Name_____ Section_____ Date 6/5/2022

Nuclear Chemistry

1. Compare the following emissions:

Emission	Matter or Energy?	Particle of Matter	Symbol	Charge	Mass to 1 S.F. (amu)
Alpha	matter	2 Proton 2 neutron	α	+2	1
Beta	Energy	electron	β^-	−1	negligible
Gamma	Energy	Photons of E and energy	γ	0	0
Positron	matter	Antimatter electron	β^+	+1	negligible
X-ray	Energy	Photo-electron	X	0	0

2. Emission of what particle causes the following changes:
   a. Atomic number decreases by 1, mass number does not change. Positron emission
   b. Atomic number does not change, mass number decreases by 1. nutron emission
   c. Atomic number increases by 1, mass number does not change. Beta emission
   d. Neither mass number nor atomic number changes. Gamma emission
   e. Atomic number decreases by two, mass number does not change 2 times positron emission

3. Write equations for the following nuclear processes:
   a. Beta emission by iodine-129

$$^{129}_{53}I \longrightarrow {}^{129}_{54}Xe + {}^{0}_{-1}e$$

   b. Positron emission producing boron-11

$$^{11}_{6}C \longrightarrow {}^{11}_{5}B + {}^{0}_{+1}e$$

   c. Alpha emission by radon-216

$$^{216}_{86}Rn \longrightarrow {}^{212}_{84}Po + {}^{4}_{2}He$$

   d. Emission of an alpha particle and two gamma rays by uranium-238

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{0}_{0}\gamma + {}^{0}_{0}\gamma + {}^{4}_{2}He$$

   e. Production of strontium-87 by beta decay.

$$^{87}_{38}Sr + {}^{0}_{-1}e \longleftarrow {}^{87}_{37}Rb$$

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4. How many half-lives of carbon-14 have passed since the Battle of Bunker Hill?

The battle of bunker hill took place in 1775 i.e ≈ 247 years ago

half-life of C-14 = 5700 ± 30yrs

Therefore, number of half-lives(n) = $\frac{247 \text{ years}}{5700 \text{ years}} \simeq$ 0.043 half-lives

5. How much of a 1.0 g sample of phosphorus-32 would remain after 71.5 days?

Half-life P-32 = 14.3 days

$n = \frac{71.5 \text{ days}}{14.3 \text{ day}}$

= 5 half-lives

Amount remaining = $1.0_g \times 0.5^5$

= $1.0_g \times 0.5^{-5}$

= 0.03125g Phosphorus-32 remain

6. How long would it take for 75% of a sample of strontium-90 to decay?

half-life of Strontium-90 = 29 days

75% decay means 25% is remaining

$\left(\frac{25}{100}\right)A = A \times 0.5^{t/29}$ where, A is starting amount and t = time -

$\left(\frac{25}{100}\right) = 0.5^{t/29}$

$t = \frac{29 \ln\left(\frac{1}{4}\right)}{\ln(0.5)}$

t = 58 years