**9** Carbon-11 is radioactive and decays by $\beta^+$ emission to form boron-11. Carbon-11 has a half-life of 20 minutes. Boron-11 is stable.

**(a)** Define half-life.

.....

..... [1]

**(b)** A sample contains $N_0$ nuclei of carbon-11 and no other nuclei at time $t = 0$.

On Fig. 9.1, sketch the variation with $t$ of the number of nuclei of **boron-11** in the sample.

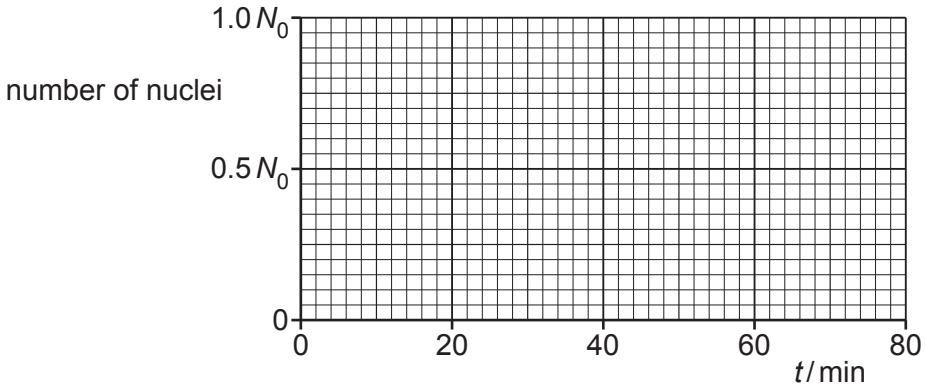


**Fig. 9.1**

[3]

**(c)** **(i)** Explain, with reference to the random nature of radioactive decay, why the activity of the carbon-11 sample in **(b)** decreases with time.

.....

.....

..... [2]

**(ii)** State, with reasons, whether a radiation detector placed near to the sample of carbon-11 indicates a measured count rate from the sample that is less than, the same as or greater than the activity of the sample.

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.....

.....

..... [3]

[Total: 9]