Gen Chem w/ Doc M

Today: 4/12 Finish Chp 19

Over Easter Break – Visit Final Exams Reviews on course website 2nd semester Exam

Tuesday: 4/18 Review in Hitchcock 108 5-6:30 pm
Wednesday: 4/19 Start Chp 11 Liquids + solids
Thursday: 4/20 Last Lab: Expt 12

$^{28}_{14}Si$ $^{29}_{14}Si$ $^{30}_{14}Si$

92.23% 4.67% 3.10%

27.976927 amu 28.976495 29.973770 Isotope mass

u

g/mol

$^{22}_{14}Si$ ... $^{27}_{14}Si$ $^{31}_{14}Si$ ... $^{39}_{14}Si$

too few neutrons
β^+-emission
(electron capture)

$^{27}_{14}Si \rightarrow {}^{0}_{+1}\beta + {}^{27}_{13}Al$

$t_{1/2} = 4.14\,s$

too many neutrons
β-emitter

$^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}\beta$

$^{31}_{14}Si \rightarrow {}^{0}_{-1}\beta + {}^{31}_{15}P$

$t_{1/2} = 2.62\,hr$

electron capture

$$^{27}_{14}Si + ^{0}_{-1}e \rightarrow ^{27}_{13}Al$$

$$^{1}_{1}p + ^{0}_{-1} \rightarrow ^{1}_{0}n$$

1st order kinetics

$$\ln\left(\frac{N_0}{N_t}\right) = kt \qquad t_{1/2} = \frac{0.693}{k}$$

N_0, N_t
one
moles
mass
percent
fraction

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

^{67}Ga is used to diagnose tumors. It has a $t_{1/2}$ of 77.9 hr. If a 0.15 mg dose is used, what mass remains after 2 weeks?

↳ 336 hrs

$$k = \frac{0.693}{77.9\ hr} = 8.90 \times 10^{-3}\ hr^{-1}$$

$$\ln\left(\frac{0.15}{N_t}\right) = 8.90 \times 10^{-3}\ hr^{-1} * 336\ hr$$

$$\ln\left(\frac{0.15}{N_t}\right) = 2.99$$

$$\frac{0.15_{mg}}{N_t} = e^{2.99}$$

$$N_t = 7.6 \times 10^{-3}\ mg$$

find ratio $\Rightarrow \frac{N_0}{N_t} = 19.9$

find percent left: $\frac{N_t}{N_0} = 0.0502 = 5.02\%$

$^{40}_{19}K \longrightarrow {}^{40}_{18}Ar + {}^{0}_{+1}\beta$ $\quad t_{1/2} = 1.28 \times 10^9\ yr$

unstable $\quad$ stable $\quad \hookrightarrow k = \frac{0.693}{t_{1/2}} = 5.41 \times 10^{-10}\ yr^{-1}$

How old is a rock in which the ratio of $^{40}_{19}K$ to $^{40}_{18}Ar$ is 1:1.35?

$$\ln\left(\frac{Kr + Ar}{Ar}\right) = \ln\left(\frac{2.35}{1}\right) = 5.41 \times 10^{-10}\ yr^{-1} * t$$

$^{238}_{92}U \rightarrow x\,^{4}_{2}\alpha + y\,^{0}_{-1}\beta + {}^{206}_{82}Pb$ $t_{1/2} = 4.51\times10^{9}$ yrs

unstable → stable

$^{238}_{92}U \rightarrow {}^{4}_{2}\alpha + {}^{234}_{90}Th$ $t_{1/2} = 4.51\times10^{9}$ yrs

$x = 8$

$y = 6$

Rxn: $2\,{}^{1}_{1}H + 2\,{}^{1}_{0}n \rightarrow {}^{4}_{2}He$ $\Delta E = ?$

nucleons: 2× 1 proton + 2× 1 neutron → 2 neutron + 2 protons

$m_p = 1.0078\ \text{amu} \times 2 + m_n = 1.00866\ \text{amu} \times 2$

$m_{2p+2n} = 4.03188$ amu

$m_{^4He} = 4.002602$ amu

$- m_{He^{2+}} = 0.00110\ \text{amu} \times 2$

$m_{^4He_{2p+2n}} = 4.000402$ amu

$\Delta m = 4.03188 - 4.000402$

$= 0.03148$ amu

speed of light: 3.0×10^{8} m/s

$E = mc^2 \Rightarrow \Delta E = \Delta m\, c^2$

$= 0.03148\ \frac{g}{mol} \Big/ \frac{kg}{1000\ g} \Big/ \frac{(3.0\times10^{8})^2\ m^2}{s^2}$

$= 2.83\times10^{12}\ \frac{kg\,m^2}{s^2\,mol}$

$= 2.83\times10^{12}\ J/mol = 2.83\times10^{9}\ kJ/mol$

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{90}_{37}Rb + {}^{144}_{55}Cs + 2\,{}^{1}_{0}n$$

$$\searrow\ {}^{85}_{55}Br + {}^{146}_{57}La + 4\,{}^{1}_{0}n$$

$$\searrow\ {}^{72}_{30}Zn + {}^{160}_{62}Sm + {}^{1}_{0}n$$

other reactions