

Mark Scheme

Combined Science GCSE

Radioactivity Test

(Levels 4-9)

	Answer	Marks
1. (a)	A: electron B: neutron C: proton	(3)
1. (b)	Atoms have no overall charge because the number of protons is equal to the number of electrons.	(1)
1. (c)	small/tiny/smaller	(1)

(Total for Question 1 = 5 marks)

	Answer	Marks								
2. (a)	Timeline 1800s - John Dalton • All matter made of atoms • Atoms cannot be broken down into anything smaller 1897 - JJ Thompson “ Plum Pudding” • Discovered the electron • Suggested atoms were positive spheres with electrons stuck on them 1909/11 - Ernest Rutherford • Discovered atom contained a central nucleus 1913 - Niels Bohr • Suggested electrons were in orbits a set distance from the nucleus <table><tr><th>0 marks</th><th>1-2 marks</th><th>3-4 marks</th><th>5-6 marks</th></tr><tr><td>No relevant content.</td><td>2 of the scientists mentioned with a rough outline of their discoveries, in the correct order but no dates.</td><td>At least 3 of the scientists mentioned in correct chronological order with a brief outline of their discoveries.</td><td>All 4 scientists mentioned with approximate dates and details of their discoveries.</td></tr></table>	0 marks	1-2 marks	3-4 marks	5-6 marks	No relevant content.	2 of the scientists mentioned with a rough outline of their discoveries, in the correct order but no dates.	At least 3 of the scientists mentioned in correct chronological order with a brief outline of their discoveries.	All 4 scientists mentioned with approximate dates and details of their discoveries.	(6)
0 marks	1-2 marks	3-4 marks	5-6 marks							
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(Total for Question 2 = 6 marks)

	Answer	Marks
3. (a)	Isotopes are the same element, having the same number of protons and a different number of neutrons.	(1)
3. (b)	Any 3 correct statements: • Both have 17 protons/same number of protons • Both have 17 electrons/same number of electrons • Cl³⁵ has 18 neutrons • Cl³⁷ has 20 neutrons	(3)

(Total for Question 3 = 4 marks)

	Answer	Marks
4.	An outer electron gains energy (1) and leaves the atom. The atom has more protons than electrons (1) and has become a positively charged ion. (1)	(3)

(Total for Question 4 = 3 marks)

	Answer	Marks
5. (a)	Three from: • Rocks • Nuclear waste • Space (cosmic rays) • Buildings • Food	(3)
5. (b)	Its rock formation.	(1)
5. (c)	X: Gamma radiation – is stopped by lead, but not by paper and aluminium. (1) Y: Beta radiation – is stopped by aluminium, but not by paper. (1)	(2)
5. (d)	Two from: • Wear gloves • Use tongs to handle the radioactive source • Keep radioactive source in a lead lined box • Do not let any children handle the radioactive source	(2)

(Total for Question 5 = 8 marks)

	Answer	Marks
6. (a)	Half-life is the time taken for half of an isotope's radioactive atoms to decay.	(1)
6. (b)	Beta particles are electrons or positrons.	(1)
6. (c)	Suitable scale (1) All points correctly plotted (1) Line of best fit added (1)	(3)
6. (d)	$\frac{700}{350} = 2$ hours	(1)
6. (e)	880 $\longrightarrow$ 440 $\longrightarrow$ 220 $\longrightarrow$ 110 $\longrightarrow$ 55 The material has to halve four times to reach 55Bq, which takes three hours. Three hours = 180 mins $180/(4) = 45$ minutes (Correct answer with no working still gains full marks.)	(2)

(Total for Question 6 = 8 marks)

	Answer	Marks
7. (a)	$\begin{array}{ c } \hline {}^{234}_{92}\text{Cl} \\ \hline \end{array} \longrightarrow \begin{array}{ c } \hline {}^{230}_{90}\text{Th} \\ \hline \end{array} + \begin{array}{ c } \hline {}^4_2\text{He} \\ \hline \end{array}$	(2)
7. (b)	Beta minus	(1)
7. (c)	Positron emission decreases the charge of the nucleus whereas neutron emission decreases the mass of the nucleus.	(4)

(Total for Question 7 = 7 marks)

Question	Answer	Marks
8. (a)	Irradiation means something has been exposed to radiation. (1) Contamination occurs when radioactive particles have got onto objects. (1)	(2)
8. (b)	Most of the radiation will exit the body. (1) Outside the body, gamma is easier to detect. (1)	(2)
8. (c)	Any five points from: Alpha particles • Helium nuclei • Made up of two neutrons and two protons • Strongly ionising • Used in smoke detectors Beta particles • Fast moving electron • Moderately ionising • When a beta particle is emitted a neutron has turned into a proton • Used to test thickness of metal sheets	(5)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 50 MARKS