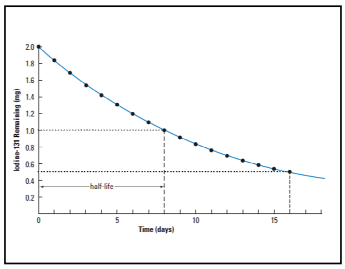
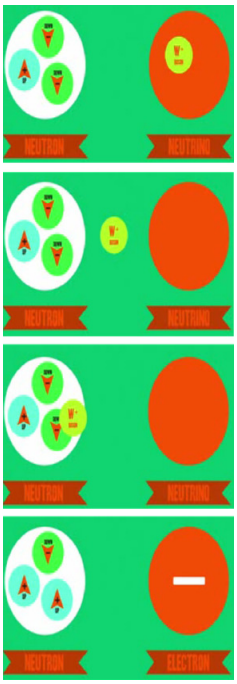
L08 – Radioactive Decay Formula

Agenda:

- Beta Decay and the Weak Force
- Half-Life Graphs
- Half-Life Equations
- Practice
  - > Pg. 817 #1, 4, 5, 6, 7, 8

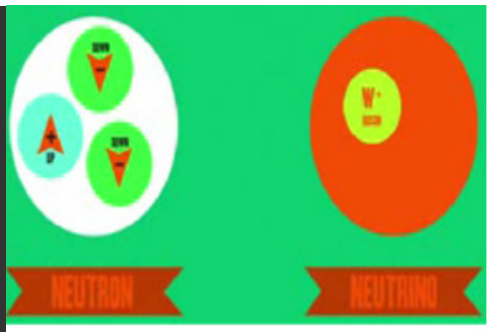
$$N = N_0\left(\frac{1}{2}\right)^n$$

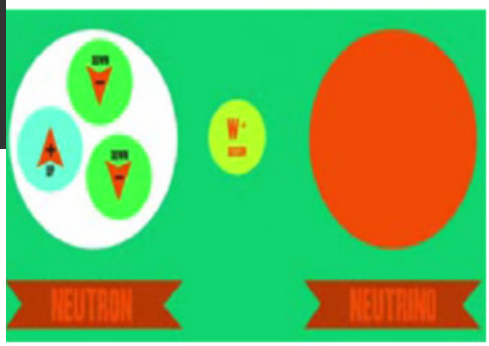


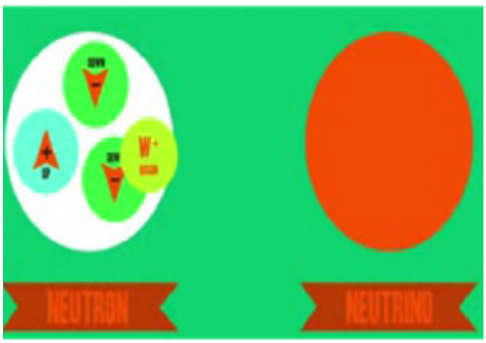


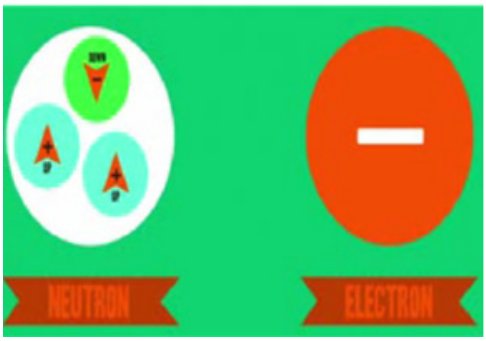
Beta Decay and the Weak Force

http://physics.tutorvista.com/modern-physics/nuclear-force.html





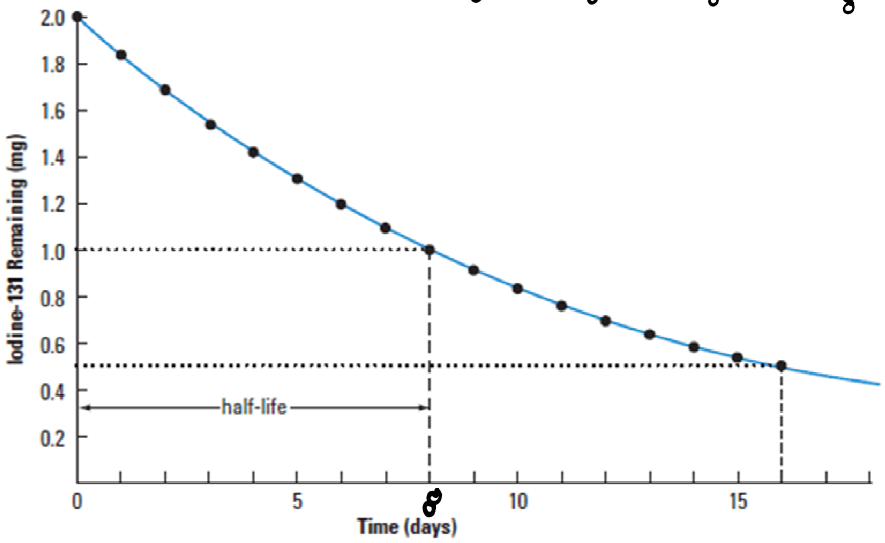




Half-Life Graphs

Half-life: The time it takes for half of the radioactive nuclei in a sample to decay

100 → 50 → 25 → 12.5 → 6.25
(÷8 ÷8 ÷8 ÷8)



Q1: Carbon 14 has a half - life of 5730 years, and it decays to Nitrogen.

$^{14}_{6}C \longrightarrow {}^{14}_{7}N$

Radioactive Dating Game

a) How long will it take for the quantity of carbon 14 in a sample to drop to one - eighth of the original value.

1 → $\frac{1}{2}$ → $\frac{1}{4}$ → $\frac{1}{8}$
(5730 5730 5730)

17,190 yrs

b) What type of decay is this? What are the other products?

$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta^{-} + \bar{\nu}$

Half-Life Equations

How you've probably seen it before:

$$A(t) = A_0\left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$

A(t) - Current number, as a function of time.

A_o - Initial number (constant).

t - time.

$t_{½}$ - time for sample to half.

As per our formula sheet:

$$N = N_0\left(\frac{1}{2}\right)^n$$

N - Current _____, as a function of time.

N_0 - Initial _____ (constant).

n - number of half-lives.

n = time ÷ half-life

So how do we measure N and N_0?

- Mass of Radioactive sample
- Number of Radioactive atoms
- Percent of Radioactive sample
- Activity: Bequerel (Bq)

Radioactive Dating Game

Q2: Radon 222 has a half life of 3.82 days. What percent of a sample of this isotope will remain after 2 weeks?

14 days

$N = N_0\left(\frac{1}{2}\right)^{n}\left(14/3.82\right)$

$N = (100)\left(\frac{1}{2}\right)^{3.66\ldots}$

$= (100)(7.884\times10^{-2})$

$= 7.884\%$

Q3: Tritium has a half life of 12.3 years. How much of a 100 mg sample of tritium will be left after 5.0 years?

$N = N_0(1/2)^n$

$N = (100)(1/2)^{(5/12.3)}$

$= 75.4\ ?$

Q4: If the activity of a radioactive sample is 28 Bq and 8.0 hours later its activity is 18 Bq, what is the half life?

$$N = N_0\left(\frac{1}{2}\right)^n$$

$18 = 28(1/2)^n$

NOT a Phys30 question.

$0.6428... = (1/2)^n$

$n = \log_{0.5}(0.6428)$

$n = \dfrac{\log_{10}(0.6428)}{\log_{10}(0.5)}$

$$y = \log_b x \quad b^y = x$$

$$\log_b x = \frac{\log_a x}{\log_a b}$$

Q5: A sample has roughly 40% of the carbon 14 it would have had at the start. How old is the object, if carbon 14 has a half life of 5730 years old?

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