

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

(a) Explain what is meant by

(i) a random process,

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

(ii) a spontaneous process.

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

- (b) Fig 6.1 illustrates the use of β -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.

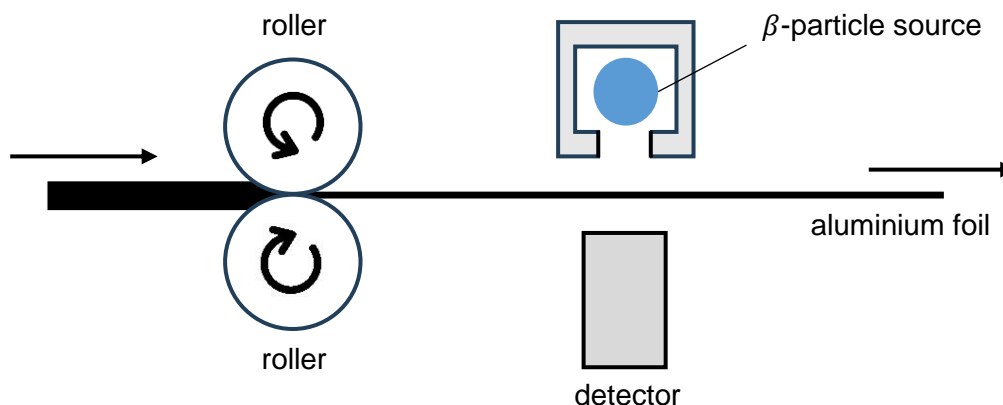


Fig. 6.1

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

- (i) Suggest and explain why a β -radiation source was used for monitoring changes instead of a γ -radiation source.

.....

 [2]

- (ii) Determine the decay constant of the β -radiation source.

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

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

ratio = [2]

- (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.

.....

.....

..... [2]

[Total: 10]