PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



MARK SCHEME

TOPIC 6: RADIOACTIVITY (PACK 1)

SCORE	PERCENTAGE
/83	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	1. advantage (1) minimises patient's exposure to radioactivity 2. disadvantage (1) (has to be produced) close to the {place / time} of use	Does not stay in the (patient's) body for a long time / Decays quickly Any time constraint (in diagnosis/scanning/treatment) Ignore confusion between biological and physical half-life	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	An explanation linking four from: • gamma (rays emitted) (1) • <u>two</u> (gamma rays) (1) • in opposite directions (1) • (because) momentum is conserved (1) • detectors / sensors placed around the patient (1) • simultaneous detection (1)	pair at 180°(to each other) gamma cameras/scintillation crystals idea of triangulation	**(4)**

Question Number		Indicative Content	Mark
QWC	*** (b)**	An explanation including some of the following points • protons and neutrons are made up of quarks • quarks can change (flavour) • proton made up of uud • neutron made up of udd • for β^+ a u changes to a d • for β^- a d changes to a u • for β^+ a p changes to a n • for β^- a n changes to a p	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. for β^+ a proton changes to a neutron OR protons and neutrons are made up of quarks which can change (flavour) • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• significant error(s) e.g. a d changes to a u [error], changing a proton to a neutron and emitting a β^+. A u changes to a d [error] changing a neutron to a proton and a β^- [errors in u and d] OR one of the processes with the correct detail e.g. A u goes to a d therefore a proton goes to a neutron and emits a β^+ • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed, accurate description of both processes e.g. A u goes to a d therefore a proton goes to a neutron and emits a β^+. A d goes to a u therefore a neutron goes to a proton and emits a β^-. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total marks for question = 12 marks)

Q2.

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)**

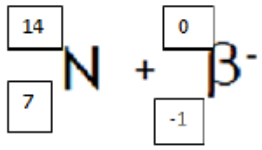
Q3.

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)**

Q4.

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)	 Any two numbers correct (1) All four numbers correct (2)		**(2)**

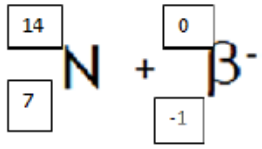
Question Number	Answer	Acceptable answers	Mark
(d)	A description to include: Up and down (quarks) / Three (quarks) (1) Correct arrangement (quarks) (1)	 Accept for two marks: uud up, up, down two up quarks and one down quark Ignore charges	**(2)**

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)**

Q5.

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)	 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)**

Q6.

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)

Q7.

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)

Q8.

Question number	Answer	Additional guidance	Mark
CS2	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**

Q9.

Question number	Answer	Additional guidance	Mark
	Substitution and rearrangement to find k (1) $k = 85000 \times 0.70^2$ Substitution to find new count rate (1) count rate = $\frac{85000 \times 0.70^2}{1.3^2}$ Answer (1) 25000 (counts per minute)	41650 24645 (counts per minute)	**(3)**

Q10.

Question Number	Answer	Mark
(i)	**D gamma** ***A*** *is not correct because alpha cannot pass through and out of the body* ***B*** *is not correct because beta plus cannot pass through and out of the body* ***C*** *is not correct because beta minus cannot pass through and out of the body*	**(1)** **AO1**

	Answer	Additional guidance	Mark
(ii) **CLIP with (ii)**	decays too quickly to give a reading (1)	accept (half-life) not long enough for reading to be taken ignore disappear after 12 min	**(1)** **AO1**

	Answer	Additional guidance	Mark
(ii) **CLIP with (ii)**	stays in the body too long (1)	accept could harm / damage other organs patients stay radioactive for too long so the patient does not get too high a dose of radiation	**(1)** **AO1**

	Answer	Additional guidance	Mark
(iii)	**Two** from: shielding (1) time limiting exposure (1) distance limiting exposure (1) wear PPE / protective clothing (1)	 accept stand behind barriers / store (source) in lead box radiation monitoring badges leave the room / go outside / stay away from the patient / use tongs lead aprons / gloves ignore goggles / masks	**(2)** **AO1**

Q11.

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. **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	**(6)**

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

Q12.

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

Q13.

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)** **fission** • (heavy) nucleus split • by a neutron • releases 2 daughter nuclei + more neutrons + energy • starts chain reaction **advantages** • already in use **disadvantages** • waste is radioactive • hard to dispose of • risk of accident	**(6)** **AO1**
	fusion • (light) nuclei joined • at high energy/temperature/pressure/particle density • releases (eg) helium + energy **advantages** • no harmful waste products **disadvantages** • not achieved yet (on a practicable scale) • difficulty in achieving high energy/temperature/pressure/particle density	

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 fission involves a nucleus being split by a neutron
Level 2	3–4	Additional guidance simple comparison of fission and fusion	Possible candidate responses fission involves a nucleus being split by a neutron whereas fusion requires combining two light nuclei.
Level 3	5–6	Additional guidance detailed comparison of fission and fusion and one advantage or one difficulty compared to the other	Possible candidate responses Fission involves nuclei split by a neutron. Fusion involves combining two light nuclei. The waste from fission is radioactive. Practicable fusion has not been achieved.

Q14.

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

Q15.

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

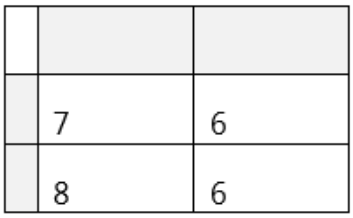
Q16.

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**

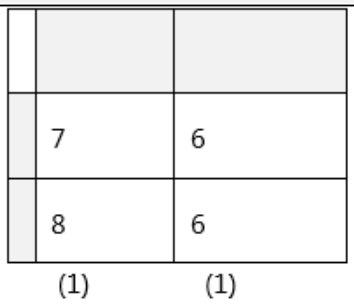
Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, 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

Q17.

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

Q18.

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

Q19.

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)**

Q20.

	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 / alpha particles different speed to marbles (1) marbles (only deflect on) hitting / contact with weight (1)	 not to scale allow marble cannot pass through the weight (1)	**(1)** **AO3**

Q21.

Question number	Answer	Mark
	An answer that combines the following points of understanding to provide a logical description: • the reactor is surrounded by a coolant (1) • the thermal energy release from the chain reaction heats the coolant (1) • the hot coolant is used to generate steam which is used to drive the turbine (1)	**(3)**

Q22.

	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**

Q23.

Question number	Answer	Additional guidance	Mark
	An answer that provides a description by making reference to: • (energy used to) create steam (1) • steam drives a turbine (1)		**(2)**

Q24.

Question Number	Answer	Additional guidance	Mark
(i)	a description to include: nebula collapses (1) under **gravity** (1) plus any one from: GPE converted into KE (1) OR (very) **high** temperatures/pressures reached (1)	 allow gas/dust for nebula allow condensing/coming together for collapses allow gravitational force producing (large) increase in **KE** of particles / more (frequent) collisions Ignore references to hot / heat	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	rearrangement **and** substitution (1) (m =) $\frac{3.86 \times 10^{26}}{(3.00 \times 10^{8})^2}$ evaluation (1) (m =) 4.29×10^{9} (kg)	 ignore Power Of Ten (POT) error until evaluation allow numbers that round to 4.3×10^{9} (kg) award full marks for the correct answer without working 4.3 to any other power of ten scores 1 mark	**(2)**

Q25.

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**

Q26.

	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**

Q27.

	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**

Q28.

Question number	Answer	Mark
CS2	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

Q29.

Question number	Answer	Additional guidance	Mark
	A description to include any three of the following		(3)
	(smaller) nuclei / atoms / particles (1)	two named eg hydrogen (nuclei)	
	come together / join (1)	allow fuse not 'bond'	
	to produce a larger nucleus / atom / particle (1)	helium for nucleus	
	needing high temperature / pressure (1)	accept fast (moving) nuclei	
	overcoming repulsion (between nuclei) (1)		
	energy released (1)	ignore energy created	

Q30.

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)**