

Q1.

Question	Answer	Mark
	<p>A gamma rays</p> <p>B X-rays, C ultraviolet, D microwaves, all applied externally</p>	<p>1 AO1.1</p>

Q2.

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

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

	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



Q3.

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

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	<p>An explanation linking four from:</p> <ul style="list-style-type: none"> • 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) 	<p>pair</p> <p>at 180°(to each other)</p> <p>gamma cameras/scintillation crystals idea of triangulation</p>	(4)

Q4.

Question number	Answer	Additional guidance	Mark
(i)	reading from graph and substitution (1) $= \frac{19.5}{50} \times 100$ evaluation (1) 39 (%)	allow use of values between 19 and 20 inclusive allow values between 38(%) and 40(%) inclusive award full marks for correct answer without working.	(2) AO2.1

Question number	Answer	Additional guidance	Mark
(ii)	a description to include any two from they collide (1) annihilate (1) (releasing a pair of) gamma ray(s) (1)	ignore interact / combine / attract / meet allow (charges) cancel / neutralise / become neutral photons release energy ignore light	(2) AO1.1

Q5.

Question	Answer	Additional guidance	Mark
(i)	<p>explanation linking any 3 from:-</p> <p>positrons and electrons annihilate (1)</p> <p>(two) gamma (rays) produced/emitted (1)</p> <p>in opposite directions /at 180° (1)</p> <p>detected by radiation detector/ gamma cameras/scintillation counters (1)</p> <p>at (almost) the same time (1)</p> <p>time difference gives distance difference (1)</p>	<p>ignore positrons for this marking point</p> <p>allow triangulation</p>	<p>3</p> <p>AO2.2</p>
Question	Answer	Additional guidance	Mark
(ii)	<p>explanation linking any two from</p> <p>must be used a short time after production (1)</p> <p>half-life is short (1)</p>	<p>must be used while activity is high</p>	<p>2</p> <p>AO1.2</p>
	<p>activity decreases rapidly/decays rapidly (1)</p>	<p>accept decays before use / does not last long</p>	

Q6.

Question Number	Answer	Additional guidance	Mark
(i)	an explanation including: (fluorine-18 has) a short half-life (1) (so) it must be used as soon as possible after making (1)	decays too quickly related to transport / proximity ignore arguments about harm to person / the environment	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>an explanation including:</p> <p>alpha short range/low penetration (1)</p> <p>(so) needs to be close to the tumour (1)</p> <p>gamma long range/high penetration (1)</p> <p>(so) can get into the body from outside (1)</p>	<p>accept highly ionising</p> <p>accept weakly ionising</p> <p>pass through the skin</p> <p>'alpha more ionising than gamma' 1 mark by itself</p>	(4)