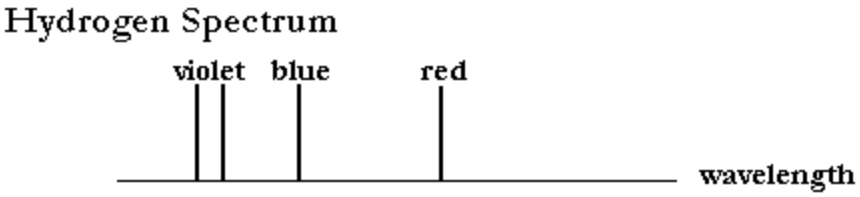
CHEM 109
Introduction to Chemistry
Fall 2010

Name: **Answer Key**

Examination 4

Multiple Choice Questions

1. As we have seen, the Hydrogen Spectrum contains four visible spectral lines; red, blue/green, violet and violet.



Arrange these spectral lines according to increasing wavelength of their photons.

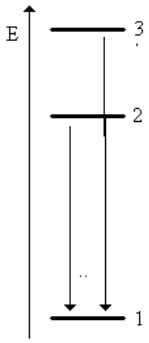
a) red < violet < blue
b) violet < blue < red ***** **red photons ~ long λ**
c) blue < red < violet
d) red < blue < violet **blue photons ~ short λ**

2. The following behavior is characteristic of waves:

a) Diffusion
b) Differential
c) Diffraction *****
d) Difference

3. What is the minimum number of quantum states required to explain <u>two</u> spectral lines?

a) 1
b) 2
c) 3 *****
d) 4



4. Young's Double Slit experiment demonstrated the:

a) wave behavior of light. ***
b) wave behavior of the electron.
c) particle behavior of the electron.
d) particle behavior of light.

5. In the Bohr Model of the Hydrogen atom, discrete orbits are required because of the:

a) particle behavior of the electron.
b) wave behavior of the electron. ***
c) wave behavior of the nucleus.
d) particle behavior of the nucleus.

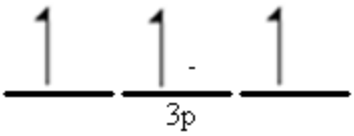
6. The *g* subshell follows the *f* subshell; 5*s*, 5*p*, 5*d*, 5*f*, 5*g*. How many quantum states are associated with the *g* subshell?

a) 6
b) 7
c) 8
d) 9 ***

***s* = 1**
***p* = 3**
***d* = 5**
***f* = 7**
g = 9

7. Consider the 3*p* electrons of the Phosphorus atom. How many of these electrons are unpaired? (Think Hund.)

a) 1
b) 2
c) 3 ***** **P = [Ne] $3s^2\ 3p^3$**



(By Hund's Rule)

d) 4

8. What is the maximum number of electrons that can be placed in the *d* orbital(s) in a given Principle Quantum level?

a) 4
b) 6
c) 8
d) 10 *** two per orbital; one spin up and one spin down**

9. The Pauli Exclusion Principle limits the number of electrons that can occupy an orbital to:

a) 1
b) 2 *** one electron spin up, the other spin down**
c) 3
d) 4

10. To which orbital block of the Periodic Table does the element Tin (Sn) belong?

a) *s* block
b) *p* block ***
c) *d* block
d) *f* block

11. Which element represents the point in the Periodic Table where the filling of the 4*d* subshell begins filling?

a) Sc
b) Ga
c) Tl
d) Y ***

12. Which element is a Period 3, Group 2A Alkaline Earth Metal?

a) Mg ***
b) Cl
c) Ca
d) K

13. How many <u>core</u> electrons does a Sulfur (S) atom contain?

a) 4
b) 6
c) 8
d) 10 *** Isoelectronic with Neon**

14. How many <u>valence</u> electrons does a Sulfur (S) atom contain?

a) 2
b) 4
c) 6 *** Group 6A**

d) 8

15. What element will have a valence level electron configuration of:

$3s^2\ 3p^5$

a) Oxygen (O)
b) Chlorine (Cl) *** Group 7A; Period 3**
c) Chromium (Cr)
d) Strontium (Sr)

Short Answer Questions

1. Mercury has three prominent spectral lines; blue, green and yellow-orange. The very bright green line responsible for the green glow emitted from its discharge tube occurs at 546 nm. What is the energy of these photons?

Needed Constants:

h = 6.626×10^{-34} J sec

c = 3.0×10^{8} m/sec

$E = hc / \lambda = (6.626 \times 10^{-34}$ J sec) $(3.0 \times 10^{8}$ m/sec) / $(546 \times 10^{-9}$ m)

$= 3.64 \times 10^{-19}$ J

2. Discuss the initial construction of the Periodic Table of the Elements by Mendeleev. Your discussion should include:

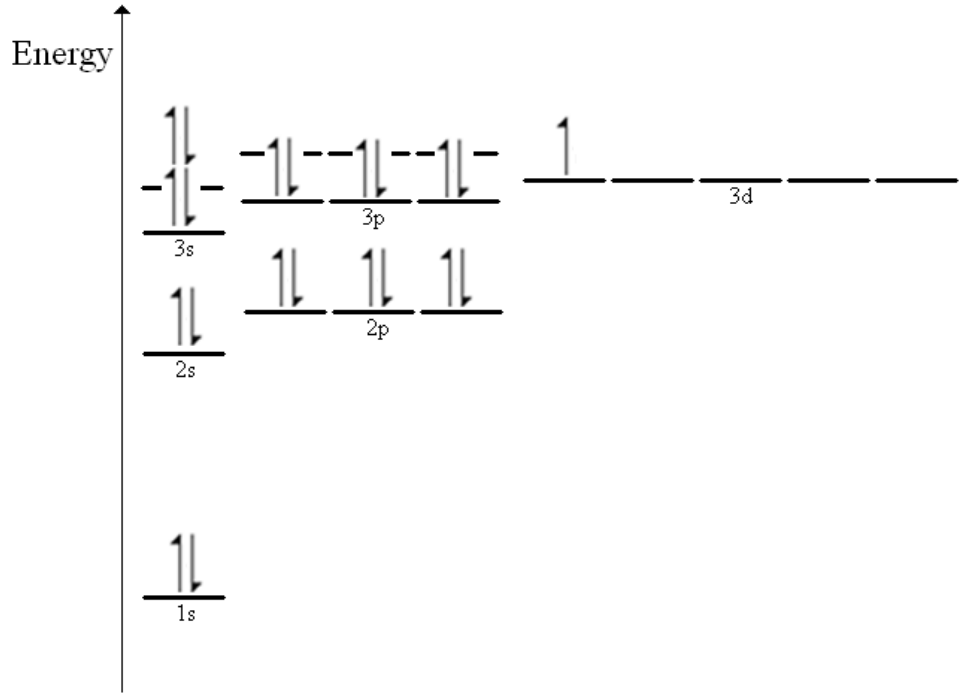
i) the basis of Mendeleev's Table.
ii) evidence Mendeleev's Table was correctly constructed.
iii) why the construction of the Table is important for today's discussion of chemistry.

Mendeleev used atomic weights to order the elements into Periods and chemical and physical similarities to order the elements into Groups. This arrangement conformed with the known "Diagonal Relationships." Evidence this Table was constructed correctly was provided by finding new elements that fit into holes in the Table. Also, Mendeleev was able to use the Table's arrangement to correctly predict the atomic weight of Beryllium. The Table conforms to predictions based on the electron configurations of the atoms.

3. Provide a complete electron configuration for the element Lead (Pb).

Pb = $1s^2$ $2s^2 2p^6$ $3s^2 3p^6$ $4s^2 3d^{10} 4p^6$ $5s^2 4d^{10} 5p^6$ $6s^2 4f^{14} 5d^{10} 6p^2$

4. Sketch an accurate Energy Diagram for the electron's in Scandium (Sc).



5. Consider the Group 5A elements:

a) Write <u>condensed</u> electron configurations for each of the following:

Na = **[Ne] $3s^1$**

Mg = **[Ne] $3s^2$**

Al = **[Ne] $3s^2 3p^1$**

b) Provide the number of Valence Electrons for each of the following:

Na #VE = **1** Mg #VE = **2** Al #VE = **3**

6. Provide Lewis Structures for the following atoms:

Silicon (Si)

4 dots

Phosphorus (P)

5 dots

Sulfur (S)

6 dots

Chlorine (Cl)

7 dots