

12 (a) State what is meant by *radioactive decay*.

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.....[2]

(b) An unstable nuclide P has decay constant  $\lambda_P$  and decays to form a nuclide D. This nuclide D is unstable and decays with decay constant  $\lambda_D$  to form a stable nuclide S. The decay chain is illustrated in Fig. 12.1.

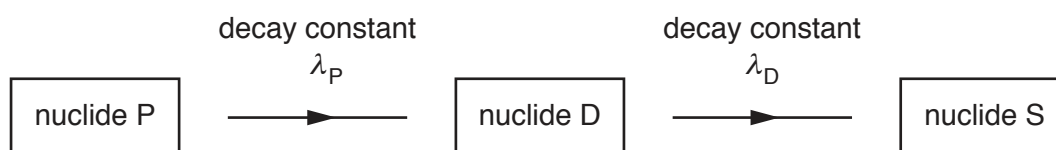


Fig. 12.1

The symbols P, D and S are not the nuclide symbols.

Initially, a radioactive sample contains only nuclide P.

The variation with time  $t$  of the number of nuclei of each of the three nuclides in the sample is shown in Fig. 12.2.

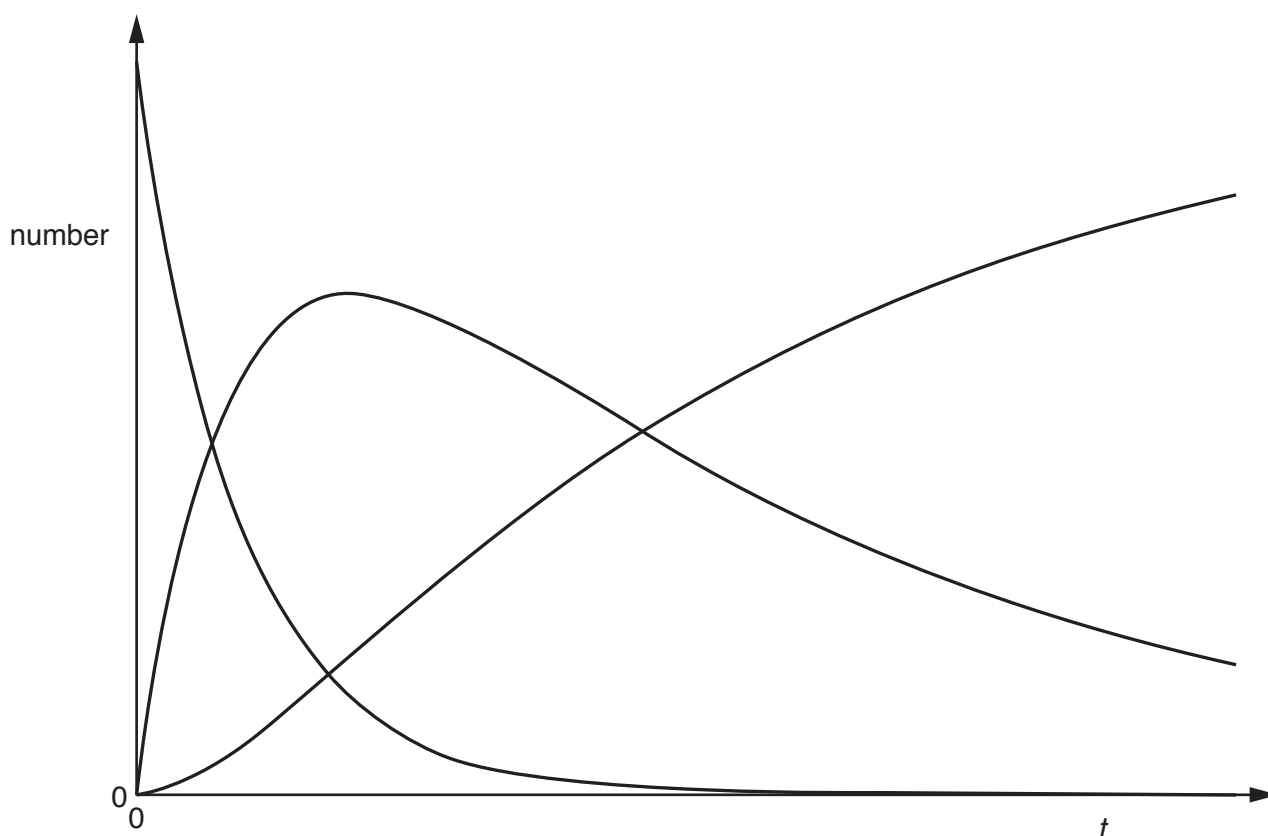


Fig. 12.2

(i) On Fig. 12.2, use the symbols P, D and S to identify the curve for each of the three nuclides. [2]

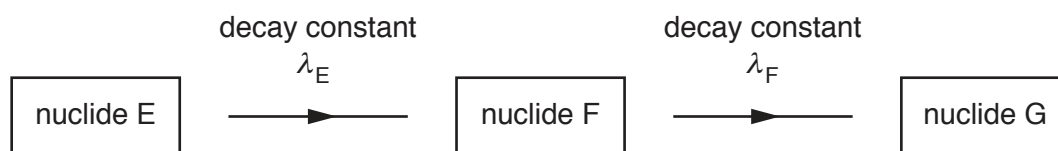
(ii) The half-life of nuclide P is 60.0 minutes.

Calculate the decay constant  $\lambda_P$ , in  $\text{s}^{-1}$ , of this nuclide.

$$\lambda_P = \dots\dots\dots \text{s}^{-1} \quad [2]$$

(c) In the decay chain shown in Fig. 12.1,  $\lambda_P$  is approximately equal to  $5\lambda_D$ .

The decay chain of a different nuclide E is illustrated in Fig. 12.3.



**Fig. 12.3**

The decay constant  $\lambda_F$  of nuclide F is very much larger than the decay constant  $\lambda_E$  of nuclide E.

By reference to the half-life of nuclide F, explain why the number of nuclei of nuclide F in the sample is always small.

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 ..... [2]

[Total: 8]

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