PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

PHYSICS



MARK SCHEME

TOPIC 6: RADIOACTIVITY (PAPER 1)

SCORE	PERCENTAGE
/91	%

STEMUP

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Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
	axes labelled correctly With label or unit (1) correct shaped smooth curve (1) line does not reach zero activity (1)	activity / Bq / count rate ignore radioactivity time/ seconds/ any time unit	**(3)**

(**Q28 1SC0/1PF, Mar 2013**)

Q2.

	Answer	Acceptable answers	Mark
	☒ **D**		**(1)**

(**Q14 1SC0/1PF, June 2013**)

Q3.

Question Number	Answer	Acceptable answers	Mark
(a)	**B** It is very ionising		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	**A** **decreases by 2** **decreases by 4**		**(1)**

(**Q15 1SC0/1PF, June 2015**)

Q4.

	Answer	**Acceptable answers**	**Mark**
(i)	Any **two** of: Gamma is a wave (1) Alpha is a helium nucleus (1) Alpha is charged (1) Alpha has a mass (1) Gamma penetrates further/ highly (1) Gamma weakly ionising (1) Gamma travels faster (1)	Reverse arguments em radiation Gamma has no charge Gamma has no mass examples of penetrating power alpha highly ionising ignore vague comments eg stronger Ignore uses and dangers	**(2)**

(**Q30 1SC0/1PF, Mar 2013**)

Q5.

Question Number	Answer	Mark
(i)	**The only correct answer is D Bq** ***A*** *is not correct because it is the unit of pressure* ***B*** *is not correct because it is the unit of moment* ***C*** *is not correct because it is the unit of time*	**(1)** **AO1.1**

Question Number	Answer	Mark
(ii)	**The only correct answer is A** ***C and D*** *are not correct because they start with most penetrating* ***B*** *is not correct because gamma is more penetrating than beta*	**(1)** **AO1.1**

Question Number	Answer	Additional guidance	Mark
(iii)	selection of (KE =) ½ mv^2 (1) evaluation (1) 6.6×10^{-18} (J)	½ × 9.1 × 10^{-31} × [3.8 × 10^6]^2 allow values that round to 6.6×10^{-18} (J) e.g. 6.5702×10^{-18} (J) award full marks for the correct answer without working	**(2)** **AO2.1**

(**QU06a 1SC0/1PH, June 2025**)

Q6.

Question number	Answer	Additional guidance	Mark
(i)	Geiger-Müller tube	accept Geiger (counter) geiger (counter) GM (tube) gm(tube) accept any recognisable (phonetic) spelling	(1)

Question number	Answer	Additional guidance	Mark
(ii)	any **two** 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 (1) use of mask (1) protective clothing (1) wear a film badge/monitor (1)	 use of screen Do not credit goggles	(2)

Question number	Answer	Additional guidance	Mark
(iii)	a description to include four from: take measurement without source (1) place source in front of/near/close to detector (1) increase the distance (between source and detector) (1) measure distance (from source to detector) (1) take reading from the screen/counter (1) until reading gets to background value /constant value (1) use same time for each count (1) repeat / check when down to low values (1)	 measure/account for background (count) DO NOT allow 'inside' allow reverse argument by starting with detector long way away from source allow zero as constant value mention of (count) <u>rate</u>	(4)

(**Q03c 1SC0/1PF, Nov 2020**)

Q7.

Question Number	Answer	Acceptable answers	Mark
	A description including any four from: (there are) 89 particles in the nucleus (1) protons (1) (there are) 36 (protons) (1) neutrons (1) (there are) 53 (neutrons) (1) i.e. 36 protons and 53 neutrons gains four marks	ignore all references to electrons (its) {mass/nucleon} number / RAM / A_r / A is 89 {atomic/proton} number / positive charge / Z = 36 Numbers must be correctly linked to gain credit e.g. 36 neutrons gets 1 mark (for neutrons) 53 protons and 36 neutrons gains two marks (for protons and neutrons) 89 protons and neutrons gets 3 marks (altogether there are) 89 protons and neutrons. 36 are protons gains 4 marks	**(4)**

(**Q10 1SC0/1PF, June 2015**)

Q8.

Question Number	Answer	Acceptable answers	Mark
(i)	A protons B neutrons C electrons	OR A neutrons B protons C electrons	**(3)**

Question Number	Answer	Acceptable answers	Mark
(ii)	**12**		**(1)**

(**Q14 1SC0/1PF, June 2015**)

Q9.

Question Number	Answer	Acceptable answers	Mark
	An explanation linking any three from • Radon is radioactive (1) • Radon can escape from rocks and buildings (1) • Radon can be inhaled (1) • Radiation (from radon) can cause cancer (1) • Radon emits alpha (1)	Ignore radiation from rocks themselves Radon enters/gets trapped in buildings/homes / increases background radiation (breathed into) lungs (DNA) mutation / cell damage (Highly) ionising radiation	**(3)**

(**Q07 1SC0/1PH, June 2015**)

Q10.

	Answer	**Acceptable answers**	**Mark**
(i)	any one of X-ray (machines) / smoke alarms/ nuclear/ radioactive waste (1)	nuclear weapons (tests) nuclear power plants (medical) tracers/technetium	**(1)**
(ii)	an explanation linking: comes from granite / rocks (1) none/ less of these (rocks) in some areas (1)	in some areas/Cornwall/Aberdeen the second mark is dependent on the first.	**(2)**

(**Q10 1SC0/1PF, Mar 2013**)

Q11.

	Answer	**Acceptable answers**	**Mark**
(i)	does not emit (ionising) radiation / no	it is not radioactive	**(1)**

	(radioactive) decay		
(ii)	$^{8}_{4}Be$ **B** 5		**(1)**
(iii)	$^{8}_{4}Be$ $^{8}_{4}Be$ A		**(1)**

(**Q17 1SC0/1PF, June 2013**)

Q12.

Question Number	Answer	Acceptable answers	Mark
(a)	☒ **D** too many neutrons.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	☒ **A** a β^+ is positively charged and a β^- is negatively charged		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	$^{14}_{7}N + {}^{0}_{-1}\beta^-$ Any two numbers correct (1) All four numbers correct (2)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(d)	A description to include: Up and down (quarks) / Three (quarks) (1) Correct arrangement (quarks) (1)	 Accept for two marks: uud up, up, down two up quarks and one down quark Ignore charges	**(2)**

Question Number	Answer	Acceptable answers	Mark
(e)	An explanation linking the following: **Either** proton changes to a neutron (1) positron/anti-electron (emitted) (1) OR up quark changes to a down quark (1) positron/anti-electron (emitted) (1) **OR** proton number goes down by one / neutron number goes up by one (1) number of nucleons stays the same (1)	Accept any correct set of statements for two marks $P \rightarrow n + \beta^+$ (1) Ignore positive electron atomic number goes down by one mass number is constant	**(2)**

(**Q10 1SC0/1PH, June 2015**)

Q13.

	Answer	Acceptable answers	Mark
(i)	☒ **A** electron		**(1)**
(ii)	suggestion to include **two** of • the ionisation is different (1) • correct difference in ionisation (1)	 alpha more ionising (than beta) scores 2 marks	**(2)**

	• the masses are different (1) • alpha is bigger than beta (1) • alpha hits more (air) particles (1) • alpha loses its energy in shorter distance (1)	RA (heavier for bigger) RA RA IGNORE references to penetration	

(**Q38 1SC0/1PH, June 2013**)

Q14.

	Answer	Acceptable answers	Mark
(i)	D		**(1)**
(ii)	B		**(1)**

(**Q31 1SC0/1PF, Mar 2013**)

Q15.

Question Number	Answer	Additional guidance	Mark
	substitution (1) $\frac{1.6726 \times 10^{-27}}{9.1094 \times 10^{-31}}$ evaluation (1) 1836 evaluation to 2 sf (1) 1800	 Allow 1 mark for answers that round to 1.836 to any power of ten for this mark 1.836×10^3 OR 1.80×10^3 accept 1840 or any rounding of 1836.125 1.8×10^3 **any number** shown to 2 sf gets this mark award full marks for the correct answer without working	**(3)**

(**Q03d 1SC0/1PF, June 2019**)

Q16.

Question number	Answer	Additional guidance	Mark
(i)	use of gradient on graph (1) $= \frac{1480}{97}$ evaluation (1) 15.3 (counts /s)	look for a triangle / line going up allow $\frac{1480}{100}$ accept other data from the graph allow numbers between 12.0 and 16.0 award full marks for answers in the correct range without working	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	explanation the process (of radioactive decay) is unpredictable / (occurs) random(ly) (1) so the count rate would not be constant / there will be variations with each reading (1)	 do not allow 'difficult to predict' ignore background results (expected to) scatter	(2)

(**Q05e 1SC0/1PH, Nov 2020**)

Q17.

	Answer	Additional guidance	Mark
(i)	260 (g)		(1) AO2

	Answer	Additional guidance	Mark
(ii)	(54 days is) 3 half-lives (1) 65 (1)	260 ÷ 2 (÷ 2) or 520 ÷ 2 ÷ 2 (÷ 2) 18, 36, 54 (represents 3 half-lives) 54/18 = 3 (half-lives) ecf answer to 4ci ÷ 4 130 scores 1 mark award full marks for the correct answer without working	(2) AO2

(**QU04c 1SC0/1PF, June 2022**)

Q18.

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

Question number	Answer	Additional guidance	Mark
(ii)	Identification of 3 half-lives OR ⅛ 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 ÷ 3)	(2) AO2.1

(**QU03c 1SC0/1PF, June 2025**)

Q19.

Question number	Answer	Mark
(i)	434	(1)

Question number	Answer	Additional guidance	Mark
(ii)	34	allow 29 to 39	(1)

Question number	Answer	Additional guidance	Mark
(iii)	Radioactive decay is a random process	allow because background count changes every time	(1)

(**Q03b 1SC0/1PF, SAM 2016**)

Q20.

	Answer	Acceptable answers	Mark
(a)	A		**(1)**
(b)	axes labelled correctly With label or unit (1) correct shaped smooth curve (1) line does not reach zero activity (1)	activity / Bq / count rate ignore radioactivity time/ seconds/ any time unit	**(3)**
(c)(i)	Idea of 2 half-lives (1) 11 400 = 2 × 5700 Idea of halving activity twice (1) 0.55 × 2 × 2 Calculation (1) 2.2 (Bq)	11 400 / 5700 = 2 2.2 (Bq) for three marks	**(3)**
(c)(ii)	Explanation linking two of: • Background radiation affects the measurement (1) • Needs to be subtracted from readings (1) • Background radiation is variable (1) • Background radiation needs to be averaged (1)	accept interfering / including varies with place/time/random nature repeating test improves reliability	**(2)** **t**
(c)(iii)	One relevant idea: (New method) more accurate (1) Hard to measure a small activity (1) Background radiation affects readings (1) Need to find difference of two small quantities (1) Can test smaller samples (1)	ignore better method/results / more reliable difficult to distinguish between the reading and background	**(1)** **grad**

Total for question = 10 marks

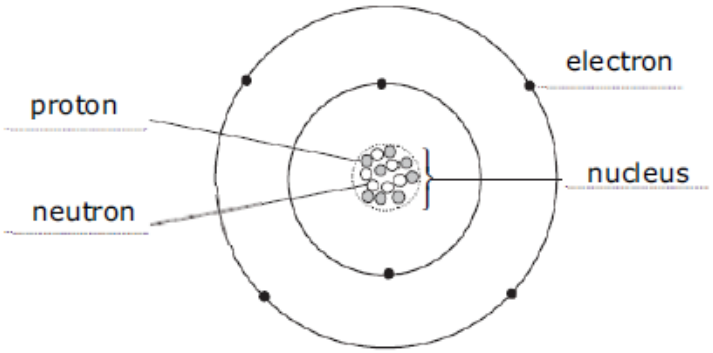
(**Q23 1SC0/1PF, Mar 2013**)

Q21.

	Answer	Acceptable answers	Mark
(i)	Idea of 2 half-lives (1) 11 400 = 2 × 5700 Idea of halving activity twice (1) 0.55 × 2 × 2 Calculation (1) 2.2 (Bq)	11 400 / 5700 = 2 2.2 (Bq) for three marks	**(3)**
(ii)	Explanation linking two of: • Background radiation affects the measurement (1) • Needs to be subtracted from readings (1) • Background radiation is variable (1) • Background radiation needs to be averaged (1)	accept interfering / including varies with place/time/random nature repeating test improves reliability	**(2)** **t**
(iii)	One relevant idea: (New method) more accurate (1) Hard to measure a small activity (1) Background radiation affects readings (1) Need to find difference of two small quantities (1) Can test smaller samples (1)	ignore better method/results / more reliable difficult to distinguish between the reading and background	**(1)** **grad**

(**Q29 1SC0/1PF, Mar 2013**)

Q22.

Question number	Answer	Mark
(i)	One mark for each correct label (4)  	(4)

Question number	Answer	Mark
(ii)	B	(1)

Question number	Answer	Mark
(iii)	zero/0/no charge	(1)

(**Q03a 1SC0/1PF, SAM 2016**)

Q23.

Question Number	Answer	Mark
	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.	**(6)** **exp**

	AO1 strand 1 (6 marks) • radio waves are (often) produced intentionally (by humans) • gamma rays are (often) produced spontaneously / randomly • radio waves are produced by (free) electrons • radio waves are produced by oscillating (free) electrons / alternating current (ac) • radio waves are produced in electrical circuits / aerials • gamma rays may result from radioactive decay • gamma rays produced in the nucleus • gamma rays produced by energy changes / rearrangement in the nucleus • gamma rays produced to stabilise the nucleus • gamma rays produced in annihilations (PET scanning etc) • gamma rays may be produced as a result of (nuclear) fission or fusion	

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Summary for guidance			
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	Additional guidance isolated fact(s) about one radiation	Possible candidate responses gamma rays are (often) produced spontaneously / randomly
Level 2	3–4	Additional guidance Some understanding shown i.e. a limited comparison made including some facts about the production of each radiation OR more detailed facts given about the production of one of them	Possible candidate responses radio waves produced in wires and gamma produced in nucleus radio waves produced by AC in wires
Level 3	5–6	Additional guidance Understanding is detailed and fully developed. detailed comparison made with linked facts about the production of each (one radiation may have significantly more detail than the other but both should feature for level 3)	Possible candidate responses radio waves produced by electrons oscillating in wires; gamma produced by annihilation of electrons interacting with positrons

(**Q06d 1SC0/1PH, June 2019**)

Q24.

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

(**Q06b 1SC0/1PF, Nov 2021**)

Q25.

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

(**Q02b 1SC0/1PH, Nov 2021**)

Q26.

Question number	Indicative content	Mark
*	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. AO1 1 **(6 marks)** **alpha** • a particle (not a wave) • made up of 4 particles • helium nucleus • has a positive charge • when emitted by a nucleus, atomic number goes down by 2 • mass number goes down by 4 **beta** • a particle (not a wave) • made up of 1 particle • electron (or positron) • has a negative charge • when emitted, atomic number goes up by 1 • mass number does not change Ignore references to range, penetration, ionisation.	**(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 ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

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	Additional guidance isolated facts	Possible candidate responses A beta particle is an electron. An alpha particle is a helium nucleus
Level 2	3–4	Additional guidance effect of alpha and beta decay or nature and effect of alpha or beta	Possible candidate responses A beta particle is an electron. When emitted the mass number doesn't change but atomic number goes up by one
Level 3	5–6	Additional guidance detailed comparison that includes nature of alpha and nature of beta and effect of either alpha or beta OR effect of alpha and beta and nature of either alpha or beta	Possible candidate responses Alpha particle is a helium nucleus AND A beta particle is an electron. When emitted the mass number doesn't change but atomic number goes up by one

(**Q06d 1SC0/1PH, Nov 2021**)

Q27.

Question Number	Indicative content	Mark
*	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. AO1 alpha nature (may be in context of emitted from nucleus) • made up of 4 particles / 2 protons and 2 neutrons • helium nucleus • is positively charged (+2) alpha decay effect on nucleus • when emitted, atomic/proton number of nucleus goes down by 2 • when emitted, mass/nucleon number of nucleus goes down by 4 • element changes • charge goes down by 2 • mass goes down by 4 gamma nature • (considered to be) a (electromagnetic / EM) wave • photon • (very) high frequency / short wavelength • no charge / no mass	**(6)** **AO1.1**
	gamma decay effect on nucleus • nucleus does not change (in atomic number or mass number) • nucleus undergoes rearrangement / becomes more stable / loses energy / mass converts to energy • element does not change Ionisation / penetration • gamma is weakly ionising / highly penetrating / stopped by (thick) lead • alpha is highly ionising / weakly penetrating / stopped by paper / few cm of air	

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents a comparison with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents a comparison that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents a comparison that has a well-developed structure which is clear, coherent and logical. (AO1)

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 response at the top, or the bottom, of that level. At each level ionising/penetrating ability may be used instead of a nature or an effect to place the response in the lower end of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated facts: related to alpha or gamma	Possible candidate responses alpha is a helium nucleus OR gamma is a wave
Level 2	3–4	Additional guidance Limited comparison that includes nature of both or effect of decay of both or nature **and** effect of one or nature of one **and** effect of other	Possible candidate responses Alpha is a helium nucleus and gamma is a wave. OR When alpha emitted the mass number decrease by 4 and when gamma emitted nucleus doesn't change. OR Gamma is a wave and when gamma is emitted the nucleus loses energy. OR Alpha is positively charged and when gamma is emitted nucleus undergoes rearrangement.
Level 3	5–6	Additional guidance detailed comparison that includes nature and effect of either alpha or gamma AND nature or effect of the other	Possible candidate responses Alpha is helium nucleus. When alpha emitted the mass number decreases by 4. When gamma emitted nucleus doesn't change.

(QU06c 1SC0/1PH, June 2025)

Q28.

Question	Answer	Additional guidance	Mark
(i)	sketch with at least three objects labelled (1) allowed labels: G-M tube counter aluminium piece(s)/sheet(s)/foil (metre) rule β/beta/source aluminium / sheets between source and G-M tube with all three labelled (1)	ignore beta particles / beta drawn as particles or waves	**2 AO3.3**

Question	Answer	Additional guidance	Mark
(ii)	one from number of pieces/sheets (of aluminium/foil)(1) thickness of aluminium (between source and G-M tube) (1)	allow amount for number	**1 AO3.3**

Question	Answer	Additional guidance	Mark
(iii)	**one** from distance between the source and the G-M tube (1) distance between source and aluminium pieces (1) distance between G-M tube and pieces of aluminium (1) activity of source (1) direction / angle of source (1) duration/time of measurement (1)	ignore background radiation / temperature accept beta / beta radiation for source for 1st, 2nd and 4th marking points do not allow 'distance of aluminium' accept (same) strength/intensity of source	**1** **AO3.3**

Question	Answer	Additional guidance	Mark
(iv)	-1 for beta β (1) correctly balanced equation with numbers in boxes adding to 38 (1) $^{90}_{38}Sr \longrightarrow \boxed{-1}\ ^{0}\beta + \boxed{39}\ ^{90}Y$		**2** **AO1.1**

(**QU05d 1SC0/1PH, June 2024**)

Q29.

Question number	Answer	Additional guidance	Mark
	mass in g / time in days 1600 / 0 800 (1) / 29 400 / 58 (1)	numbers in correct boxes	(2)

(**Q03b 1SC0/1PF, Nov 2020**)

Q30.

Question Number	Answer	Additional guidance	Mark
	7 / 6 (1) 8 / 6 (1)	one mark for each column must have both numbers in a column correct to get the mark	(2)

(**Q06a 1SC0/1PF, June 2019**)

Q31.

Question Number	Answer	Additional guidance	Mark
	<table><tr><td></td><td></td><td></td></tr><tr><td></td><td>7</td><td>6</td></tr><tr><td></td><td>8</td><td>6</td></tr></table> (1) (1)	one mark for each column must have both numbers in a column correct to get the mark	**(2)**

(**Q02a 1SC0/1PH, June 2019**)

Q32.

Question number	Answer	Mark
	1 mark for answer in each box, marked independently: <table><tr><th>particle</th><th>name of particle</th><th>charge</th></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> 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	**(4)** **AO1.1**

(**QU03a 1SC0/1PF, June 2025**)

Q33.

Question number	Answer	Additional guidance	Mark
	The time taken for the activity of a radioactive nuclide to halve (1)	accept for nuclide: isotope sample	**(1)**

(**Q04bi 1SC0/1PH, SAM 2016**)

Q34.

	Answer	Additional guidance	Mark
(i)	A description including: roll / release / drop a marble (down the slope) (1) and **one** from record where the marbles go (1) **OR** measure the angle of path (1)	 allow alpha particle for marble allow any method of recording	**(2)** **AO3**

	Answer	Additional guidance	Mark
(ii)	any **one** from marble / weight has no charge (1) the edge of the paper is not far enough away from the weight (1) the marble / weight is too big / small (1) there is only one marble / weight (1) it is 2 dimensional / not 3D (1) all marbles have the same speed (1) marbles (only deflect on) hitting / contact with weight (1)	not to scale allow marble cannot pass through the weight (1)	**(1)** **A03**

(**QU05c 1SC0/1PH, June 2022**)

Q35.

Question number	Indicative content	Mark
*	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)

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	Additional guidance At least one isolated fact about the dangers of radiation and/or protection from radiation	Possible candidate responses 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	Additional guidance 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	Possible candidate responses 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	Additional guidance detailed explanation of the dangers of radiation and protection from radiation	Possible candidate responses radiation is ionising and can kill cells **and** use tongs and stay at a distance from the radiation source

(**Q06d 1SC0/1PF, Nov 2021**)

Q36.

Question number	Answer	Additional guidance	Mark
	33 days is 3 half-lives (1) $2.1(25) \times 10^{22}$ (1)	$\frac{1.7 \times 10^{23}}{2 (\times 2 \times 2)}$ 2.1(25) to any other power of ten scores mp1 only award full marks for correct answer without working.	**(2)** **AO2**

(**Q02d 1SC0/1PH, Nov 2021**)

Q37.

	Answer	Additional guidance	Mark
	A description to include **two** from: (radioactive material/substances) inside the food/body (1) emit radiation from inside the body (1) damage body cells (1)	 trapped in the body exposed to radioactivity cause cancer	**(2)** **AO1**

(**Q06a 1SC0/1PH, Nov 2021**)

Q38.

Question Number	Answer	Additional guidance	Mark
	description to include proton (1) becomes a neutron (1)	 charge decreases by 1 atomic number decreases by 1 mass (number) stays the same neutron number increases by 1 award 2 marks for p → n award both marks for answers in terms of quarks: up → down or u → d or uud → udd if no other mark scored award 1 mark for n → p	**(2)** **AO1.1**

(**QU06b 1SC0/1PH, June 2025**)

Q39.

	Answer	Additional guidance	Mark
	description to include: proton (1) becomes a neutron (1)	award 2 marks for p → n award 2 marks for answers in terms of quarks: u→d or up → down or uud→udd if no other mark scored, allow 1 mark for any **one** of neutron becomes proton n → p d→u decrease in atomic number by one mass number stays the same gains a neutron reduce charge (of nucleus) by one responses referring to emission of gamma or neutrino	**(2)** **AO1**

(**QU05c 1SC0/1PH, June 2023**)

Q40.

Question Number	Answer	Additional guidance	Mark
	processing (1) $\frac{125\ 000}{1\ 000\ 000}$ OR $\frac{1}{8}$ OR 3 half-lives or 3 x 5700 evaluation (1) 17 100	 accept an appropriate attempt using more than one halving 17 000 award full marks for the correct answer without working	**(2)**

(**Q06c 1SC0/1PF, June 2019**)