Regents Chemistry: Nuclear Equations
Name: _____   Date: _____

Complete the following equations.

1. $\underline{\hspace{2cm}} \rightarrow {}^{4}_{2}\text{He} + {}^{229}_{90}\text{Th}$
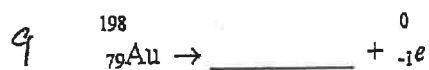
2. $\underline{\hspace{2cm}} \rightarrow {}^{32}_{16}\text{S} + {}^{0}_{-1}e$

3. ${}^{19}_{10}\text{Ne} \rightarrow \underline{\hspace{2cm}} + {}^{0}_{+1}e$

4. ${}^{37}_{20}\text{Ca} \rightarrow {}^{37}_{19}\text{K} + \underline{\hspace{2cm}}$

5. ${}^{131}_{53}\text{I} \rightarrow {}^{131}_{54}\text{Xe} + \underline{\hspace{2cm}}$

6. ${}^{220}_{87}\text{Fr} \rightarrow {}^{216}_{85}\text{At} + \underline{\hspace{2cm}}$

7. $\underline{\hspace{2cm}} \rightarrow {}^{235}_{92}\text{U} + {}^{4}_{2}\text{He}$

8. $\underline{\hspace{2cm}} \rightarrow {}^{10}_{5}\text{B} + {}^{0}_{+1}e$

9. ${}^{198}_{79}\text{Au} \rightarrow \underline{\hspace{2cm}} + {}^{0}_{-1}e$

10. ${}^{218}_{84}\text{Po} \rightarrow \underline{\hspace{2cm}} + {}^{4}_{2}\text{He}$

11. ${}^{3}_{1}\text{H} \rightarrow \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$ (Hint: See Table N.)

12. ${}^{37}_{19}\text{K} \rightarrow \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$

13. ${}^{16}_{7}\text{N} \rightarrow \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$

14. ${}^{90}_{38}\text{Sr} \rightarrow \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$
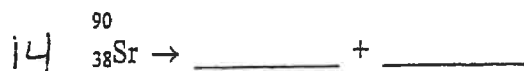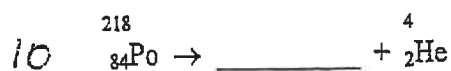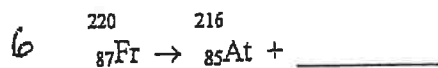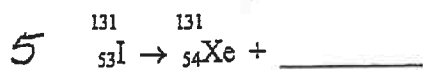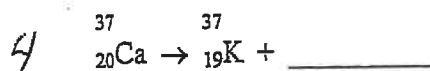
3–4 Practice Problems

1. Write a nuclear equation for the alpha decay of $^{231}_{91}Pa$.

6. Write a nuclear equation for the alpha decay of $^{146}_{62}Sm$.

2. Write a nuclear equation for the beta decay of $^{223}_{87}Fr$.

7. Write a nuclear equation for the beta decay of $^{198}_{85}At$.

3. Write a nuclear equation for the alpha decay of $^{149}_{62}Sm$.

8. Write a nuclear equation for the alpha decay of $^{150}_{64}Gd$.

4. Write a nuclear equation for the beta decay of $^{165}_{61}Pm$.

9. Write a nuclear equation for the beta decay of $^{152}_{54}Xe$.

5. Write a nuclear equation for the alpha decay of $^{249}_{101}Md$.

10. Write a nuclear equation for the beta decay of $^{120}_{55}Cs$.

Regents Chemistry: Half-Life Problems

Name: _____   Date: _____

Refer to Table N in Chemistry Reference Tables as needed.

1. How many hours are required for potassium-42 to undergo three half-life periods?

2. Which of the following radioisotopes has the shortest half-life?

   a) C-14   b) H-3   c) K-37   d) P-32

3. Which of the following 10-g samples of a radioisotope will decay to the greatest extent in 28 days?

   a) P-32   b) Kr-85   c) Fr-220   d) I-131

4. Which radioactive sample would contain the greatest remaining mass of the radioactive isotope after 10 years?

   a) 2.0 grams of Au-198   b) 2.0 grams of K-42   c) 4.0 grams of P-32   d) 4.0 g of Co-60

5. After 62.0 hours, 1.0 g remains unchanged from a sample of K-42. How much K-42 was in the original sample?

6. If 80 mg of a radioactive element decays to 10 mg in 30 minutes, what is the element's half-life in minutes?

7. A sample of I-131 decays to 1.0 g in 40 days. What was the mass of the original sample?

8. What is the total mass of Rn-222 remaining after 19.1 days from an original sample of 160-mg?

24–1 Practice Problems

1. The half-life of cesium-137 is 30.2 years. If the initial mass of a sample of cesium-137 is 1.00 kg, how much will remain after 151 years?

2. Given that the half-life of carbon-14 is 5730 years, consider a sample of fossilized wood that, when alive, would have contained 24 g of carbon-14. It now contains 1.5 g of carbon-14. How old is the sample?

3. A 64-g sample of germanium-66 is left undisturbed for 12.5 hours. At the end of that period, only 2.0 g remain. What is the half-life of this material?

4. With a half-life of 28.8 years, how long will it take for 1 g of strontium-90 to decay to 125 mg?

5. Cobalt-60 has a half-life of 5.3 years. If a pellet that has been in storage for 26.5 years contains 14.5 g of cobalt-60, how much of this radioisotope was present when the pellet was put into storage?

6. A 1.000-kg block of phosphorus-32, which has a half-life of 14.3 days, is stored for 100.1 days. At the end of this period, how much phosphorus-32 remains?

7. A sample of air from a basement is collected to test for the presence of radon-222, which has a half-life of 3.8 days. However, delays prevent the sample from being tested until 7.6 days have passed. Measurements indicate the presence of 6.5 µg of radon-222. How much radon-222 was present in the sample when it was initially collected?

8. A 0.500 M solution of iodine-131, which has a half-life of 8.0 days, is prepared. After 40. days, how much iodine will remain in 1.0 L of solution? Express the result in moles.

9. The half-life of sodium-25 is 1.0 minute. Starting with 1 kg of this isotope, how much will remain after half an hour?

10. What is the half-life of polonium-214 if, after 820. seconds, a 1.0-g sample decays to 31.25 mg?

Radioisotopes in Everyday Life and Science

Instructions: Answer each question with a brief explanation. Be specific in your responses.

1. Explain how americium-241 functions in smoke detectors and why it's effective for this purpose.

2. Which radioisotope is used to diagnose thyroid disorders? Describe why this particular isotope is chosen for this application.

3. Carbon-14 is used in archaeological dating. Explain the principle behind this method and why it's limited to organic materials less than 50,000 years old.

4. Identify a radioisotope used in cancer treatment and describe its mechanism of action against cancer cells.

5. What radioisotope is commonly used in food irradiation? Explain why this isotope is preferred and how it extends food shelf life.

6. Describe how tritium is used in exit signs and why it's suitable for this application.

7. Explain how iodine-131 is used to track pollution in water systems and why it's effective for this purpose.

8. Which radioisotope is used in portable X-ray fluorescence (XRF) devices? Describe its function in analyzing material composition.

9. Plutonium-238 is used in space exploration. Explain its role and why it's preferred over other power sources for long-term space missions.

Name: _____

Nuclear Reactor

Instructions: Answer the following short response questions about the parts of a Nuclear Reactor, their functions, and materials. Provide detailed explanations where appropriate.

1. Describe the primary function of the fuel rods in a nuclear reactor. What material are they typically made of, and why is this material chosen?

Answer: _____

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2. Explain the role of the moderator in a nuclear reactor. Compare and contrast two common materials used as moderators and their effectiveness.

Answer: _____

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3. What is the purpose of control rods in a nuclear reactor? Discuss how their composition affects their ability to control the nuclear reaction.

Answer: _____

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4. Explain the role of the coolant in a nuclear reactor. Compare the advantages and disadvantages of using water versus liquid metal as a coolant.

Answer: _____

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5. What is the purpose of the containment structure in a nuclear reactor? Discuss the materials used in its construction and why are those materials used?

Answer: _____

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