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

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Name of the Student:____

Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

Question Number	Answer		Mark
(a)	Use of $\lambda = \ln 2/t_{1/2}$ $\lambda = 1.22 \times 10^{-4}$ (yr^{-1}) [$\lambda = 3.86 \times 10^{-12}$ (s^{-1}), $\lambda = 2.31 \times 10^{-10}$ (min^{-1})] Use of $A = A_0 e^{-\lambda t}$ $t = 950$ (yr) [if $\lambda = 1.2 \times 10^{-4}$, then $t = 960$ (yr)] [credit answers that use a constant ratio method to find the number of half lives elapsed] Example of calculation $\lambda = \frac{0.693}{5700\text{ yr}} = 1.22 \times 10^{-4}\text{ yr}^{-1}$ $14.7\text{s}^{-1} = 16.5\text{s}^{-1} \times e^{-1.22\times10^{-4}\text{ yr}^{-1}\times t}$ $t = \frac{\ln\left(\frac{14.7\text{s}^{-1}}{16.5\text{s}^{-1}}\right)}{-1.22\times10^{-4}\text{ yr}^{-1}} = 947\text{ yr}$	(1) (1) (1) (1)	4
(b)	Initial value of count rate should be bigger than 16.5 min^{-1} **Or** greater count rate from living wood in the past [e.g. A/A_0 smaller] **Or** initial value of count rate underestimated in the calculation **Or** Initial number of undecayed atoms greater [e.g. N/N_0 smaller] Age of sample has been underestimated **Or** ship is older than 950 yr **Or** sample has been decaying for a longer time [If a calculation has been carried out to show that a greater value of initial activity leads to a greater age, then award both marks]	(1) (1)	2

Q2.

Question Number	Acceptable answers		Additional guidance	Mark
	• Alpha won't penetrate the plastic so the gas can't escape • Alpha won't penetrate the plastic so there is no risk	(1) (1)	For MP1, accept answers in terms of the small range of alpha particles in the air in the bag	2

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	• top: 40, 0 (1) • bottom: 20, -1 (1)		2

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Top line correct (1) • Bottom line correct (1)	Example of equation $^{137}_{55}Cs \rightarrow ^{137}_{56}Ba + ^{0}_{-1}\beta^{-} + ^{0}_{0}\bar{\nu}_e$	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Use of $\lambda = \frac{\ln 2}{t_{1/2}}$ (1) • Use of 5000 m^3 (1) • Use of $A = A_0 e^{-\lambda t}$ (1) • t = 1400 year (1)	Example of calculation $\lambda = \frac{\ln 2}{30 \text{ year}} = 0.0231 \text{ year}^{-1}$ $100 \text{ Bq} = (5000 \times 2.35 \times 10^{12})\text{Bq} \times e^{-0.0231 \text{ year}^{-1} \times t}$ $\therefore t = \frac{\ln(8.51 \times 10^{-15})}{-0.0231 \text{ year}^{-1}} = 1402 \text{ year}$	4

Q5.

Question Number	Acceptable answers	Additional guidance	Mark
	• High temperature so sufficient (kinetic) energy to overcome the repulsion between (positively charged) ions/nuclei (1) • High density to ensure ions close enough to each other to maintain collision rate to maintain fusion (1)		2