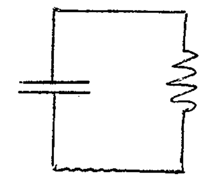
Ridioactivity



$V = IR$

$\frac{Q}{C} = \frac{-\Delta Q}{\Delta t} R$

$\frac{\Delta Q}{\Delta t} = \frac{Q}{CR}$

$Q = Q_0 e^{-t/CR}$; $t_c = CR$

λ: transition probability /per unit time

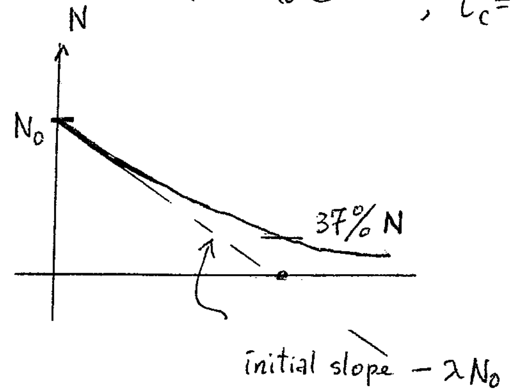
$\Delta N = -\lambda N \Delta t$; $\frac{\Delta N}{\Delta t} = -\lambda N$

$N = N_0 e^{-\lambda t}$

[Straight line approximation

$N = N_0 - \lambda N_0 t$

$N \tilde{\approx} 0$ when $t = \frac{1}{\lambda} \equiv \tau$



In fact $N(t = 1/\lambda) = 37\%\ N$

half life time $t_{1/2} = 0.693\ \tau$

Carbon dating

15 decay/gm/minute for active Carbon sample

A piece of tissue 0.5g from a prehistoric corpse, found in Alps, 1992, has a β decay rate 450 in 2 hrs. How old is the corpse? What is the error?

$\text{rate} = \frac{450}{2 \cdot 60} \frac{\text{decay}}{\text{min} \cdot 0.5g} = 7.5 \frac{\text{decay}}{\text{gm min}}$; time $= t_{\frac{1}{2}} = 5730$ year $(\pm 4.7\%$

$\text{error}(\%) = \frac{\sqrt{450}}{450} = \frac{1}{\sqrt{450}} = 4.7\%$

± 269 yrs

The Pope agrees to test the shrine of Turin by carbon dating. It was found that a peice of the cloth of 1 gm produce 38,000 decays in two days. Found the date of the shrine.

$\text{decay rates} = \frac{38000}{2 \times 24 \times 60 \text{min} \times 1 \text{gm}} = 13.2$ decay/gm/min

$13.2 = 15 e^{-\frac{t}{\tau}}$

$\frac{13.2}{15} = e^{-t/\tau}$; $-t/\tau = \ln \frac{13.2}{15} = -0.128$

$t = 0.128\ \tau = 0.128 \times \frac{5330}{0.693} = 1060$ yea