Name: Key Period: _____ Date: _____

U5M4 Practice – Nuclear Chemistry

Complete the following reactions by writing the full atomic symbol of the missing isotope. Below each, classify the reaction as fusion, fission, or radioactive decay. If radioactive decay, determine the type (alpha, beta)

1. $^{222}_{86}\text{Rn} \rightarrow$ $^{218}_{84}\text{Po}$ $+ ^{4}_{2}\text{He}$ Alpha Decay

2. $^{144}_{58}\text{Ce} \rightarrow ^{144}_{59}\text{Pr} + ^{0}_{-1}\text{e}$ Beta decay

3. $^{234}_{90}\text{Th} \rightarrow ^{230}_{88}\text{Ra} +$ $^{4}_{2}\text{He}$ Alpha decay

4. $^{59}_{26}\text{Fe} \rightarrow ^{59}_{27}\text{Co} +$ $^{0}_{-1}\text{e}$ Beta decay

5. $^{250}_{98}\text{Cf} +$ $^{10}_{5}\text{B}$ $\rightarrow ^{258}_{103}\text{Lr} + 2\,^{1}_{0}\text{n}$ fusion

6. $^{235}_{92}\text{U} + ^{1}_{0}\text{n} \rightarrow ^{144}_{54}\text{Xe} +$ $^{90}_{38}\text{Sr}$ $+ 2\,^{1}_{0}\text{n}$ fission

Write a balanced reaction for each of the following scenarios:

7. ^{187}Re undergoes beta decay

$^{187}_{75}\text{Re} \rightarrow ^{187}_{76}\text{Os} + ^{0}_{-1}\text{e}$

8. ^{40}K undergoes beta decay

$^{40}_{19}\text{K} \rightarrow ^{40}_{20}\text{Ca} + ^{0}_{-1}\text{e}$

9. ^{238}U undergoes alpha decay

$^{238}_{92}\text{U} \rightarrow ^{234}_{90}\text{Th} + ^{4}_{2}\text{He}$

10. ^{210}Po undergoes alpha decay

$^{210}_{84}\text{Po} \rightarrow ^{206}_{82}\text{Pb} + ^{4}_{2}\text{He}$

11. A tritium isotope (^{3}H) fuses with a deuterium isotope (^{2}H) to produce a Helium-4 atom and an additional particle

$^{3}_{1}\text{H} + ^{2}_{1}\text{H} \rightarrow ^{4}_{2}\text{He} + ^{1}_{0}\text{n}$

Solve the following problems and report your final answer using the correct number of sig figs. Show all work!

1. Carbon-14 has a half-life of 5,700 years and decays to nitrogen-14. What **fraction** remains of parent and daughter after:

	Parent	Daughter
5,700 years	$\frac{1}{2}$	$\frac{1}{2}$
11,400 years	$\frac{1}{4}$	$\frac{3}{4}$
17,100 years	$\frac{1}{8}$	$7/8$

2. To produce the particles he fired at gold foil in his experiements, Rutherford used Polonium-210, which undergoes alpha decay with a half-life of 138.4 days. How many milligrams of polonium-210 remain after 415.2 days if you start with 2.0 mg of this isotope?

$\frac{415.2 \text{ days}}{138.4 \text{ days}} = 3$ half lives

$\frac{1}{8}$ parent remains $\quad 2.0\text{mg} \times \frac{1}{8} = \boxed{0.25\text{ mg}}$

3. The half-life of tritium (hydrogen-3) is 12.3 years. If 48.0 mg of tritium is released from a nuclear power plant during the course of a mishap, what mass of tritium will remain radioactive after 49.2 years? After 98.4 years?

$\frac{49.2\text{ yrs}}{12.3\text{yrs}} = 4$ HL $\Rightarrow \frac{1}{16}$ th parent $\quad 48.0\text{mg} \times \frac{1}{16} = \boxed{3\text{mg}}$

$\frac{98.4\text{ yrs}}{12.3\text{yrs}} = 8$HL $\Rightarrow \frac{1}{256}$ th parent $\quad 48.0\text{ mg} \times \frac{1}{256} = \boxed{0.1875\text{mg}}$

4. You begin with 12.0g of a given radioactive isotope. After 11 years, there are 3.0g left. What is the half-life?

$\frac{3g}{12g} = \frac{1}{4} \Rightarrow$ 2HL have passed

$\frac{11}{2} = 5.5 \qquad \boxed{\text{HL is } 5.5\text{ yrs}}$