Revision Sheet

A-Level Physics · Unit 24 Medical physics

9 vocabulary items · 37 marks of exam questions (4 questions)

Part 1 · Vocabulary review answer key. Section A wants the exact English spelling.

Question	Answer	Marks
1	contrast	1
2	transducer	1
3	ultrasound	1
4	specific acoustic impedance	1
5	intensity reflection coefficient	1
6	attenuation coefficient	1
7	computed tomography	1
8	tracer	1
9	positron emission tomography	1

10(a)	to produce a 3-dimensional image of structure/body
10(b)	X-rays (are used)
	scanning in sections
	scanning from many angles
	image of each section is 2-dimensional
	scanning repeated for many sections **or** images of many sections combined together

11(a)	substance containing radioactive nuclei that is introduced into the body *or* substance containing radioactive nuclei that is absorbed by the tissue being studied
11(b)(i)	a particle interacting with its antiparticle so that mass is converted into energy
11(b)(ii)	electron(s) and positron(s)
11(c)(i)	$E = 2mc^2$ $= 2 \times 9.11 \times 10^{-31} \times 3.00 \times 10^{-82}$ $= 1.64 \times 10^{-13}$ J
11(c)(ii)	$\lambda = \frac{2hc}{E}$ $= \frac{2 \times 6.63 \times 10^{-34} \times 3.00 \times 10^{8}}{1.64 \times 10^{-13}}$
	$= 2.43 \times 10^{-12}$ m
11(d)	Any 3 from: • the two gamma photons travel in opposite directions • gamma photons detected (outside body / by detectors) • gamma photons arrive (at detector) at different times • determine location of production (of gamma) • image of tracer concentration in tissue produced

12(a)(i)	electrons decelerate (on hitting target) so X-ray photons produced
	range of decelerations
	photon energy depends on (magnitude of) deceleration
12(a)(ii)	$eV = \frac{hc}{\lambda}$
	$\lambda = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{1.6\times10^{-19}\times15000}$
	$= 8.3\times10^{-11} m$
	or $E = hf$ and $c = f\lambda$ and electron energy = eV *or* $E = hc / \lambda$ and electron energy = eV electron energy = $1.6 \times 10^{-19} \times 15000$ $= 2.4 \times 10^{-15}$
	$\lambda = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{2.4\times10^{-15}}$
	$\lambda = 8.3\times10^{-11} m$
12(b)(i)	μ = – gradient *or* ln $(I / I_o) = -\mu x$
	(e.g. 2.08 / 10.0) = **0.21** cm^{-1}
12(b)(ii)	$\ln(0.05) = -\mu x$
	$x = \frac{\ln 0.05}{-\mu}$ $e.g.\ x = 14\,cm$

13(a)(i)	material introduced into the body **and** (position in body) can be detected **or** absorbed by the tissue (being studied)
13(a)(ii)	X = β^+ **or** e^+ **and** $P = 1$
	$Q = 0$ **and** $R = 18$
13(b)(i)	positrons (emitted in the decay) and electrons annihilate
	mass of particles becomes energy of gamma photons
13(b)(ii)	arrival times of photons are processed
	image built up of tracer concentration in the tissue
13(c)(i)	$A = \lambda N$ **and** $\lambda = \ln 2 / T$
	$N = n \times N_A$
	2 photons produced from each decay, so $R_0 = 2 \times \lambda \times n \times N_A$ $R_0 = (2 \ln 2)\, nN_A / T$ (*allow 0.693 for ln 2*)
13(c)(ii)	sketch: exponential decay curve from $t = 0$ to $t = 2T$, starting at $(0, R_0)$ and with a negative gradient of continuously decreasing magnitude
	line with negative gradient passing through $(T, R_0/2)$ and $(2T, R_0/4)$