**Chapter 5 – Practice Questions on Trends[[1]](#footnote-1)**

1. Copper (29Cu) has an anomalous electron configuration. On the following table:
   1. Give the expected and anomalous shorthand electron configurations for an atom of copper.
   2. Complete orbital filling diagram to show the arrangement of electrons for copper (expected and anomalous) and its ions (Cu1+ and Cu2+).
   3. For each species of copper, state the number of unpaired electrons in the *d* orbitals?

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | e- configuration |  |  |  |  |  |  | # unpaired e- |
| 29Cu | *expected* |  |  |  |  |  |  |  |
| 29Cu | *anomolous* |  |  |  |  |  |  |  |
| Cu1+ |  |  |  |  |  |  |  |  |
| Cu2+ |  |  |  |  |  |  |  |  |
|  |  | 4s | 3d | | | | |

1. Rank the following species *from largest to smallest* radius: O2-, F-, or F. Support your answer by giving the electron configurations of each atom. Explain - be sure to include calculate the effective nuclear charge (Zeff).

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1. Arrange the following atoms in order of *decreasing* atomic radii: Al, Na, Cl, P, Mg. Support your answer. A complete answer addresses the principle quantum number(s), shell(s), nuclear charge(s) (Z), effective nuclear charge (Zeff), shielding electrons, and valence electrons.

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1. An isoelectronic series is a group of atoms or ions that have the same number and arrangements of electrons. Of the ions listed below, which form an isoelectronic group with krypton (Kr)? Support your decision by showing your work. Include support for those species that are not isoelectronic with krypton.

Ag+, Br-, Cd2+, Sc3+, Se2-, Sr2+, Ti2+, Zn2+

1. What does it mean if an atom has a *high* ionization energy?
2. Why do ionization energies generally *decrease* as you go down a family? Include shell(s), distance, and shielding electrons in your answer.
3. Ionization energy is the energy needed to remove an electron. These energies typically *increase* as you go across a row on the periodic table as shown below with sodium and magnesium. Why does this happen? Support your answer by providing the shorthand electron configuration and addressing effective nuclear charge.

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| --- | --- | --- | --- | --- |
| **Z** | **Atom** | **I1 (kJ/mol)** | **Shorthand e- configuration** | **Zeff** |
| 11 | Sodium | 496 |  |  |
| 12 | Magnesium | 738 |  |  |

1. There are exceptions to the trend of increasing ionization energy across a row. The first ionization energy for aluminum (13Al) is lower than for magnesium (12Mg), yet it has a larger nuclear charge. Give a reason for this anomaly using their orbital filling diagrams.

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| --- | --- | --- | --- |
| **Z** | **Atom** | **I1 (kJ/mol)** | **Orbital filling diagrams** |
| 12 | Magnesium | 738 |  |
| 13 | Aluminum | 578 |  |

1. The first ionization energy for a potassium atom is 419 kJ/mol. The second ionization energy for the ion is 3052 kJ/mol. Why is the 2nd ionization energy greater than the first? Use electron configurations to support your answer.
2. Electron affinity is the change in energy when an electron is added to a neutral atom in the gaseous phase. This process is exothermic for halogens. Complete the following general chemical equation depicting this for an atom of any halogen (X).

X(g) +  🡪 X-(g) +  .

1. Answers will be provided in a separate document. [↑](#footnote-ref-1)