

- 8 The isotope phosphorus-33 ( $^{33}_{15}\text{P}$ ) undergoes  $\beta$ -decay to form sulfur-33 ( $^{33}_{16}\text{S}$ ), which is stable.  
The half-life of phosphorus-33 is 24.8 days.

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

.....  
 .....  
 ..... [2]

(ii) Show that the decay constant of phosphorus-33 is  $3.23 \times 10^{-7} \text{ s}^{-1}$ .

[1]

(b) A pure sample of phosphorus-33 has an initial activity of  $3.7 \times 10^6 \text{ Bq}$ .

Calculate

(i) the initial number of phosphorus-33 nuclei in the sample,

number = ..... [2]

(ii) the number of phosphorus-33 nuclei remaining in the sample after 30 days.

number = ..... [2]

- (c) After 30 days, the sample in (b) will contain phosphorus-33 and sulfur-33 nuclei.  
Use your answers in (b) to calculate the ratio

For  
Examiner's  
Use

$$\frac{\text{number of phosphorus-33 nuclei after 30 days}}{\text{number of sulfur-33 nuclei after 30 days}} .$$

ratio = .....[2]