

- 12 (a) A sample of a radioactive isotope contains N nuclei of the isotope at time T . At time $(T + \Delta T)$, the sample contains $(N - \Delta N)$ nuclei of the isotope. The time interval ΔT is short.

Use the symbols N , ΔN , T and ΔT to give expressions for:

- (i) the average activity of the sample during the time ΔT

..... [1]

- (ii) the probability of decay of a nucleus in the time ΔT

..... [1]

- (iii) the decay constant λ of the isotope.

..... [1]

- (b) The isotope polonium-208 ($^{208}_{84}\text{Po}$) is radioactive and decays to form lead-204 ($^{204}_{82}\text{Pb}$). The nuclear equation for this decay is



Data for nuclear masses are given in Fig. 12.1.

	mass/u
^4_2He	4.002 603
$^{204}_{82}\text{Pb}$	203.973 043
$^{208}_{84}\text{Po}$	207.981 245

Fig. 12.1

- (i) Determine, for the decay of one nucleus of polonium-208:

1. the change, in u, of the mass

$$\text{mass change} = \dots \text{u} \quad [1]$$

2. the total energy, in pJ, released.

energy = pJ [3]

- (ii) The polonium-208 nucleus is initially stationary. The initial kinetic energy of the ${}^4_2\text{He}$ nucleus (α -particle) is found to be less than the energy calculated in (i) part 2.

Suggest **two** possible reasons for this difference.

1.

.....

2.

.....

[2]

[Total: 9]

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