

CH301 Fall 2009 Practice Quiz 2 Answer Key

1. What is the ground state electron configuration for silver (Ag) ?

- a. $[\text{Kr}]4d^{10} 5s^1$
- b. $[\text{Kr}]5s^2 4d^9$
- c. $[\text{Kr}]5s^2 5d^9$
- d. $[\text{Kr}]3d^9 4s^1$

Certain members of the d-transition metals can "borrow" nearby s electrons in order to half-fill or fill their d subshell.

2. Calculate the effective nuclear charge experienced by the valence electrons in a neutral germanium (Ge) atom.

- a. 14
- b. 4
- c. 2
- d. 10

Valence electrons are those contained within the outermost energy level. To calculate effective nuclear charge the number of shielding electrons (all electrons in lower energy levels) are subtracted from the actual nuclear charge (number of protons in the nucleus).
 $32 - 28 = 4$

3. Arrange the following atoms in order of increasing electron affinity: Na, N, Cl, Cu

- a. $\text{Cu} < \text{Cl} < \text{Na} < \text{N}$
- b. $\text{Na} < \text{Cu} < \text{N} < \text{Cl}$
- c. $\text{Cl} < \text{Cu} < \text{Na} < \text{N}$
- d. $\text{N} < \text{Na} < \text{Cu} < \text{Cl}$

In general, electron affinity follows the same trend as ENC. Nitrogen however has the lowest affinity because it has a half filled p subshell, which results in extra stability. Therefore it will not want to add an electron to its subshell. Although electron affinity typically decreases down the periodic table copper will have a higher electron affinity than sodium because it only needs 1 electron to complete its d subshell.

4. Arrange the following in order of decreasing ionic radius: Cu^+ , Ga^{3+} , Ge^{4+} , Zn^{2+} .

- a. $\text{Cu}^+ > \text{Zn}^{2+} > \text{Ge}^{4+} > \text{Ga}^{3+}$
- b. $\text{Cu}^+ > \text{Zn}^{2+} > \text{Ga}^{3+} > \text{Ge}^{4+}$
- c. $\text{Zn}^{2+} > \text{Cu}^+ > \text{Ga}^{3+} > \text{Ge}^{4+}$
- d. $\text{Ge}^{4+} > \text{Ga}^{3+} > \text{Zn}^{2+} > \text{Cu}^+$

The set of isoelectronic ions (Cu^+ , Zn^{2+} , Ga^{3+} , Ge^{4+}) have the same number of electrons, but germanium has the greatest number of protons with which to attract them and copper has the least, with zinc and gallium having incrementally more as they appear on the periodic table.

5. What is the electronic configuration of gold (Au)?

- a. $[\text{Xe}] 6s^1 5d^{10}$
- b. $[\text{Xe}] 6s^2 4f^{14} 5d^9$
- c. $[\text{Xe}] 6s^2 4f^{13} 5d^{10}$
- d. $[\text{Xe}] 6s^1 4f^{14} 5d^{10}$

Gold is a member of the d block which is able to "borrow" nearby s electrons in order to half-fill its d subshell.

6. Which atom, oxygen or nitrogen, has the higher ionization energy?

- a. Nitrogen, because it has a lower effective nuclear charge
- b. Nitrogen, because it has a stable, half-filled p subshell and removing an electron decreases its stability
- c. Oxygen, because it has a higher effective nuclear charge

d. Oxygen, because it does not have a stable, half-filled p subshell and removing an electron increases its stability

In general, a filled or half-filled subshell will afford an atom or ion additional stability relative to atoms and ions with similar, but not filled/half-filled subshells in their electron configuration.