

**6** Radioactive decay is a *random* and *spontaneous* process.

**(a)** Explain what is meant by

**(i)** a random process,

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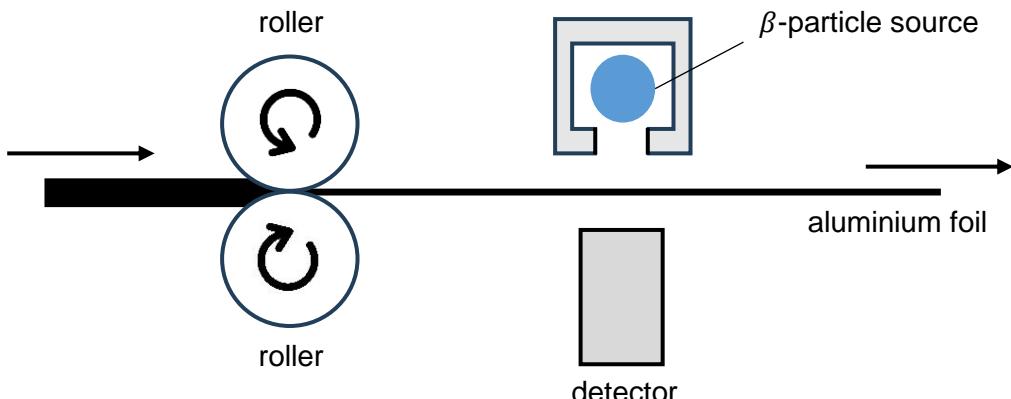
[1]

**(ii)** a spontaneous process.

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[1]

- (b) Fig 6.1 illustrates the use of  $\beta$ -radiation to monitor the thickness of a sheet of aluminium foil. The output from the detector controls the separation of the rollers with the intention to maintain a constant foil thickness.



**Fig. 6.1**

The setup in Fig 6.1 is then installed with a  $\beta$ -radiation source of half-life 14 days and then used for a working day of 8.0 hours.

- (i) Suggest and explain why a  $\beta$ -radiation source was used for monitoring changes instead of a  $\gamma$ -radiation source.

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[2]

- (ii) Determine the decay constant of the  $\beta$ -radiation source.

$$\text{decay constant} = \dots \text{ s}^{-1} [2]$$

- (iii) Determine the ratio  $\frac{\text{activity of source at end of working day}}{\text{activity of source at start of working day}}$

$$\text{ratio} = \dots [2]$$

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- (iv) Due to an error, the set up was programmed to maintain a constant foil thickness based on the detector output at the start of the working day without making any allowance for radioactive decay.

With reference to your answer in (b)(ii), state and explain the changes in foil thickness at the end of one working day.

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[2]

[Total: 10]