Chemistry CP

Name:

Review Sheet: Nuclear Chemistry and Periodicity

Section:

After studying this unit, you should be able to:

- Explain the processes of radioactivity and radioactive decay.
- Distinguish between isotopes and radioisotopes.
- Describe the characteristics of alpha, beta, and gamma radiation and list their origins.
- Define the terms nuclear stability, half-life, and transmutation.
- Write balanced nuclear equations.
- Compare fission and fusion processes.
- Calculate the amount of radioisotope remaining using the half-life method.
- Explain how radioisotopes can be used to date objects.
- Explain the roles of Mendeleev and Moseley in the development of the periodic table.
- Distinguish between a group and a period in the periodic table.
- Categorize the elements as main group element, noble gas, transition metal, or inner transition metal.
- Describe how the elements belonging to a group of the periodic table are interrelated in terms of atomic number.
- Locate and name the four blocks of the periodic table. Explain the reasons for these names.
- Discuss the relationship between group configurations and group numbers.
- Describe the locations in the periodic table of the alkali metals, the alkaline-earth metals, the halogens, and the noble gases.
- Interpret the trend shown by atomic radii within the periodic table.
- Explain the variation in ionization energies within the periodic table.
- Interpret the trend shown by atomic sizes within the periodic table.
- Interpret the trend shown by electronegativities within the periodic table.
- State how many valence electrons are present in atoms of each main-group element.
- Use factor label strategies in problem solving.

Nuclear Chemistry problems for you to try:

1. Describe the composition of alpha, beta, and gamma radiation. Include the appropriate nuclear symbols, showing mass number and atomic number for each.

2. Write balanced nuclear equations for:
    a. The alpha decay of thorium-230

    b. The beta decay of hydrogen-3

    c. The alpha decay of polonium-218

    d. The beta decay of lead-210

3. Complete the following transmutation equations:

   a. $^{9}_{4}Be + {}^{1}_{1}H \rightarrow {}^{4}_{2}He +$ _____

   b. $^{238}_{92}U + {}^{4}_{2}He \rightarrow 2\ {}^{1}_{0}n +$ _____

   c. $^{15}_{6}C + {}^{1}_{0}n \rightarrow$ _____

4. Sodium-24 has a half-life of 15 hours. How much sodium-24 will remain in an 18.0 g sample after 60 hours?

5. After 42 days, a 2.0 g sample of phosphorus-32 contains only 0.25 grams of isotope. What is the half life of phosphorus-32?

Classify each of these statements as always true, AT; sometimes true, ST, or never true, NT.

6. _____ Beta radiation is emitted when a radioisotope decays.
7. _____ Gamma radiation has a negative charge.
8. _____ If you start with 100 grams of a radioisotope, after 10 half-lives, there will be none of the radioisotope left.
9. _____ Gamma radiation and Xrays are high energy electromagnetic radiation.
10. _____ $^{238}_{92}U + {}^{0}_{-1}e \rightarrow {}^{239}_{92}U$
11. _____ A radioisotope has a half-life of 12 minutes. After 36 minutes, only one-third of the radioactive atoms initially present will remain.
12. _____ In nuclear fusion, the nuclei of two large atoms fuse together.
13. _____ When a beta particle is emitted, the atomic number increases by 1, and the mass number stays the same.
14. _____ When a radioactive nucleus emits a beta particle, its atomic number decreases by 4 and its mass number decreases by 2.
15. _____ When a gamma ray is emitted, atomic mass and atomic number increase.
16. _____ In his periodic table, Mendeleev arranged the elements in ascending order of atomic number.
17. _____ The transition elements are in groups 1 and 2.
18. _____ Chlorine has the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^7$.
19. _____ The element in group 13, period 4 is gallium.
20. _____ The radius of an atom cannot be measured directly.
21. _____ Removing one electron from an atom results in the formation of a positive ion with a +1 charge.
22. _____ Positive ions are always larger than the neutral atoms from which they form.
23. _____ Electronegativities increase as you go down a group.

24. Draw Lewis structures for:
    Ge S Br Ca Rb Kr

Periodicity problems for you to try:

Atomic Radius

25. Order the following atoms in order of increasing atomic radius

Na, K, Be, Mg _____ < _____ < _____ < _____

N, P, O, Ga _____ < _____ < _____ < _____

Ionic Charge

25. Use orbital notation to write the electron configurations of neutral Sr and Sr^{2+} ion
    a. Sr

    b. Sr^{2+}

    c. Why is the 2+ ion the one that typically tends to form?

    d. Which has a larger atomic radius, Sr, or Sr^{2+}? Why? Use shielding and/or Z_{eff} in your answer

26. Write the electron configuration (using orbital notation) of neutral O and of the O^{2-} ion.
    a. O

    b. O^{2-}

    e. Which has a larger radius, O or O^{2-}? Why? Use shielding and/or Z_{eff} in your answer

27. Circle all of the ions below that do **not** have noble gas stability.
    K^+ S^{2-} Mg^+ I^- Al^{3+} Sc^{2+}

28. What are the typical ions of:
    Ga Cl Ba Si N

Atomic Properties and the Periodic Table

For each of the following descriptions of elements, select the element that best corresponds to the description given. Circle the correct element and identify its group and period number.

	Group	Period
29. good conductor, readily forms a 2^+ ion He, Na, Sr, I, O	_____	_____
30. Poor conductor, brittle, readily forms a 2^- ion Se, F, Cu, Fe, Ca	_____	_____
31. Reactive, gaseous, forms a 1^- ion Mg, Ge, O, Br, Kr	_____	_____
32. Solid, unreactive Na, Pt, Br, O, P	_____	_____

Electronegativity

33. For the following pairs, circle the element with the higher electronegativity.

F, Br Cs, K Ca, Rb P, O

Ionization Energy

34. For the following pairs, circle the element with the higher ionization energy.

O, Se Ga, As K, Mg I, Sb

Factor Label

35. Write all the possible ratios for: 1 year = 1 decade
12 months = 1 year

36. Use factor label to solve the following problem:
How many decades are in 16720 months?