Average life of radioactive nuclei and Numericals

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Average Life period of nuclei (τ)

The statistical average of the lives of all atoms present at any time is called the average life.

Units : time

Equation $\tau = \dfrac{1}{\lambda}$ OR $\tau = 1.44 \times t_{1/2}$

Numerical Problems
1) Half life period of a radioactive element is 10 years. Calculate its disintegration constant & average life?
Solution
Data given
$t_{1/2} = 10$ years
λ = ?
τ = ?
$\lambda = 0.693 / t_{1/2}$

= $0.693 / 10$
$\lambda = 0.0693$ years $^{-1}$
$\tau = 1.44 \times t_{1/2}$

=1.44×10
τ = 14.4 years

2) Half life of $_{83}I^{125}$ is 60 days. How much of its radioactivity remains after 180 days ?

Solution
Data given
$t_{1/2}$ = 60 days ,
t = 180 days
No = 1 g
Nt = ?

$\lambda = \dfrac{0.693}{t_{1/2}}$

   = 0.693/60

λ = 0.01155 days^{-1}

$\lambda \quad = \dfrac{2.303}{t} \log \dfrac{No}{Nt}$

$0.01155 = \dfrac{2.303}{180} \log \dfrac{1}{Nt}$

$\log \dfrac{1}{Nt} \quad = 0.9027$

$\dfrac{1}{Nt} \quad = 7.993$

Nt   = 0.125g

3) Half life period of a radioactive element is 35 Hours. Calculate its disintegration constant & the time required to reduce by 63% of its initial activity?

Solution

Data given

$t_{1/2}$ = 35 Hours

N_0 = 100 %

Nt = 100 − 63 = 37 %

λ = ?

t = ?

$\lambda = 0.693 / t_{1/2}$

$_= 0.693 / 35$

$\lambda = 0.0198$ Hours^{-1}

$\lambda \quad = \dfrac{2.303}{t} \log \dfrac{No}{Nt}$

$0.0198 = \dfrac{2.303}{t} \log \dfrac{100}{37}$

$t \quad = \dfrac{2.303}{0.0198} \log 2.703$

$t \quad = 116.31 \times 0.4318$

$t \quad = 50.22$ Hours