Electron Configurations

Name: _____

Student ID: _____

Date: _____

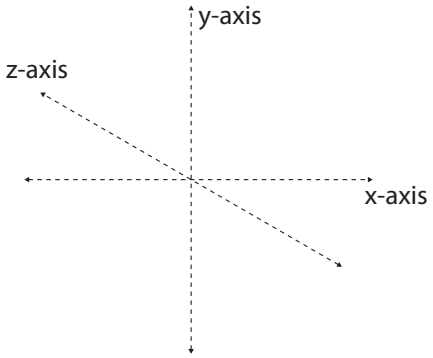
"A chemist is just an atom's way of looking at itself." — Niels Bohr

Note: $E = h\nu$ $c = \lambda\nu$ $h = 6.626 \times 10^{-34}$ Js $c = 3.00 \times 10^{8}$ m/s

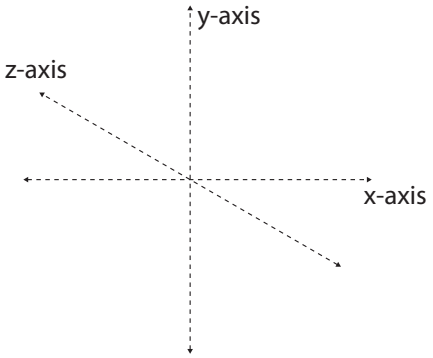
Quantum Numbers

1. Sketch and name (eg: $2p_x$ or 4s) the orbitals described by the following quantum numbers. Consider the relative size, shape and orientation of each orbital when sketching it.

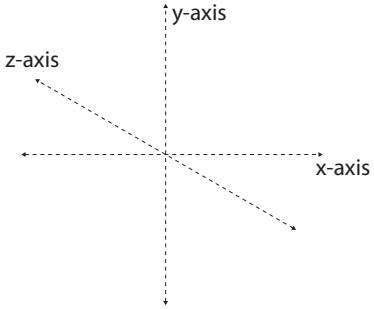
a) n = 2, l = 1, m_L = -1 name _____



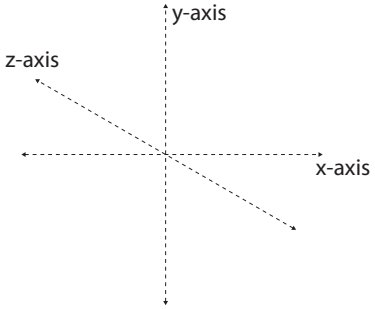
b) n = 2, l = 0, m_L = 0 name _____



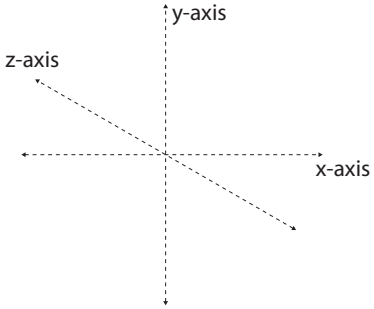
c) n = 3, l = 0, m_L = 0 name _____



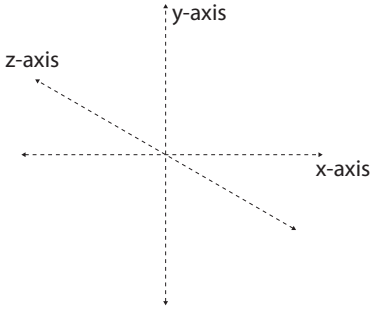
d) a) n = 2, l = 1, m_L = +1 name _____



e) n = 2, l = 1, m_L = 0 name _____



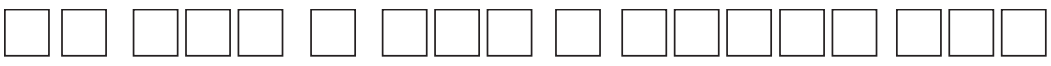
f) a) n = 3, l = 1, m_L = +1 name _____

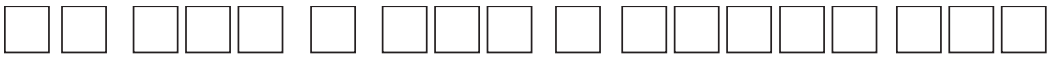


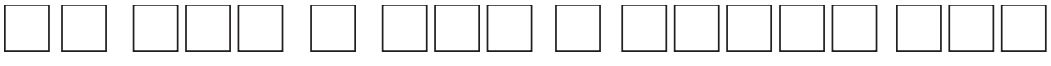
Orbital Diagrams

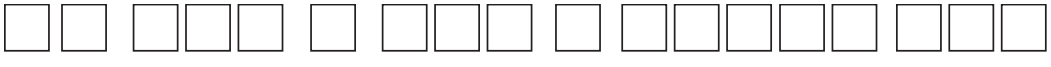
2. (a) Complete the orbital diagram for the ground state of each element or ion below. (b) Write each sub-shell name (eg. 4s or 2p) over the boxes in the first row before you begin.

Atoms

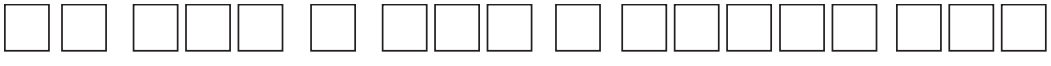
Al 

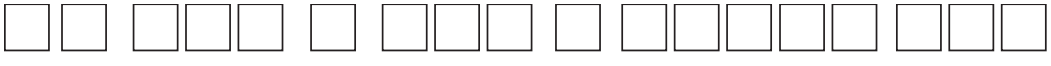
Be 

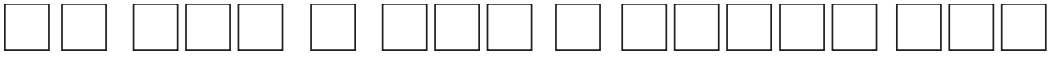
Cu 

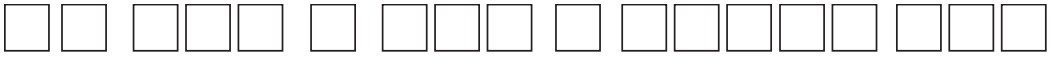
Ne 

Anions

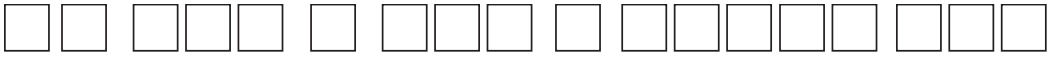
F^{1-} 

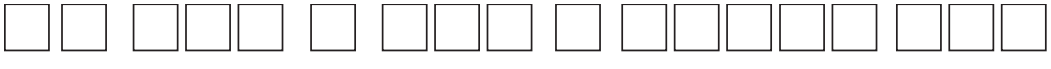
C^{2-} 

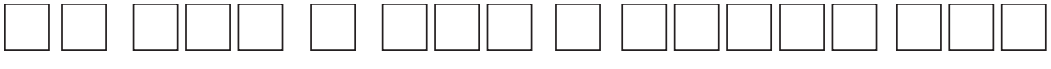
O^{2-} 

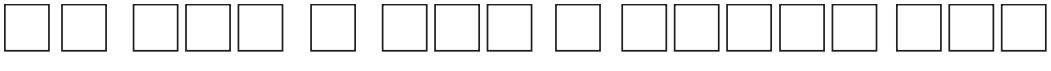
Si^{1-} 

Cations

Na^{1+} 

Al^{3+} 

Sc^{1+} 

V^{2+} 

3. Consider the following electron configuration.

a. What neutral atom can have this electron configuration?
b. Is this a ground state or excited configuration?
c. What +2 cation also has this electron configuration?
d. What -1 anion also has this electron configuration?
e. How many valence electrons are there in this configuration?

4. Consider the following electron configuration.

a. What neutral atom can have this electron configuration?
b. Is this a ground state or excited configuration?
c. What +2 cation can have this electron configuration?
d. What -1 anion also has this electron configuration?
e. Circle the valence electrons in this configuration.

5. Consider the following electron configuration.

a. What neutral atom can have this electron configuration?
b. Is this a ground state or excited configuration?
c. Circle the valence electrons in this configuration.
d. There is room for how many more electrons in this configurations valence shell?

6. Consider the following electron configuration.

a. What neutral atom can have this electron configuration?
b. Is this a ground state or excited configuration?
c. Circle the valence electrons in this configuration.
d. There is room for how many more electrons in this configurations valence shell?

Electron Configuration Notation

7. Consider the following electron configuration.

$$1s^2\ 2s^2\ 2p^6\ 3s^2$$

a. What neutral atom can have this electron configuration?
b. What cation does that element normally form?
c. If that cation formed would it be larger or smaller in diameter than the neutral atom?

8. Consider the following electron configuration.

$$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$$

a. What neutral atom can have this electron configuration?
b. What cation does that element normally form?
c. If another electron was added to the given configuration, what orbital would it most likely go into?

9. Write the ground state electron configuration notation for the following diagram
(a) without a nobel gas core abbreviation and (b) with a nobel gas core abbreviation.

a. _____

b. _____

10. Write the ground state electron configuration notation for a neutral sulfur atom.
(a) without a nobel gas core abbreviation and (b) with a nobel gas core abbreviation

a. _____

b. _____

11. Write the ground state electron configuration notation for a sulfide ion.
(a) without a nobel gas core abbreviation and (b) with a nobel gas core abbreviation

a. _____

b. _____

12. Consider the following two experiments, where we drop an electron from a higher energy state to a lower energy state and a photon is released. The before and after state of the electron is shown with orbital diagrams. What are the quantum numbers that describe the before and after states of the electron?

Experiment #1:

Before: n = _____ l = _____ m_L = _____ m_S = _____

After: n = _____ l = _____ m_L = _____ m_S = _____

Experiment #2:

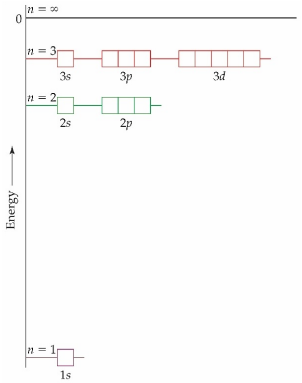
Before: n = _____ l = _____ m_L = _____ m_S = _____

After: n = _____ l = _____ m_L = _____ m_S = _____

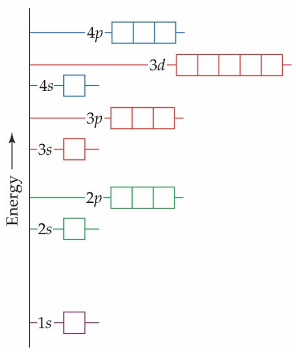
13. Sub level splitting occurs due to electron-electron interactions. When you place more than one electron in an atom or ion, some sub levels get more stable (1s, 2s, 3s etc decrease in energy) and some sub levels become less stable (2p, 3p, 4p etc and 3d, 4d, 5d etc increase in energy.)

a. If the experiment described in #12 above was done with hydrogen, would the light coming out of the two experiments be the same color?
b. If we used lithium instead, would the light be the same color in both experiments?

A. (no splitting)



B. (with sub-level splitting)



14. If the energy levels in the first experiment of question #12 were 4.650×10^{-19} J apart what wavelength (in nm) of light would be emitted? (hint: $n = 10^{-9}$).

15. Circle all the atoms or ions below that could have the following configuration:

Argon Cl P^{3-} Mg^{2+} As^{3-} Ne^{2+}

Mg Cl^{1-} Ne Sulfide ion Ca^{2+} Mg

Describe the configuration above using electron configuration notation, both with and without a nobel gas core.

a. _____

b. _____

c. How many shells does this electron configuration have?