in this booklet



3 (a) Figure 5 shows a diagram of a helium atom.

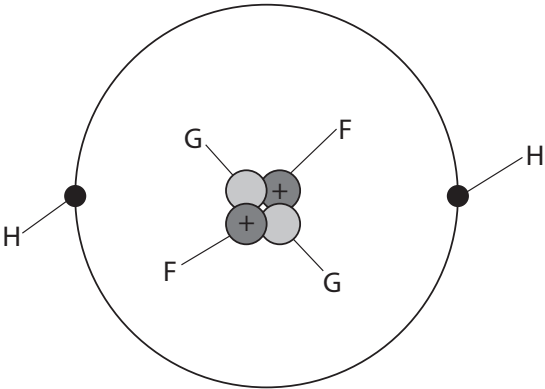


Figure 5

Complete the table for particles G and H, as shown in Figure 5.

(4)

particle	name of particle	charge
F	proton	positive
G		
H		

(b) An atom of beryllium has the symbol



The beryllium atom has 4 protons.

(i) Determine the number of neutrons in this atom.

(1)

number of neutrons

(ii) Determine the number of electrons in this atom.

(1)

number of electrons

(c) (i) Which of these is the unit for the activity of a radioactive isotope?

(1)

- ☐ A second (s)
- ☐ B kilogram (kg)
- ☐ C kelvin (K)
- ☐ D becquerel (Bq)

(ii) The isotope nitrogen-13 (N-13) has a half-life of 10 minutes.

A sample of N-13 has an initial mass of 120 g.

Calculate the mass of N-13 that remains after 30 minutes.

(2)

mass remaining = ... g

(Total for Question 3 = 9 marks)



10-MARK QUESTIONS

2 questions in this booklet



- 4 (a) Figure 7 shows a safety sign on the door of a laboratory where radioactive materials are used.



Figure 7

- (i) State **one** way that radioactivity can be dangerous to humans.

(1)

.....

.....

- (ii) State **one** piece of equipment that can be used to measure radioactivity.

(1)

.....

.....

- (iii) Alpha (α) radiation and ultraviolet (UV) radiation are ionising radiations.

Give **two** other ionising radiations.

(2)

1

.....

2

.....

(b) Sulfur-35 is a radioactive isotope of sulfur.

Figure 8 represents a nucleus of sulfur-35.



Figure 8

Draw one line from each type of particle to the number of that type of particle in a nucleus of sulfur-35.

(3)

type of particle

number of particles

proton

35

neutron

16

nucleon

51

19



(c) A sample of a radioactive isotope has a mass of 520 g.

The half-life of the radioactive isotope is 18 days.

(i) Calculate the mass of the original radioactive isotope remaining after 18 days.

(1)

mass after 18 days g

(ii) Calculate the mass of the original radioactive isotope remaining after 54 days.

(2)

mass after 54 days g

(Total for Question 4 = 10 marks)



4 Figure 6 is a diagram representing an atom.

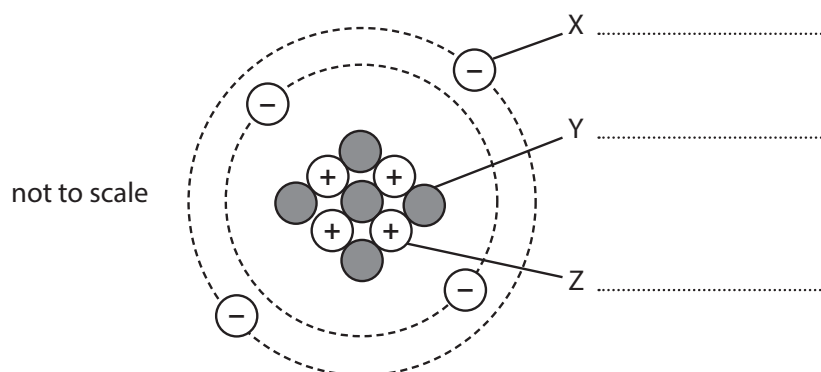


Figure 6

(a) Write the names of the particles X, Y and Z on the lines next to each letter in Figure 6.

(3)

(b) The nucleus of a different atom emits a gamma ray.

What happens to the number of particles in the nucleus?

(1)

- ☒ **A** it decreases by one
- ☒ **B** it decreases by two
- ☒ **C** it decreases by four
- ☒ **D** it does not change

(c) A teacher demonstrates a radioactivity experiment to a class of students.

The teacher places a radioactive source in front of a radiation detector.

(i) State **one** safety precaution the teacher should take.

(1)

(ii) The teacher uses the detector to measure the activity of the source several times.

Figure 7 shows the results.

	1st measurement	2nd measurement	3rd measurement	4th measurement
activity in Bq	21	23	19	22

Figure 7

The teacher tells the class that radioactive decay is random.

State how the data in Figure 7 supports this statement.

(1)

(iii) Calculate the mean of the **four** measurements in Figure 7.

(1)

mean = ... Bq



- (d) The teacher moves the radiation detector to different distances from the radioactive source.

The teacher determines the mean detector reading at each distance from the source.

The teacher plots the results on graph paper, as shown in Figure 8.

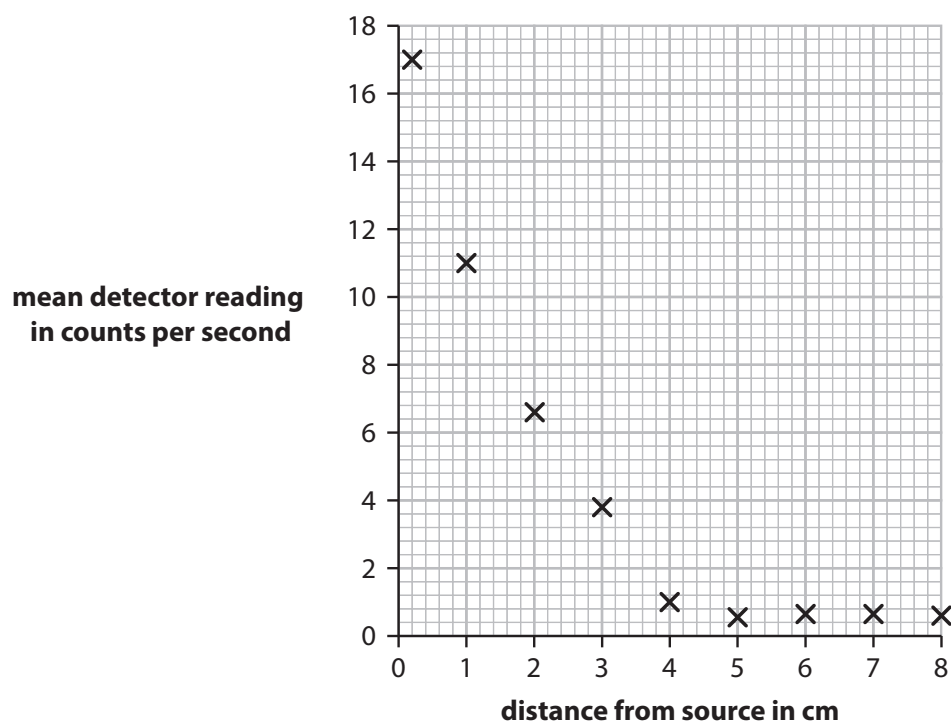


Figure 8

- (i) The source emits alpha radiation **only**.

Explain how the graph in Figure 8 shows that the source only emits alpha radiation.

(2)

.....

.....

.....

- (ii) Give a reason why the mean detector reading in Figure 8 does not fall to zero in this experiment.

(1)

.....

.....

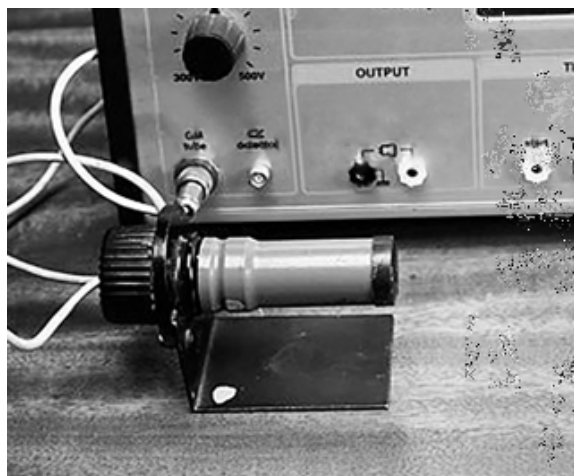
(Total for Question 4 = 10 marks)

13-MARK QUESTIONS

2 questions in this booklet



- 6 Figure 10 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



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Figure 10

- (a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(b) A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

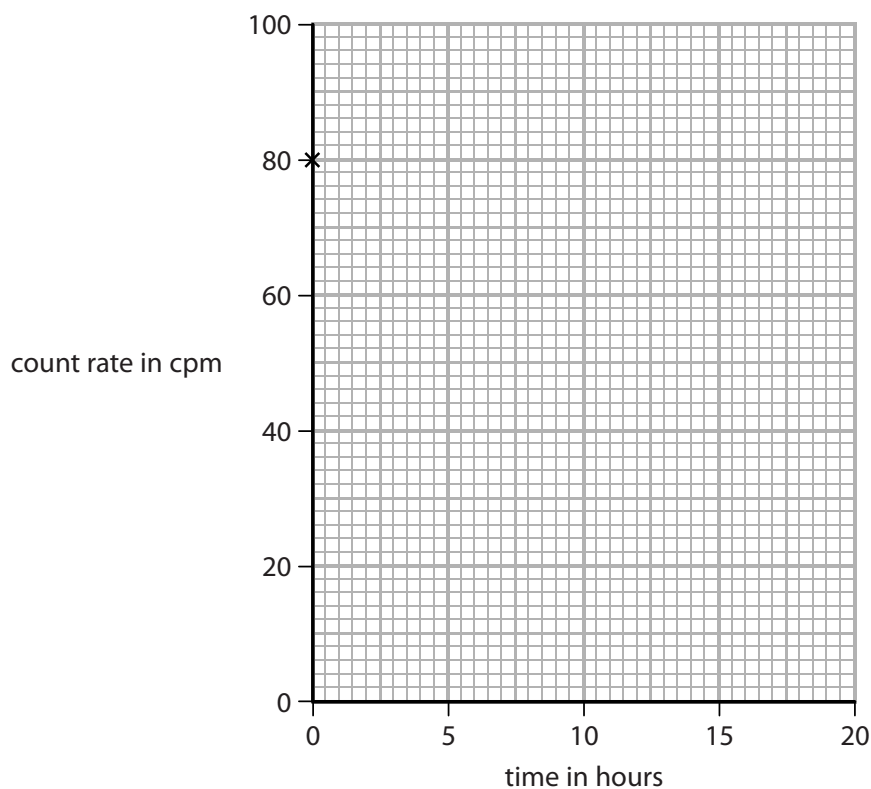


Figure 11

Complete the graph on Figure 11, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

The first point is already drawn in Figure 11.

(3)



6 This question is about radioactivity.

(a) Alpha (α), beta (β) and gamma (γ) are three types of radioactive emissions.

Which statement describes **all** of these radioactive emissions?

(1)

- ☐ A ionising and emitted by stable nuclei
- ☐ B ionising and emitted by unstable nuclei
- ☐ C neutral and emitted by stable nuclei
- ☐ D neutral and emitted by unstable nuclei

(b) Fluorine-19 is a stable isotope of the element fluorine.

The element fluorine also has several radioactive isotopes.

Describe **one** similarity and **one** difference between the numbers of particles in one nucleus of fluorine-19 and one nucleus of a radioactive isotope of fluorine.

(2)

similarity

.....

difference

.....



- (c) Figure 10 shows a Geiger–Muller (G–M) tube attached to a counter. The G–M tube is used to measure the activity of a source of beta (β) radiation. There is an aluminium sheet between the beta source and the G–M tube. The counter is switched on and after 1 minute shows a count of 268.

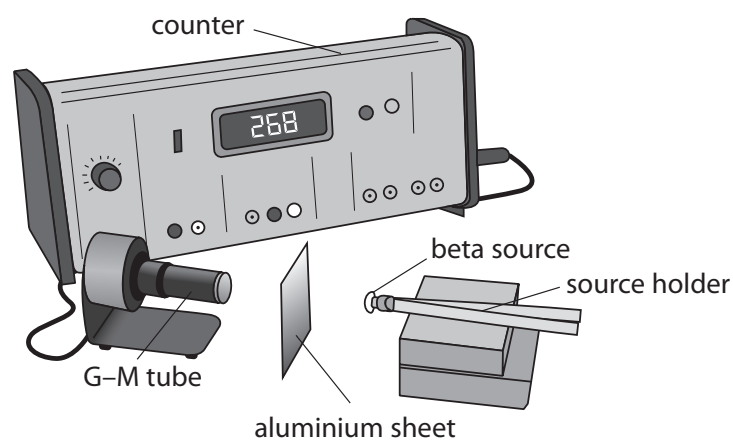


Figure 10

- (i) The aluminium sheet is taken away. The counter is reset to zero and then switched on again. A new count is taken for 1 minute.

Explain why the new count is greater than 268.

(2)

.....

.....

.....

.....

- (ii) The beta source is then also taken away.
The counter is reset to zero and switched on again.
A new count is taken for 1 minute.

Give a reason why there would now be a reading on the counter.

(1)

- (iii) State the SI unit for the activity of a radioactive source.

(1)

- *(d) Exposing people to radioactive sources can be dangerous.

Describe the dangers of exposure to radioactive sources and what can be done to protect hospital staff when they are working with radioactive sources.

(6)

(Total for Question 6 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Mark													
3 (a)	1 mark for answer in each box, marked independently:	(4) AO1.1													
	<table><tr><td>particle</td><td>name of particle</td><td>charge</td></tr><tr><td>F</td><td>proton</td><td>positive</td></tr><tr><td>G</td><td>neutron (1)</td><td>zero / 0 / neutral (1)</td></tr><tr><td>H</td><td>electron (1)</td><td>-1 / negative (1)</td></tr></table>		particle	name of particle	charge	F	proton	positive	G	neutron (1)	zero / 0 / neutral (1)	H	electron (1)	-1 / negative (1)	
	particle		name of particle	charge											
	F		proton	positive											
	G		neutron (1)	zero / 0 / neutral (1)											
	H		electron (1)	-1 / negative (1)											
	if name of particle for G or H is incorrect:														
1 mark for neutron and zero / 0 / neutral charge on same row															
1 mark for electron and -1 / negative charge on same row															

Question number	Answer	Additional guidance	Mark
3 (b) (i)	5 (1)	five	(1) AO1.1

Question number	Answer	Additional guidance	Mark
3 (b) (ii)	4 (1)	four	(1) AO1.1

Question number	Answer	Additional guidance	Mark
3 (c) (i)	D becquerel (Bq) A, B and C are not units for activity		(1) AO1.1

Question number	Answer	Additional guidance	Mark
3 (c) (ii)	Identification of 3 half-lives OR $\frac{1}{8}$ left (1) evaluation (1) 15 (g)	evidence of halving a number 3 times evidence of halving 120(g) award full marks for correct answer without working award one mark only for 40(g) (thinking three half lives means $\div 3$)	(2) AO2.1

Total for Question 3 = 9 marks



4(a)(i)	One from: cell damage (1) cancer (1) radiation sickness / poisoning (1) mutation (1) chromosomal damage (1) dna damage (1) skin damage (1) (named) organ damage (1) burns (1) releases ionising radiation (1)	allow ionises / kills cells	(1) AO1
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	Answer	Additional guidance	Mark
4 (a)(ii)	any one from: Geiger (Muller) (tube/counter) photographic film dosimeter	accept recognisable spellings GM film badge	(1) AO1

	Answer	Additional guidance	Mark
4 (a)(iii)	any two from: beta(minus)/ $\beta(-)$ (1) beta + (1) x-rays (1) gamma/ γ (1)	accept positron in place of beta + accept proton beam accept electron beam maximum of 1 mark if one incorrect radiation given zero marks if two incorrect radiations given	(2) AO1

Question number	Answer	Additional guidance	Mark
4(a)	X: electron (1) Y: neutron (1) Z: proton (1)	accept recognisable spellings. accept Y and Z in the wrong order for 1 mark independent of any mark for X	3 AO1.1

Question number	Answer	Additional guidance	Mark
4(b)	D it does not change A, B and C are incorrect because the number of nucleons does not change in gamma emission		1 AO1.1

Question number	Answer	Additional guidance	Mark
4(c)(i)	any one from: keep a safe distance (1) point the source away from people (1) handle the source with tongs/at a distance (1) limit exposure time/return source to store (asap) (1) use shielding (1) use of gloves / mask (1) protective clothing (1) wear a film badge/monitor (1)	(store in) lead-lined box use of screen PPE ignore goggles	1 AO1.2

Question number	Answer	Additional guidance	Mark
4(c)(ii)	the activity varies (slightly) (1)	numbers / counts / results / measurements are different no pattern increases and decreases ignore random(ly)	1 AO1.1

Question number	Answer	Additional guidance	Mark
4(c)(iii)	21 (1)	$\frac{21+23+19+22}{4}$ or $\frac{85}{4}$ accept 21.3 or 21.2 or 21.25 do not accept 21.5 (median)	1 AO3.2

Question number	Answer	Additional guidance	Mark
4(d)(i)	an explanation linking any two from readings fall (to almost zero) (1) radiation is (all) absorbed (1) after a few cm (of air) (1)	accept graph / activity / measurements for readings stopped by air in a short distance (in air) reverse arguments must include beta and gamma	2 AO2.1

Question number	Answer	Additional guidance	Mark
4(d)(ii)	background radiation (1)	or words to that effect accept named examples ignore reference to original alpha source	1 AO2.1

Total for question 4 = 10 marks



Question Number	Answer	Additional guidance	Mark
6(a)	a description to include: 1. put rock(s) in front of/near tube (1) 2. measure (count rate) separately for the two different rocks (1) 3. measure each count for the same time period (1) 4. keep source-detector distance the same for both rocks (1) 5. take (into account)/measure background count (1) 6. repeat readings and take average(s) (1)	not 'in' tube keep rocks apart	(4) AO 2 2

Question Number	Answer	Additional guidance	Mark
6(b)	- point after first half-life - 6, 40 (1) - point after second half-life - 12, 20 (1) - point after third half-life - 18, 10 (1)	within 1 small square by eye smooth curve starting at 80, with a decreasing gradient passing through one correct half-life point scores 2 marks smooth curve starting at 80, with a decreasing gradient passing through two correct half-life points scores 3 marks if no other mark scored smooth curve showing decreasing gradient but not going through any correct points scores 1 mark	(3) AO 3 1a

Question Number	Answer	Mark
6(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. A03 Strand 2a and 2b (6 marks) • shows some idea that the data can support arguments about alpha, beta and gamma radiation being present • argues that there is some evidence that alpha might be emitted (count rate going down with paper interposed) • argues that there is a lot of evidence that beta particles are emitted (count rate goes down a lot when the aluminium is inserted) • argues that there might be some gamma getting through (lead stopping everything apart from gamma) OR that with the lead present the count rate has gone down to a level consistent with background, so no gamma was present a level 3 answer will use data effectively	(6) AO 1 1

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. • Judgements are supported by limited evidence. (AO3)
Level 2	3-4	• Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently. • Judgements are supported by evidence occasionally. (AO3)
Level 3	5-6	• Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. • Judgements are supported by evidence throughout. (AO3)

(Total for Question 6 = 13 marks)



Question number	Answer	Mark
6(a)	B ionising and emitted by unstable nuclei A is incorrect stable nuclei do not give radioactive emissions C is incorrect not all radioactive emissions are neutral D is incorrect not all radioactive emissions are neutral	(1) AO1

Question number	Answer	Additional guidance	Mark
6(b)	same number of protons (1) different number of neutrons (1)	same atomic number different mass number	(2) AO2

Question number	Answer	Additional guidance	Mark
6(c)(i)	An explanation to include; there is no aluminium to absorb β particles (1) (therefore) more β particles reach the G-M tube (1)	aluminium absorbs/stops/blocks beta particles accept reverse arguments accept radiation for beta particles	(2) AO2

Question number	Answer	Additional guidance	Mark
6 c (ii)	(idea of) background radiation	a named source of background radiation	(1) AO3

Question number	Answer	Additional guidance	Mark
6c (iii)	becquerel	accept Bq accept close spelling	(1) AO1

Question number	Indicative content	Mark
6d*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Dangers of exposing people to radioactive sources / radiation. • it is ionising • may cause cancer • may destroy /kill cells • can mutate DNA • can burn the skin Protection of hospital staff using radioactive sources / radiation. • use tongs to carry radioactive sources • use lead containers to store sources • stay at a distance from radioactive sources • use sources for as short a time as possible • wear (lead lined) protective clothing (PPE) • give treatments from behind a shield /wall • wear a radiation badge (dosimeter)	(6) AO1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1)



		Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)
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Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> At least one isolated fact about the dangers of radiation and/or protection from radiation	<u>Possible candidate responses</u> it's ionising causes cancer burns you kills cells mutates DNA wear a radiation badge use tongs work from behind a shield use protective clothing
Level 2	3–4	<u>Additional guidance</u> simple explanation of the dangers of radiation and a fact about protection or reverse OR detailed explanation of the dangers of radiation or protection from radiation	<u>Possible candidate responses</u> radiation is ionising and can kill cells so wear a radiation badge or use tongs and stay at a distance from radiation source as it can cause cancer or use tongs to stay at a distance from radiation sources and wear a radiation badge
Level 3	5–6	<u>Additional guidance</u> detailed explanation of the dangers of radiation and protection from radiation	<u>Possible candidate responses</u> radiation is ionising and can kill cells and use tongs and stay at a distance from the radiation source

Total marks for question 6 = 13

