

**Nuclear Physics – 2021 A2**

1. Nov/2021/Paper\_41/No.12

(a) Define radioactive *decay constant*.

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

(b) A sample of radioactive iodine-131 ( $^{131}_{53}\text{I}$ ) of mass  $5.87 \times 10^{-10}$  kg has an activity of  $2.92 \times 10^9$  Bq.

Determine the decay constant of iodine-131.

decay constant = .....  $\text{s}^{-1}$  [3]

(c) Suggest **two** reasons why a detector placed near to the sample in (b) would record a count rate much less than  $2.92 \times 10^9$  counts per second.

1. ....  
.....  
2. ....  
.....  
..... [2]

[Total: 7]

(a) Radioactive decay is both random and spontaneous.

State what is meant by:

(i) *random*

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

(ii) *spontaneous*.

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

(b) A sample of radioactive material contains atoms of an unstable nuclide X. The activity of the sample due to the atoms of X is A. The variation with time  $t$  of  $\ln A$  is shown in Fig. 12.1.

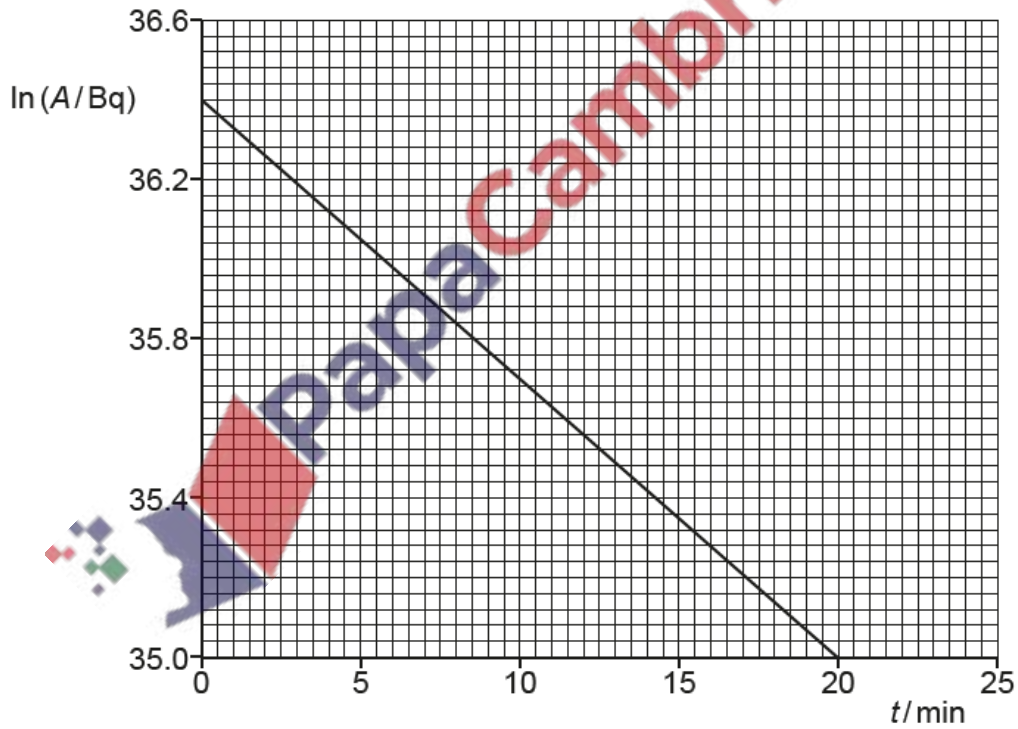


Fig. 12.1

(i) Use Fig. 12.1 to determine the half-life, in minutes, of nuclide X.

half-life = ..... min [3]

(ii) At time  $t = 0$ , the mass of the atoms of X in the sample is  $5.66 \times 10^{-7}$  kg.

Determine the nucleon number of X.



nucleon number = ..... [3]

[Total: 8]

(a) Radioactive decay is both spontaneous and random.

State what is meant by:

1. *spontaneous decay* .....
2. *random decay* .....

[2]

(b) Strontium-90 ( ${}_{38}^{90}\text{Sr}$ ) is an unstable nuclide.

The activity of a sample of  $1.0 \times 10^{-9}$  kg of strontium-90 is 5.2 MBq.

(i) Determine the decay constant  $\lambda$  of strontium-90.

$\lambda = \dots\dots\dots \text{s}^{-1}$  [3]

(ii) The activity of the sample after a time of 1.0 half lives is found to be greater than the expected 2.6 MBq.

Suggest a possible reason for this.

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

[Total: 6]