6 **(a)** Explain what is meant by the *activity* of a radioactive source.

.....

.....

..... [1]

(b) A sample of pure $^{235}_{92}U$ has a mass of 2.40×10^{-6} g has an activity of 0.1919 Bq.

(i) Determine the number of radioactive nuclei in this sample.

number of radioactive nuclei = ... [2]

(ii) Hence, calculate the decay constant of $^{235}_{92}U$.

decay constant = ... s^{-1} [2]

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[Question continues next page.]

(c) The nuclide Potassium-42 $\left({}^{42}_{19}\mathrm{K}\right)$ undergoes radioactive decay to become Calcium-42 $\left({}^{42}_{20}\mathrm{Ca}\right)$.

A fresh sample of radioactive material contains N_o nuclei of Potassium-42 and no Calcium-42 at time t = 0. Fig. 6.2 shows the variation with time t of the ratio of the number N of nuclei of Potassium-42 to its original number N_o.

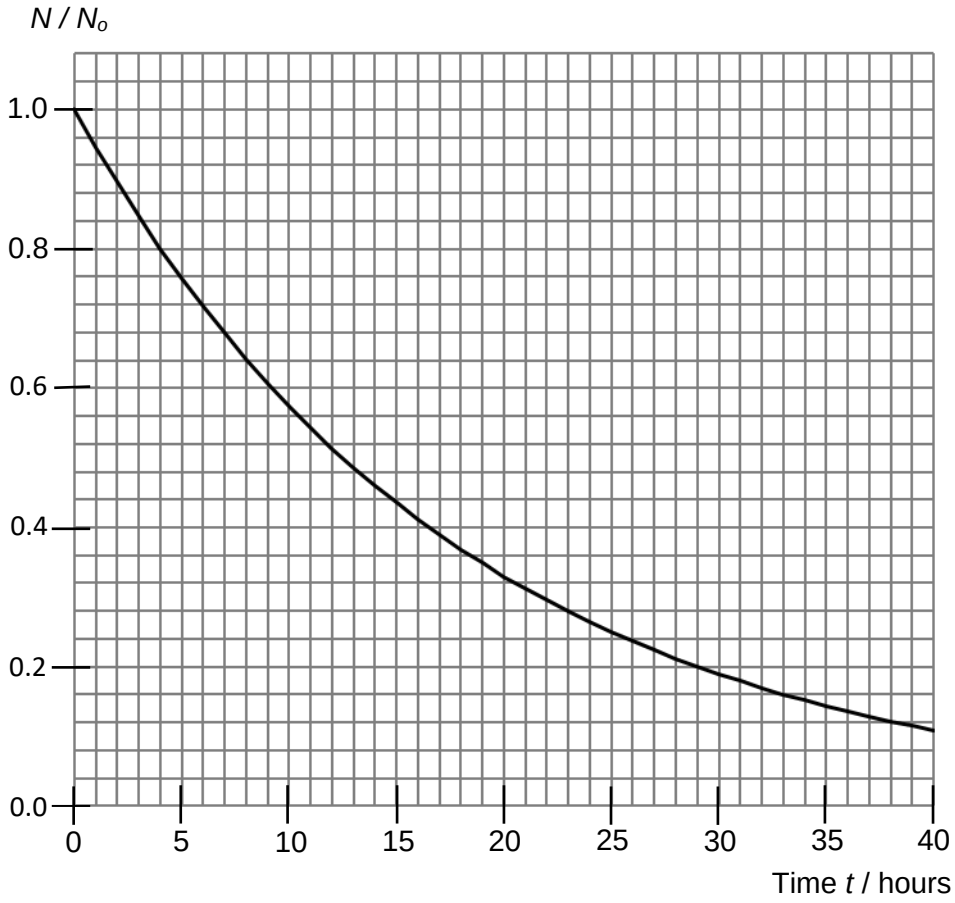

Fig. 6.2

(i) State the particles emitted in the radioactive decay of Potassium-42.

.....[1]

(ii) Use Fig 6.2 to estimate the half-life of Potassium-42 in hours.

half-life = ...h [1]

(iii) Calcium-42 is stable. On Fig. 6.2, sketch a graph to show the variation with time t of the number of Calcium-42 atoms in the sample. [2]

(iv) Using Fig. 6.2, or otherwise, determine the age of the radioactive sample when the ratio $\frac{\text{Number of Calcium-42 atoms}}{\text{Number of Potassium-42 atoms}}$ is equal to 4.0.

age = ...h [2]

[Total: 11]