For Examiner's Use

5 Plutonium–239 decays by α-emission to form the isotope uranium–X. The half-life of plutonium–239 is 2.4×10^4 years. The half-life of uranium-X is 7.1×10^8 years.

(a) (i) Explain the term *isotope*.

.....

.....[1]

(ii) Define *half-life*.

.....

.....[1]

(iii) Complete the nuclear equation for the nuclear reaction below.

$$^{239}_{\cdots}\text{Pu} \rightarrow {}^{\cdots}_{92}\text{U} + {}^{\cdots}_{\cdots}\alpha$$ [2]

(b) A pure sample of plutonium–239 has N nuclei at time $t = 0$. On Fig. 5.1, sketch graphs to show the variation with t of the number of nuclei of

(i) plutonium–239 (label this graph P),

(ii) uranium–X (label this graph U).

Your graphs should cover the range from $t = 0$ to $t = 5.0 \times 10^4$ years.

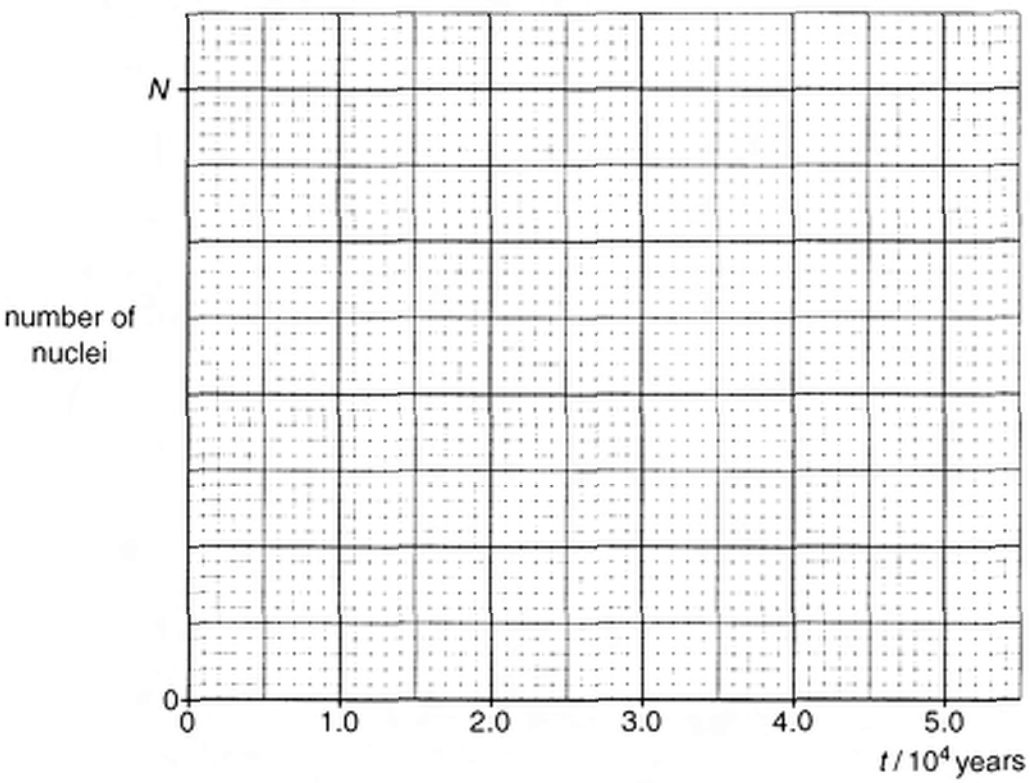

Fig. 5.1

[3]

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(c) In the nuclear reaction in **(a)**, 5.26 MeV of energy is released. The energy of the emitted α-particle is 5.15 MeV.

Suggest and explain why these two values are different.

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.....[2]