

- 10** Carbon-15 ($^{15}_6\text{C}$) is an isotope of carbon that undergoes radioactive decay to nitrogen-15 ($^{15}_7\text{N}$), which is a stable isotope of nitrogen.

Radioactive decay is both a random and a spontaneous process.

- (a) State what is meant by:

(i) random

.....
..... [1]

(ii) spontaneous.

.....
..... [1]

- (b) A small sample of carbon-15 decays. The mass M of carbon-15 in the sample decreases with time t .

Fig. 10.1 shows the variation with t of the value of $\ln(M/10^{-16}\text{g})$.

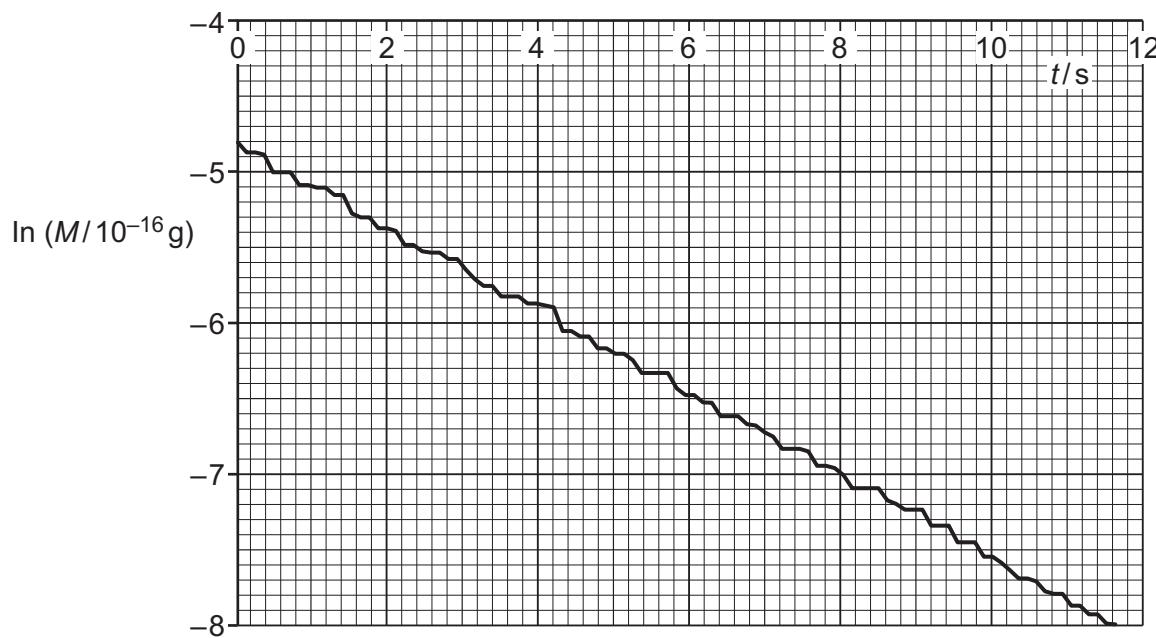


Fig. 10.1

- (i) State how Fig. 10.1 demonstrates that radioactive decay is random.

.....
..... [1]

- (ii) On Fig. 10.1, draw the straight line of best fit. [1]

- (iii) Show that the decay constant λ of carbon-15 is given by the magnitude of the gradient of your line in (b)(ii).

[1]

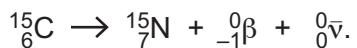
- (iv) Use your line in (b)(ii) to determine λ . Give a unit with your answer.

$$\lambda = \dots \text{unit} \dots [2]$$

- (v) Use your answer in (b)(iv) to calculate the half-life of carbon-15.

$$\text{half-life} = \dots \text{s} [1]$$

- (c) The equation for the decay of carbon-15 can be written as



State and explain how the mass of the products of the decay must compare with the mass of the carbon-15 nucleus.

.....

 [2]