21/(40) ^{14}C

38 cpm = t years, NOW "t"

58.2 cpm = "new" - START

$t_{1/2} = 5715$ yrs

$K = \frac{0.693}{t_{1/2}}$

$\ln A_t = -Kt + \ln A_0$

$\ln(38) = -(1.21 \times 10^{-4}\ yr^{-1})\,t + \ln(58.2)$

Apr 22-7:37 AM

Rock: (NOW) $\frac{0.257\ mg\ Pb\text{-}206}{1\ mg\ U\text{-}238}$ NOW

HOW OLD is The rock

$t_{1/2} = 4.5 \times 10^9$ yr

U-238 → Pb-206

UNSTABLE STABLE

START U = NOW U + NOW Pb

= 1 mg U + 0.257 mg Pb

A_0: 1.297 mg U = A_t: 1 mg U + 0.297 mg U

START

How much U was lost to get 0.257 mg Pb? (RADIOACTIVE → NON-RAD)

$0.257\ mg\ Pb \left(\frac{238\ U}{206\ Pb}\right)$ = 0.297 mg U

MASS RATIO

$\ln A_t = -Kt + \ln A_0$

$\ln(1) = (-1.54 \times 10^{-10})\,t + \ln(1.297)$

$K = \frac{0.693}{t_{1/2}}$, $t_{1/2} = 4.5 \times 10^9$ yr

$K = 1.54 \times 10^{-10}$

$t = 1.69 \times 10^9$ yr

Apr 22-7:52 AM

Practice ^{14}C = 11.6 dps , fresh = 15.2 dps

$t_{1/2}$ = 5715 yr
how old is this?

$\frac{K}{1} = \frac{0.693}{t_{1/2}}$

$K = 1.21 \times 10^{-4}\ yr^{-1}$

$\ln A_t = -Kt + \ln A_0$

$\ln(11.6) = (-1.21 \times 10^{-4})t + \ln(15.2)$

Apr 22-8:07 AM

$\ln A_t = -Kt + \ln A_0$

$\ln A_t - \ln A_0 = -Kt$

$\ln\left(\frac{A_t}{A_0}\right) = -Kt$

RATIO ≡ $\frac{\text{have now}}{\text{Total}} = \frac{\text{Part}}{\text{Whole}} \times 100 \approx \%$

Apr 22-8:12 AM

Medical imaging ^{18}F $t_{1/2} = 110\text{min}$

After 300min, What % of original radioactivity is left ??

PART / Whole

$\ln\left(\frac{A_t}{A_0}\right) = -Kt$

$K = \frac{0.693}{t_{1/2}}$

$= 0.0063 \text{ min}^{-1}$

$6.3\times10^{-3} \text{ min}^{-1}$

$\ln\left(\frac{A_t}{A_0}\right) = -(6.3\times10^{-3})(300)$

$\frac{A_t}{A_0} = 0.15 \Rightarrow 15\%$ left.

Apr 22-8:15 AM

STRONG NUCLEAR FORCES

energy that keeps nucleus stable

$E = mc^2$

$J = Kg * \left(\frac{m}{sec}\right)^2$

Find Δ Mass

Δ Mass $\Rightarrow E$

Mass defect

Nuclear binding energy

Apr 22-8:40 AM

$^{4}_{2}He$ 2p 2(1.00728) amu ← Given constant mass p+n

2n 2(1.00866)

$^{4}_{2}He$ = 4.03188 amu calculated mass

4.00150 amu Given mass

ΔM = 0.03038 amu (Mass defect)

0.03038 g/Mole

$E = mc^2$

$E = \left(\frac{0.03038 \times 10^{-3}\ kg}{mole}\right)(3\times10^8)^2$

$E = \frac{2.7342\times10^{12}\ J}{Mole\ He} \times \frac{1\ Mole\ He}{4\ nucleon} = 6.836\times10^{11}\ J/nucleon$

Find BE J/atom

$\frac{2.7342\times10^{12}\ J}{Mole\ He} \times \frac{1\ Mole\ He}{6.023\times10^{23}\ atom} = 4.557\times10^{-12}\ J/atom$

Apr 22-8:43 AM

Fission

Nuclear Power Plant

Break up

heavier mass → Lighter mass

$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3\,^{1}_{0}n$ +Energy

(236 / 92) → (233 / 92) (3 / 0)

Fusion

Add / Weld together

Smaller mass → Larger mass

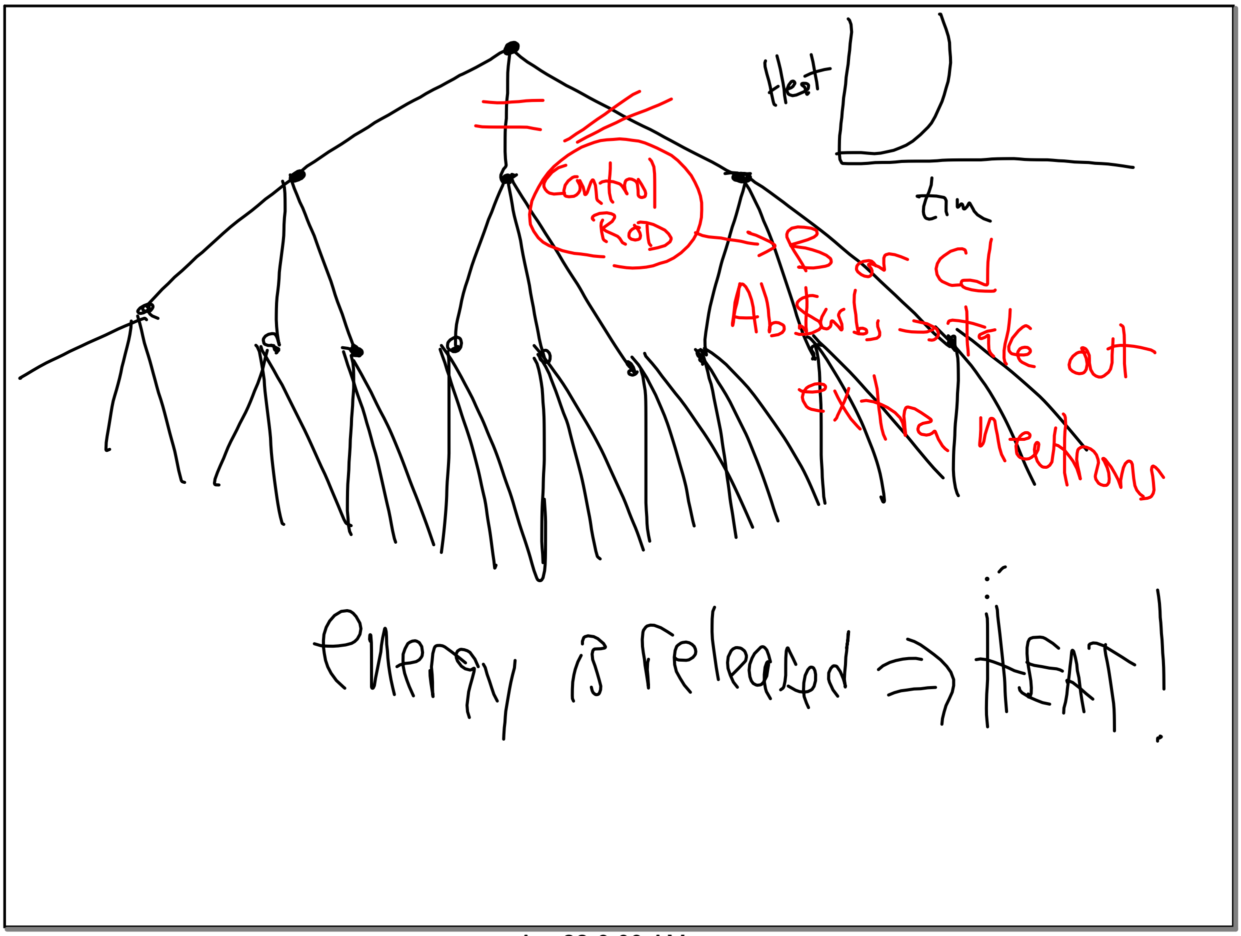
(Sun → Thermonuclear fusion 40,000,000 Kelvin)

"Cold Fusion" 5,000,000 K

$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{4}_{2}He$ + Energy

$^{1}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He$

Apr 22-8:57 AM


Heat
tim
Control
ROD
B or Cd
Absorbs ⇒ take out
extra neutrons
energy is released ⇒ HEAT!

Apr 22-9:09 AM