

Potassium-42 is a radioactive isotope of potassium that is artificially produced in the laboratories for use in medical research studies involving potassium metabolism.

The nuclide Potassium-42 ($^{42}_{19}\text{K}$) undergoes radioactive decay to become Calcium-42 ($^{42}_{20}\text{Ca}$), a stable nuclide. A radioactive sample contains N_0 atoms of Potassium-42 at time $t = 0$. Fig. 7.1 shows the variation with time t of the number N of atoms of Potassium-42.

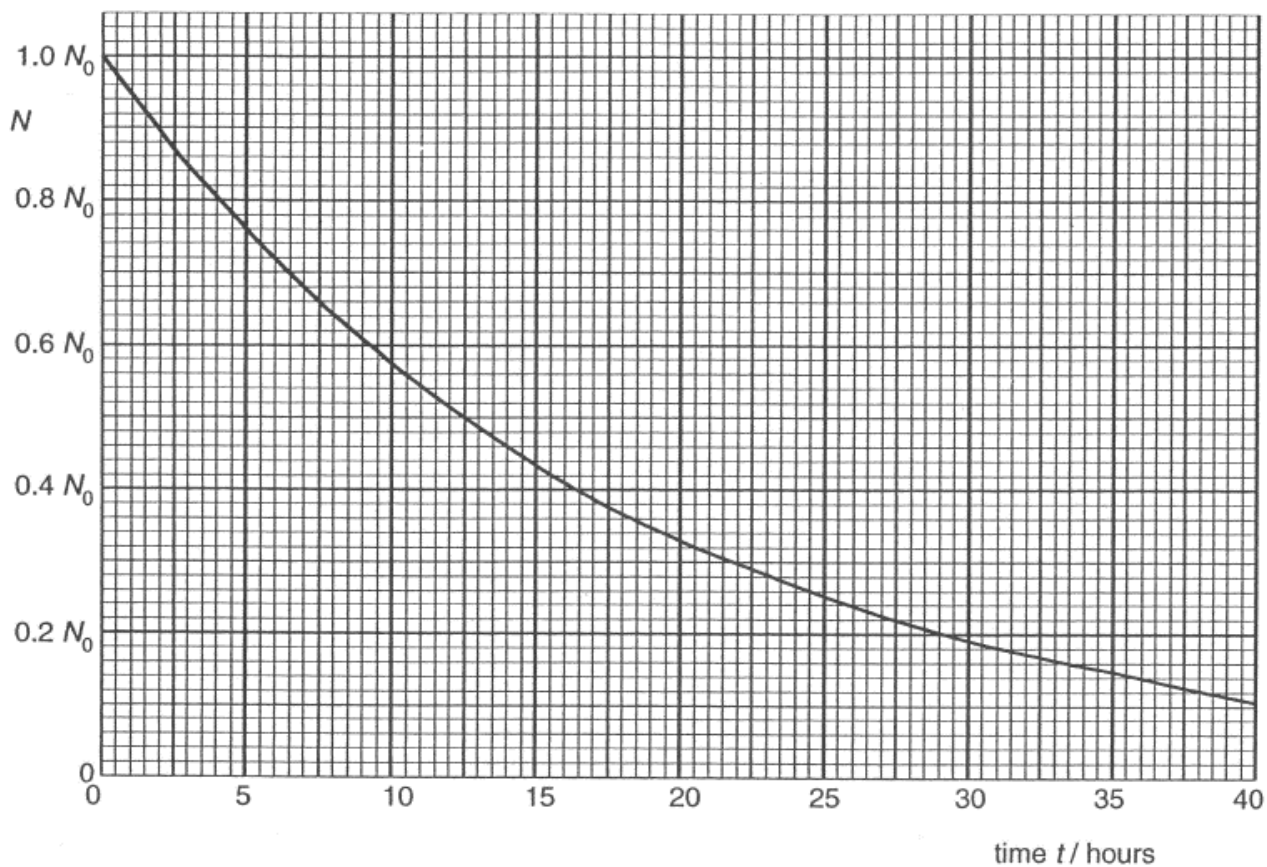


Fig. 7.1

(a)

Define *half-life* of a radioactive sample.

.....[1]

|

(b)

Explain what is meant by the *activity* of a radioactive sample.

.....[1]

(c)

(i)

Use Fig. 7.1 to determine the probability per unit time that Potassium-42 decays.

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probability per unit time = s^{-1} [3]

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(ii)

Determine, in terms of N_0 , the activity of Potassium-42 at $t = 27.5$ hours.

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activity = N_0 Bq [2]

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(d)

Fig. 7.2 shows the variation of the logarithm of the activity A with time t for the decay of Potassium-42.

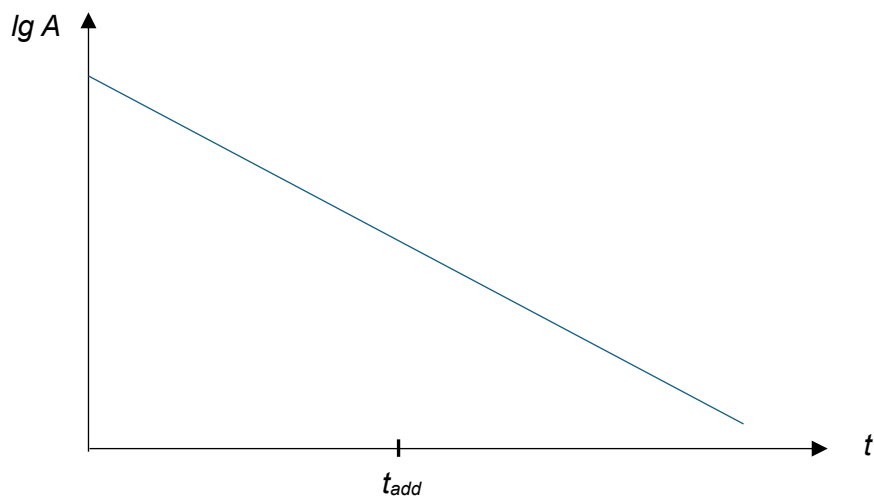


Fig. 7.2

(i)

If more Potassium-42 is added to the sample at time t_{add} , sketch on Fig. 7.2 the new variation of the logarithm of A with time t . Label this graph **P**.

(ii)

If instead of more Potassium-42, another nuclide of a *very much shorter* half-life were added, sketch also on Fig. 7.2 the new variation of the logarithm of A with time t . Label this graph **Q**.
[2]

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[Total: 9]