Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic : 11_Nuclear Radiation

Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Mark Schemes

Q1.

Question Number	Answer		Mark
(a)(i)	Ionising radiation removes electrons from atoms/molecules	(1)	1
(a)(ii)	Least ionising → most ionising γ | β | α	(1)	1
(b)(i)	See table below	(1) (1) (1)	3
(b)(ii)	(There is the possibility of) exposure to neutrons Uncharged particles are not (directly) ionising	(1) (1)	2
	Total for question		7

	Paper	0.5 cm aluminium	0.5 cm lead
α radiation	**stopped**	stopped	**stopped**
β radiation	**passes through**	**stopped**	stopped
γ radiation	passes through	**passes through**	**passes through**

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• The energy equivalent to the mass deficit **(1)** • When nucleons bind together to form an atomic nucleus **(1)**		2

Q3.

Question Number	Answer		Mark
(a)(i)	Use of $\lambda t_{1/2} = \ln 2$	(1)	
	$\lambda = 5.8 \times 10^{-8}\ (s^{-1})$	(1)	
	Use of $\frac{\Delta N}{\Delta t} = -\lambda N$	(1)	
	$\frac{\Delta N}{\Delta t} = (-)1.5\times10^{8}$ Bq [accept s^{-1} **Or** counts s^{-1}]	(1)	**4**
	Example of calculation		
	$\lambda = \frac{0.693}{(138\times24\times3600)s} = 5.81\times10^{-8}s^{-1}$		
	$\frac{\Delta N}{\Delta t} = -5.81\times10^{-8}s^{-1}\times2.54\times10^{15} = -1.48\times10^{8}$ Bq		
(a)(ii)	Use of $N = N_0 e^{-\lambda t}$	(1)	
	Fraction of nuclei remaining = 0.90	(1)	
	10% of nuclei have decayed [accept 0.1 **Or** 1/10]	(1)	**3**
	Example of calculation		
	t = 21 × 24 × 3600 s = 1 814 400 s		
	$\frac{N}{N_0} = e^{-5.81\times10^{-8}s^{-1}\times1.81\times10^{6}s}$		
	$\frac{N}{N_0} = e^{-0.105} = 0.900$		
	Fraction decayed = 1- 0.9 = 0.1		

(b)	Idea that α-particles are not able to penetrate the (dead layer of) skin (from outside the body) Damage/danger if energy is transferred to cells/DNA **Or** damage/danger to cells/DNA due to ionisation	(1) (1)	**2**
(c)(i)	$^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}\alpha$ Top line correct Bottom line correct	 (1) (1)	**2**
(c)(ii)	So that momentum is conserved	(1)	**1**
(d)	Spontaneous means that the decay cannot be influenced by any external factors. Random means that we cannot identify which atom/nucleus will (be the next to) decay **Or** we cannot identify when an individual atom/nucleus will decay **Or** we cannot state exactly how many atoms/nuclei will decay in a set time **Or** we can only estimate the fraction of the total number that will decay in the next time interval	(1) (1)	**2**
(e)	Idea that traces of the isotope will be excreted from the body (and deposited in the surroundings) Idea that the half life is long enough for the activity to be detectable for a long time	(1) (1)	**2**
	Total for question		**16**