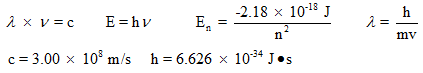
General Chemistry I NAME: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Chem 111-01 Exam #3 Fall 2015

Some Equations and Constants for your use:



**1. Light and Energy**

Consider electromagnetic radiation that delivers 2.00 x 10-19 J for each photon. Include units.

a. What is the frequency of the radiation, in Hz?

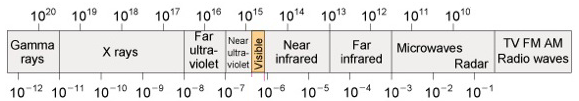
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. What is the wavelength of this light, in nm?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**2. Electromagnetic Spectrum**

Consider the electromagnetic spectrum below. The labels for the x-axis numbers have been omitted.



a. Which x-axis represents wavelength: top or bottom

b. increasing wavelength = increasing or decreasing frequency

c. increasing frequency = increasing or decreasing photon energy

d. Which type of radiation has greater energy per photon? Radio or IR

e. Which type of radiation has greater frequency? X-rays or UV

**3.** Fill in the following chart regarding orbitals. The answer to at least one of these is zero.

number of orbitals number of electrons

that can be held

n = 3 shell \_\_\_\_\_\_ \_\_\_\_\_\_

4p subshell \_\_\_\_\_\_ \_\_\_\_\_\_

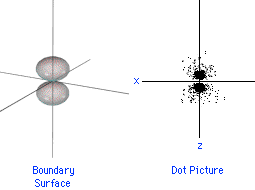
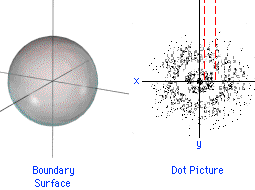
3px orbital \_\_\_\_\_\_ \_\_\_\_\_\_

2f subshell \_\_\_\_\_\_ \_\_\_\_\_\_

5g subshell \_\_\_\_\_\_ \_\_\_\_\_\_

**4. Orbital Shapes**

Give the orbital designation for each orbital pictured. For example, 2s or 4px.

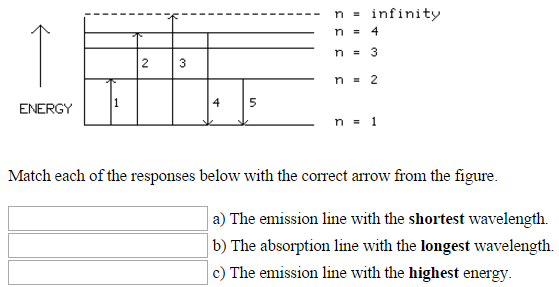
Orbital: Orbital:

how many planar nodes? \_\_\_\_\_\_\_ how many planar nodes? \_\_\_\_\_\_\_

how many spherical nodes? \_\_\_\_\_\_\_ how many spherical nodes? \_\_\_\_\_\_\_

Consider the wavefunction below. r, x, and y = represent distances of the electron from the nucleus. In what regions would it equal zero (that is, have a node)? (Answer something like “when z = 0” and there can be more than one answer.)

**5.**



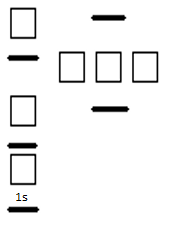
**6.** Which of the following sets of quantum numbers are allowed (circle each that is allowed):

a. n = 3, *l* = 2, m*l =* -1

b. n = 3, *l* = 3, m*l =* 0

c. n = 9, *l* = 0, m*l =* 0

**7.** Complete the electron configuration for nitrogen using the diagram below. I have labeled the 1s subshell. You need to add arrows for electrons and label all the other subshells.



Is a nitrogen atom paramagnetic or diamagnetic?

**8.** Give electron configurations for the following (using spdf (1s2 2s2 etc. notation, **or** noble gas notation):

a. Na

b. S2-

c. Mg2+

d. Cr3+

**9. Trends!**

An atom has the following attributes:

a. it is smaller than As

b. it is smaller than Te

c. it has lower energy orbitals than Se

d. it is larger than Cl

e. it forms a 1- ion

What element is it? \_\_\_\_\_\_\_

Which is larger:

Radius of: P or As

Radius of: Ar or Na

Radius of: Na+ or F-

Radius of: O or O2-

Ionization energy of: S or Ar

Ionization energy of: Na or Be

Ionization energy of: N or O

Energy of 2p orbital in C or Energy of 2p orbital in O

Energy of 2p orbital in C or Energy of 3p orbital in Si

**Thermochemistry**

**10.**

Given the standard enthalpy changes for the following two reactions:  
  
**(1)** **2C(s)** + **2H2(g)**http://cxp.cengage.com/contentservice/assets/T=1448221732807/owms01h/mediaarchives/GenChem/Image/Arrow.gif**C2H4(g)**...... ΔH° = **52.3** kJ  
  
**(2)** **2C(s)** + **3H2(g)**http://cxp.cengage.com/contentservice/assets/T=1448221732807/owms01h/mediaarchives/GenChem/Image/Arrow.gif**C2H6(g)**......ΔH° = **-84.7** kJ  
  
what is the standard enthalpy change for the reaction:  
  
**(3)** **C2H4(g)** + **H2(g)**http://cxp.cengage.com/contentservice/assets/T=1448221732807/owms01h/mediaarchives/GenChem/Image/Arrow.gif**C2H6(g)**......ΔH° = ?

**11.**

A student determines the heat of dissolution of solid **magnesium chloride** using a coffee-cup calorimeter of negligible heat capacity.  
  
When **0.630** g (= 0.00662 mol) of **MgCl2**(s) is dissolved in **119.00** g of water, the temperature of the solution increases from **25.00** to **27.19**°C. Calculate the enthalpy of dissolution of **MgCl2**(s) in kJ/mol. Assume the specific heat of the solution is 4.184 J/g°C.

ΔHdissolution =  kJ/mol

**12.**

Using standard heats of formation, calculate the standard enthalpy change for the following reaction.   
  
**2H2S(g)** + **3O2(g)**http://cxp.cengage.com/contentservice/assets/T=1447970453796/owms01h/mediaarchives/GenChem/Image/Arrow.gif**2H2O(l)** + **2SO2(g)**

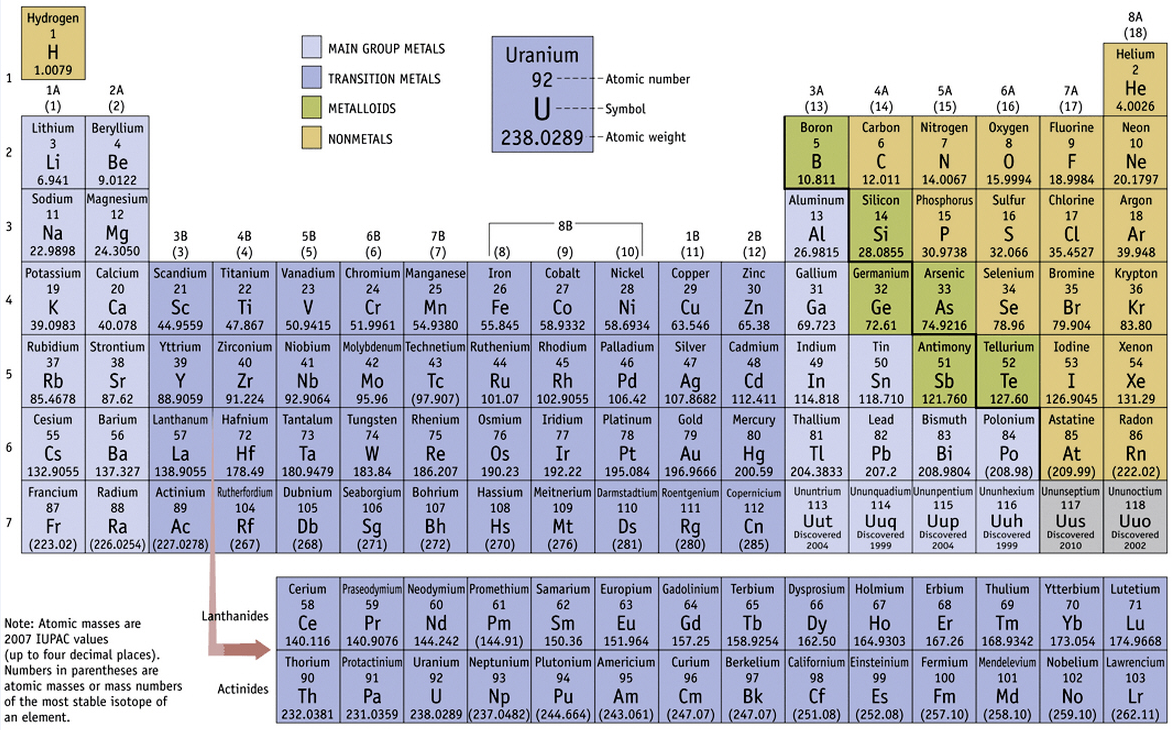
ΔHfo , kJ/mol

H2S(g) -20.6

H2O(l) -285.8

SO2(g) -296.8

ANSWER:  kJ



**Take Home Extra Credit: You can work with anyone in our class but no one else.**

**13.** In the area below, sketch what the periodic table would look like if:

a) *all* orbital subshells (s, p d, f, etc.) could have exactly two orbitals instead of the way it really works (s = 1 orbital, p = 3 orbitals, d = 5 orbitals, etc.).

and

b) three spin quantum numbers were allowed +1/2, 0, and -1/2.

Any other quantum number rules remain unchanged. Include just boxes in appropriate rows and columns, and do so for the first 4 periods of the periodic table. **Do not** put in element symbols. You're making a picture with a bunch of properly positioned boxes.