

CHEM 105 - Fundamentals of Chemistry

Problem Set 2 - Periodic Law

- Based on the relationship between electron configuration and the periodic table, give the number of:
 - outer-shell electrons for an atom of Sb
 - electrons in the fourth principle electronic shell of Pt
 - elements whose atoms have six outer-shell electrons
 - unpaired electrons in an atom of Te
 - transition elements in the sixth period

- Match each of the lettered items in the column on the right. All of the numbered items should be used at least once, and some must be used more than once.

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|-------------|--|
| a. $Z = 37$ | 1. two unpaired p electrons |
| b. $Z = 9$ | 2. diamagnetic |
| c. $Z = 16$ | 3. more electron affinity than elements on either side |
| d. $Z = 30$ | 4. lower first ionization energy than Ca but greater than Cs |
| e. $Z = 82$ | |
| f. $Z = 12$ | |

- The following species are isoelectronic with the noble gas Krypton. Arrange them in order of increasing size and comment on the principles involved in doing so.



- What is the maximum number of Cs^+ ions that can be produced per joule of energy absorbed by a sample of gaseous Cs atoms?
- In the electron configuration of first ten elements, those of the noble gases He ($1s^2$) and Ne ($1s^2 2s^2 2p^6$) are especially stable. Another stable configuration is that in which the 1s and 2s are filled ($1s^2 2s^2$). Still another is that in which the 2p orbitals are half-filled, that is with unpaired electrons in each of the 2p orbitals; $1s^2 2s^2 2p^3$. Show how these facts help to explain the following order of the first ionization energies of the second period elements.



- Write electron configurations consistent with the following data on number of unpaired electrons: V^{3+} : two, Cu^{2+} : one, Cr^{3+} : three.

7. With reference only to the periodic table, arrange the following atoms in terms of:
- Increasing first ionization energies: O, Rb, Br, Ca, Sc, Se, F, Cs, He.
 - Decreasing metallic character: I, O, Cs, K, Te, F, Mg, Al.
8. Based on the periodic table and electron configuration rules, indicate the number of:
- 2p electrons in N
 - 4s electrons in Rb
 - 4d electrons in As
 - 4f electrons in Au
 - unpaired electrons in Pb
 - elements in group 4A
 - elements in the sixth period
9. For the following groups of elements select the one that has the property noted:
- The largest atom: H, Ar, Ag, Ba, Te, Au
 - The lowest first ionization energy: B, Sr, Al, Br, Mg, Pb
 - The most negative electron affinity: Na, I, Ba, Se, Cl, P
 - The largest number of unpaired electrons: F, N, S²⁻, Mg²⁺, Sc³⁺, Ti³⁺
10. Which one of the following has the largest radius?
- S²⁻ Cl Cl⁻ K⁺ S
11. How many valence electrons are there in Ti⁺², Br⁻ and Y⁺²
12. Explain why the ionization energy of Helium is higher than any other atom.
13. To what period and group of the periodic table does the element with each of the following atomic numbers belong? Classify as metal or nonmetal.
- 2 7 9 11 16 19
14. Which of the following are isoelectronic with each other?
- Rb⁺, Sr⁺², Xe
 - Al⁺³, Na⁺, Ne
 - Br⁻, Na⁺, Se⁻²
 - K⁺, Ca⁺², Ar
 - Al, Mg²⁺, Si
 - Ar, Ne, Kr