

Name \_\_\_\_\_

Section \_\_\_\_\_

Date 6/5/2022**Nuclear Chemistry**

1. Compare the following emissions:

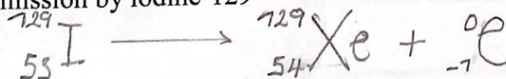
Emission	Matter or Energy?	Particle of Matter	Symbol	Charge	Mass to 1 S.F. (amu)
Alpha	Matter	2 Proton 2 neutron	$\alpha$	+2	1
Beta	Energy	electron	$\beta^-$	-1	negligible
Gamma	Energy	Photons of EM energy	$\gamma$	0	0
Positron	Matter	Antimatter electron	$\beta^+$	+1	negligible
X-ray	Energy	Photo-electron	$\chi$	0	0

2. Emission of what particle causes the following changes:

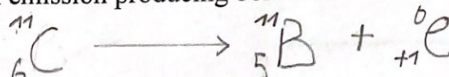
- a. Atomic number decreases by 1, mass number does not change. *Positron emission*
- b. Atomic number does not change, mass number decreases by 1. *neutron emission*
- c. Atomic number increases by 1, mass number does not change. *Beta emission*
- d. Neither mass number nor atomic number changes. *Gamma emission*
- e. Atomic number decreases by two, mass number does not change *2 times positron emission*

3. Write equations for the following nuclear processes:

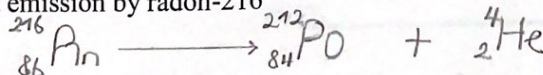
- a. Beta emission by iodine-129



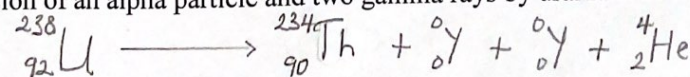
- b. Positron emission producing boron-11



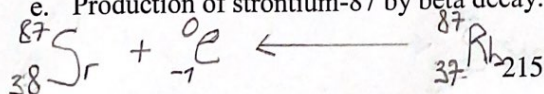
- c. Alpha emission by radon-216



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



- e. Production of strontium-87 by beta decay.



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.  $\approx 247$  years ago  
 half-life of C-14 =  $5700 \pm 30$  yrs

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

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

$$= 5 \text{ half-lives}$$

$$\text{Amount remaining} = 1.0 \text{ g} \times 0.5^5$$

$$= 1.0 \text{ g} \times 0.5^5$$

$$= \underline{\underline{0.03125 \text{ g Phosphorus-32 remain}}}$$

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

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

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

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

$$\underline{\underline{t = 58 \text{ years}}}$$