Honors Chemistry: Review of Nuclear Chemistry Name_____

Part A:

Complete the table below

Particle	Charge	Mass	Location
Proton	+	1 amu	nucleus
Electron	−	1/1837 amu	in electron cloud
Neutron	no charge	1 amu	nucleus

1. The number of protons is equal to the atomic number.
2. The number of neutrons is equal to the mass number minus the atomic number.
3. The number of electrons in a neutral atom is equal to the number of protons.
4. Which atomic particle determines the ~~type of~~ element? protons
5. What parts of the atom are responsible for the mass number? protons neutrons

Complete the table below

Name	Symbol	Atomic Number	Protons	Neutrons	Electrons	Mass number
Chlorine-37	$^{37}_{17}Cl$	17	17	20	17	37
Sodium-23	$^{23}_{11}Na$	11	11	12	11	23
Aluminum-27	$^{27}_{13}Al$	13	13	14	13	27

* radioactive

1. The number written after the element's name is the mass of the atom.
2. The mass on the periodic table is a weighted average mass of all the isotopes for that element.
3. What makes an isotope radioactive? Too many or too few neutrons

Complete the table below

	Symbol	Atomic Number	Mass Number	Protons	Neutrons	Electrons
Sulfur - 32	$^{32}_{16}S$	16	32	16	16	16
Sulfur -34	$^{34}_{16}S$	16	34	16	18	16
Sulfur -36	$^{36}_{16}S$	16	36	16	20	16

1. Sulfur-32, Sulfur-34, and Sulfur-36 are all isotopes of Sulfur.
2. Which subatomic particle will differ in isotopes of the same element? neutrons
3. Isotopes of an element will have the same atomic number but the mass number will differ.

Part B:

Complete the table below

Radiation Type	Symbol	Charge	Mass	Penetrating Ability	Damage
Alpha	$^{4}_{2}He$	+2	4 amu	low	high
Beta	$^{0}_{-1}e$	−1	1/1837 amu	medium	medium
Gamma	$^{0}_{0}\gamma$	none	none	high	low

Identify the following as alpha, beta, or gamma

1. Radiation that is NOT a particle gamma
2. Particle with no mass gamma
3. Can be stopped by paper or cardboard alpha
4. Can be stopped by a beaker or foil beta
5. Least penetrating alpha
6. Most damaging inside body alpha

Write equations for the following nuclear reactions.

1. Uranium-234 undergoes alpha decay.

$$^{234}_{92}U \rightarrow {}^{4}_{2}He + {}^{230}_{90}Th$$

2. Thorium-230 undergoes radioactive decay to form protactinium-230.

$$^{230}_{90}Th \rightarrow {}^{230}_{91}Pa + {}^{0}_{-1}e$$ beta decay

3. Promethium-147 undergoes beta decay.

$$^{147}_{61}Pm \rightarrow {}^{0}_{-1}e + {}^{147}_{62}Sm$$

4. Bismuth-214 undergoes alpha decay.

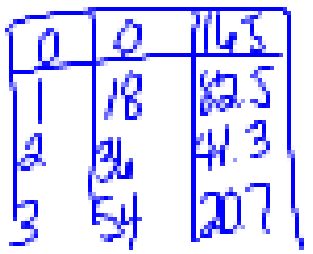
$$^{214}_{83}Bi \rightarrow {}^{4}_{2}He + {}^{210}_{81}Tl$$

5. Neptunium-239 undergoes radioactive decay to form plutonium-239. Which type of decay is taking place? (Hint: Write a reaction and fill in the missing particle.)

$$^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + {}^{0}_{-1}e$$

Solve the following problems.

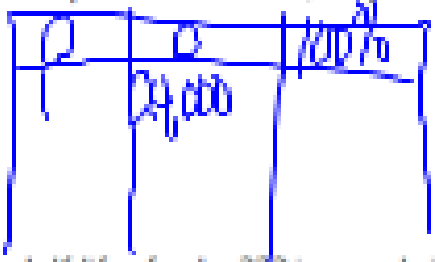
1. Technetium-104 has a half-life of 18.0 min. How much of a 165 g sample remains after 90.0 minutes have passed?



$\frac{90.0}{18} = 5$

$\frac{165}{2^5} = 5.2\,g$

2. The half-life of plutonium-239 is 24,000 years. How much nuclear waste will remain in 1500 years?



$\frac{1500}{24000} = .0625$

$\frac{100}{2^{4}} = 6.25\%$

3. What is the half-life of radon-222 is a sample initially contains 150 mg and only 18.7 mg remain after 11.4 days?

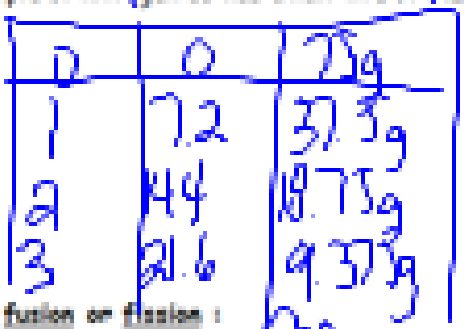
$\frac{150}{2^x} = 18.7$

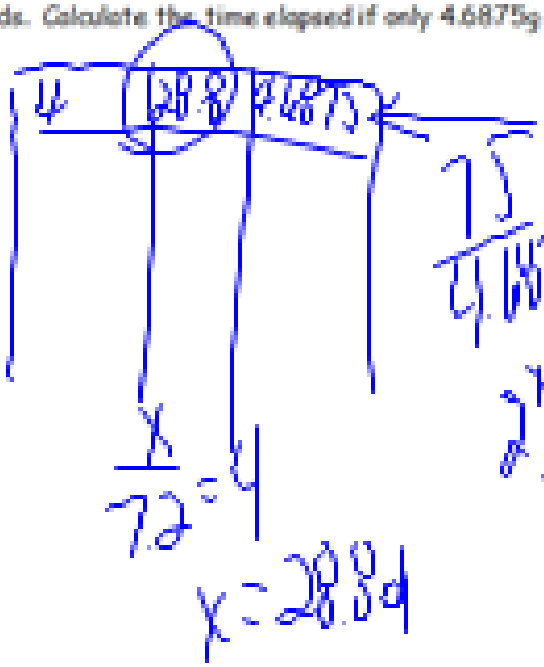
$2^x = 8$

$x = 3$

$\frac{11.4}{3} = 3.8\,d$

4. A 75g sample of nitrogen-16 has a half life of 7.2 seconds. Calculate the time elapsed if only 4.6875g are left.





$\frac{75}{4.6875} = 16$

$2^x = 16$

$x = 4$

$\frac{x}{7.2} = 4$

$x = 28.8\,s$

Part C:

Identify as fusion or fission :

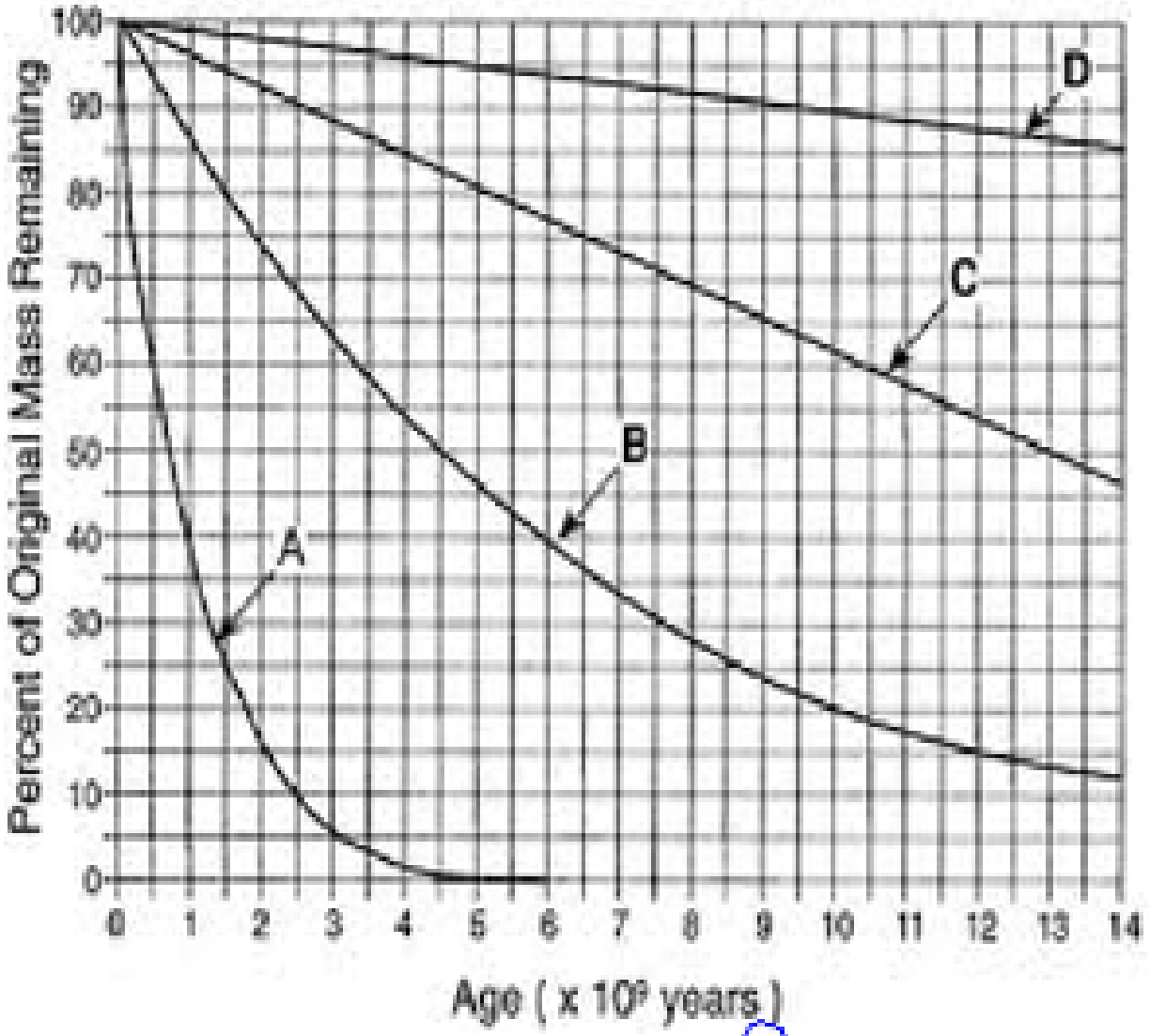
1. Used in nuclear power plants _____
2. Found in the sun _____
3. Most power in per gram _____
4. Nucleus divides _____
5. Requires high temperature _____
6. Combination of nuclei _____

Complete the following reactions:

1. $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{137}_{52}Te + {}^{96}_{40}Zr + 2\,{}^{1}_{0}n$

2. An atom of oxygen-18 is bombarded with a proton to produce an alpha particle and one other particle. What other particle is produced? Write the complete equation.

Use the graph below to answer the questions that follow:



1. Which radioactive material has a half-life of 13 billion years? C
2. Which radioactive material has the longest half-life? D
3. Which radioactive material has a half-life less than 2 billion years? A
4. What percentage of material B remains at 6 billion years? 40%
5. How long would it take for 75% of material A to decay? 1.5 billion years
6. At what time would ¼ of material B remain? 9.75 billion years