Mark Schemes

Q1.

		Indicative Content	Mark
		an explanation which may include some of the following points: properties of nuclear waste • radioactivity is dangerous • some isotopes in nuclear waste have long half-lives/radioactive for thousands of years • products of fission are warm • identified radiation from nuclear waste e.g alpha, beta, gamma problems caused by nuclear waste • leakage of radioactivity • contamination of ground/sea water/lakes /rivers • contamination of crops/fish/animals/drinking water • harm to humans/cancer/radiation poisoning/ damage to cells/mutation of cells or DNA • difficulty in transporting safely/ stolen by terrorists fears of local people solutions for dealing with nuclear waste safely • long term storage,	**(6)**

		underground /under the sea radiation shielding, lead/steel/concrete/ containers, sealed in glass. human safety, radiation suits, using tongs/lead jackets safe location, away from people/remote areas/sea cooling, ponds information to persuade local people of safety	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation mentioning at least one point, but without linking, e.g. radioactivity is dangerous ; nuclear waste should be stored underground ; terrorists might steal nuclear waste; • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation mentioning two points with an appropriate linkage e.g. nuclear waste is dangerous and it must be stored underground ; the isotopes in nuclear waste have long half-lives so they must be stored for a long time; • 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 explanation mentioning a range of points with appropriate linkages e.g. gamma rays from nuclear waste causes damage to cells so it must be stored away from where people live ; the isotopes in nuclear waste have long half-lives so they must be stored underground or in remote areas; • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q2.

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 **Diagnosis** Tracers radioactive sources swallowed by or injected into patients travel around the body emit gamma radiation (from radioactive decay) gamma radiation passes out through the body detected outside the body with a gamma camera PET Scanner (more of) the tracer goes to the cancer cells gamma radiation is emitted (gamma rays) from/in different directions gamma detected by gamma cameras (3D) pictures produced on a computer screen Named tracer, e.g. technetium, iodine, fluorine	**(6) AO1**

	Treatment Radiotherapy Use of gamma rays/x-rays kills cancer (cells) radiating small area of body (with gamma rays/X rays) radiation used for a short time (gamma rays) from/in different directions brachytherapy radioactive sources inside the body may not be removed put close to cancerous tumour **Ignore references to chemotherapy**	

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 description 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 description 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 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	<u>Additional guidance</u> isolated facts about cancer diagnosis or cancer treatment using radioactivity OR limited description about cancer diagnosis **or** limited description about cancer treatment using radioactivity OR allow isolated facts about cancer diagnosis using x-rays, C(A)T scans, MRI, ultrasound for level 1 if no other mark scored	<u>Possible candidate responses</u> Uses/emits gamma (rays) can kill cancer(ous) cells radiotherapy Cancer is treated using gamma rays CT scan is used to find tumours
Level 2	3–4	<u>Additional guidance</u> limited description about cancer diagnosis **and** limited description about cancer treatment using radioactivity OR detailed description of either cancer diagnosis or treatment using radioactivity	<u>Possible candidate responses</u> PET scans are used in diagnosis and radiotherapy is used to treat cancer OR Cancer is treated using gamma rays, the gamma rays kill the cancer cells

Level 3	5–6	Additional guidance detailed description about either diagnosis OR cancer treatment using radioactivity AND limited description about either cancer treatment OR diagnosis using radioactivity	Possible candidate responses Tracers are used in diagnosis and radiotherapy uses gamma rays to kill cells. OR Tracers emit gamma rays which pass out through the body and radiotherapy uses x-rays

Q3.

Question number	Answer	Mark
	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**

Q4.

	Answer	Additional guidance	Mark
(i)	one from: high temperature (1) high pressure (1) high (particle) density (1) high (particle) speed / KE (1)	 allow 'heat' for 'temperature' in this context	(1) AO1

	Answer	Additional guidance	Mark
(ii)	description to include: (two) isotopes/nuclei/atoms (1) fusing (1)	 hydrogen allow joining / coming together / bonding IGNORE collide	(2) AO2

	Answer	Additional guidance	Mark
(iii)	substitution (1) $\underline{1.32 (\times 10^3)}$ $4.92 (\times 10^2)$ evaluation (1) 2.68	 accept 110 : 41 for 2 marks 11 : 41 for 1 mark POT error scores 1 award full marks for the correct answer without working	(2) AO2