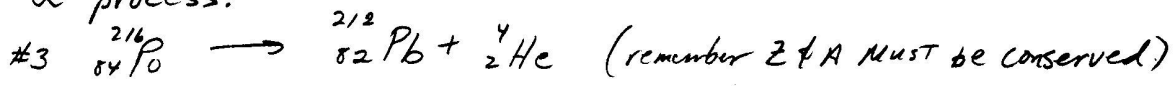


Nuclear Chemistry Notes Examples

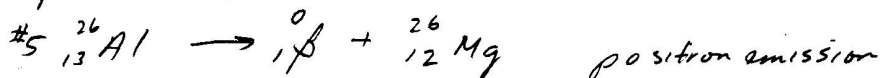
Set 1

#1 Rubidium-90 decays through beta emission since a mass of 90 is greater than the periodic table average of 85.4678.

#2 For Z (atomic number) > 83 decay is generally through the α process.



#4 ${}_{21}^{42}\text{Sc}$ is unstable primarily because it has an odd number of protons (21) & neutrons (21)



Set 2

#1 mass defect = $236.9970 - (232.9901 + 4.0015) = .0054 \text{ u}$

$.0054 \text{ amu}$	1 mole = # of atoms in 12.0g of Carbon-12 6.022×10^{23} atoms in 12.0g = 1.99×10^{-23} g/atom 12 protons/neutrons per atom 1.99×10^{-23} g/atom / 12 nucleons/atom = 1.66×10^{-24} g/nucleon
$.0054 \text{ amu} \times 1.66 \times 10^{-24} \text{ g/amu}$	
$= 8.964 \times 10^{-27} \text{ g} = 8.964 \times 10^{-30} \text{ kg}$	

$E = mc^2 \quad E = (8.964 \times 10^{-30} \text{ kg})(3.00 \times 10^8 \text{ m/s})^2 = 8.068 \times 10^{-13} \text{ J}$

$8.068 \times 10^{-13} \text{ J} \times \frac{1 \text{ eV}}{1.6022 \times 10^{-19} \text{ J}} \times \frac{\text{MeV}}{1 \times 10^6 \text{ eV}} = \underline{5.03 \text{ MeV}}$

#2 mass defect = $.0029 \text{ u} = 1.68 \times 10^{-30} \text{ kg}$

$E = (1.68 \times 10^{-30} \text{ kg})(9 \times 10^{16}) = 4.33 \times 10^{-13} \text{ J} = \underline{2.70 \text{ MeV}}$ (Note: we

get the same answer whether atomic masses or nuclear masses (atomic masses - electrons) are used.)

#3 $t_{1/2} = 0.693/k \quad 5.3 = 0.693/k \quad k = .131$

$N = N_0 e^{-kt} = (10.0 \text{ mg})e^{-(.131 \times 21.2)} = \underline{.622 \text{ mg}}$

another way to solve this is 21.2 years is 4 half lives so

$10.0 \text{ mg} \left(\frac{1}{2}\right)^4 = .625 \text{ mg}$

Nuclear Chemistry Notes Examples 2

$$\#4 \quad R = R_0 e^{-kt}$$

$$1600 = 6400 e^{-k(6.00)}$$

$$.25 = e^{-k(6.00)}$$

$$\ln .25 = -k(6.00)$$

$$-1.386 = -k(6.00)$$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{.231} = \underline{3.00 \text{ hours}} \quad \leftarrow k = .231$$

#5 Carbon-14 decays to nitrogen-14 w/ $t_{1/2} = 5,730$ years

Carbon-12 is a stable isotope that doesn't decay

If the ratio of C-14/C-12 is .72 (and C-12 is fixed)

then the number of C-14 atoms is only .72 of what it

originally was. Therefore $\frac{N}{N_0} = .72$ $k = .693/5730 = 1.209 \times 10^{-4}$

$$N = N_0 e^{-kt}$$

$$\ln \frac{N}{N_0} = -kt$$

$$\ln \left(\frac{.72}{1} \right) = -(1.209 \times 10^{-4})t$$

$$t \approx \underline{2700 \text{ years}}$$