De Chemistry Biology

Quantum Numbers and Periodic Trends

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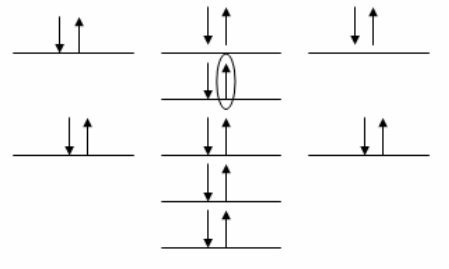
Test ID #_____ Date 10/30/2008

1. **Draw an energy level diagram for carbon.**

2a. What element is described by the following energy level diagram?

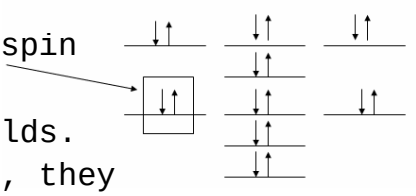
Argon



2b. Give the 4 quantum numbers for the circled electron

(3 , 0 , 0 , +1/2)

3. Explain how two electrons can exist in the same sub-orbital even though they are both negatively charged?



The up and down arrow represent the spin of the electron. Because they are spinning, they generate magnetic fields. Because they are spinning oppositely, they produce opposing magnetic fields. Opposing magnetic fields attract, reducing the amount of repulsion caused by the negative charges, allowing both electrons to be in the same orbital.

4. In the <u>order of energy,</u> write out the electron configuration for Ge.

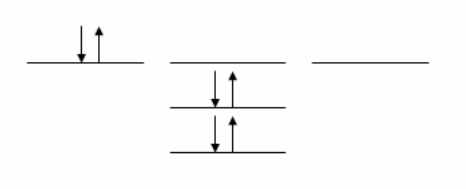
1s2, 2s2, 2p6, 3s2, 3p6, 4s2, 3d10, 4p2

5. Draw the cloud structure/electron probability field for Beryllium.

This should be a to spherical probability fields, one within the other. 1s and 2s.

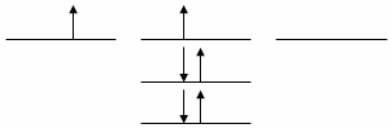
6a. Which energy configuration is more likely.

Situation 1



Circle One

Situation 2



This is the correct one.

6b. Why?

All the orbitals in 2p have the same energy. Because electrons repel, they will try to occupy empty orbitals if possible.

Consider two elements.
Element A has the electron configuration $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10,}$ $4p^5$.
Element B has the electron configuration $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^5$.

7a. Which one will be more magnetic?

One should predict B to be more magnetic.

7b. Using a clearly labeled electron orbital diagram explain your answer in CLEAR AND CONCISE words.

3d has 5 orbitals and 5 electrons. This means that each electron will occupy one orbital and be unpaired. Unpaired electrons spin and produce a magnetic field. Since each electron is unpaired you can magnetize all five orbitals, or in other words have all five electrons with the same magnetic field. This means that B will magnetize much more effectively in the presence of a magnet.

8. Which of the following:

a. has the greatest electronegativity: K, Al, Cl? Cl

b. has the highest ionization energy: Sr, Be, C? Sr

c. has the lowest electronegativity: Sc, As, O? Sc

d. has the lowest ionization energy: Cs, Ca, B? Cs

e. requires the most energy to remove an electron: Cs, Sn, P? P

f. is/are not isoelectronic with a noble gas: Sr^{2+}, As^{3-}, Ge^{4+}, P^{4-}, Ti^{+3}? P4-, T3+

j. has the highest ionization energy: C, O, N? O

9. In its ground state Br has more electrons than Ga. Which is larger and why?

Ga is larger. Both Br and Ga have the same valence energy level, 4. Br has a greater Effective Nuclear Charge and will therefore pull its electrons closer to the nucleus. This means that Br will be smaller.

10. When thrown into the pond K produces a larger explosion than Na. In clear and concise terms relate this to one of the periodic trends. Explain why this happens.

The explosion was a measure of reactivity. The greater the reactivity the greater the explosion. Reactivity is based on the ability to gain, share, or lose electrons. K's valence electrons, the electrons involved in a reaction, are in a higher energy level. This means there is less of a Effective Nuclear Force on them. The outer electrons are being shielded from the positive nuclear center by the inner orbitals/energy levels. Therefore K is much more likely to lose an electron, resulting in a higher reactivity, and a bigger faster explosion.