CH 06 blank

1. (5 points) Using your knowledge of the everyday and super hero world, place the following sources of light in order of increasing energy: [This means: **start with the smallest energy and end at the highest energy**. Do not put numbers next to the letters; you need to write out the correct order of letters. You will receive no credit if you are not clear about your answer.]:

    a. Gamma rays that turned Bruce Banner into the Hulk
    b. The red color in red dye no. 28; a component of an insecticide used to kill Mediterranean fruit flies
    c. Infrared heat from the wires in your toaster used to burn toast
    d. Superman's x-ray vision used to see through walls and watch nefarious evil deed doers.
    e. The green color of the Green Lantern's lamp

2. ((6 points) A sample of gold metal must absorb radiation with a minimum frequency of $1.2619 \times 10^{15} s^{-1}$ before it can emit an electron from its surface via the photoelectric effect.

    a. (2 points) What is the minimum energy required to produce this effect? (ϕ)
    b. (2 points) What wavelength radiation will provide a photon of this energy?
    c. (2 points) If the surface of the gold sample is radiated with light of wavelength 106 nm, what is the maximum possible kinetic energy of the emitted electrons?

3. [4 points] An electron in the hydrogen atom can undergo only set transitions. Calculate the wavelength for an electron transitioning from n =12 to n =3. Is this visible, infrared, or ultraviolet light?

4. (2 points) How many angular nodes does a 6f orbital have? How many radial nodes does a 12d orbital have?

5. (5 points) Fill in the blanks with the correct response:
   a. The number of orbitals with the quantum numbers [3,2,0] is _____

   b. The number of un-paired electrons in a Mn^{2+} ion is _____

   c. The sub shell with the quantum numbers [4,2] is _____

   d. When n = 2, the angular momentum quantum number ,l, can be what value(s) _____

   e. The total number of electrons with n=4, l = 1 is _____

6. (8 points) A sample of molybdenum metal must absorb radiation with a minimum frequency of 1.09 X 10^{15}s-1 before it can emit an electron from its surface via the photoelectric effect.
   d. What is the minimum energy required to produce this effect? (ϕ)
   e. What wavelength radiation will provide a photon of this energy?
   f. If molybdenum is radiated with light of wavelength 122 nm, what is the maximum possible kinetic energy of the emitted electrons?

7. (6 points) State which of the following sets of quantum numbers would be possible and which would not. Using one or two sentences (not <,>, =,≥, or

any with slashes) explain what is wrong with the quantum numbers that are not possible. Note: missing the spin quantum number is not an error.

a. [1,0,0]
b. n =5, l = 9, ml = -1
c. n = 18, l =0, ml = 0
d. n =9, l = 2, ml = -1
e. [-5, 0, 1]
f. [2, -1, 0]

8. (5 points) Given below are several electron configurations that might be correct for the nitrogen atom. Indicate whether each of these representations are the ground state, the excited state, or un-allowed (forbidden) state. Using Hund's rule, the Pauli principle, and aufbau (building up), BRIEFLY explain your choices. [Some might violate more than one rule.]

a) $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\downarrow}$ $\underline{\quad}$
1s 2s 2p 3s

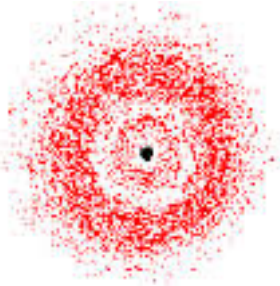
b) $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\quad}$
1s 2s 2p 3s

c) $\underline{\uparrow\downarrow}$ $\underline{\uparrow\uparrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\quad}$
1s 2s 2p 3s

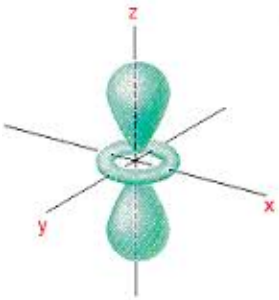
d) $\underline{\uparrow\downarrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$ $\underline{\uparrow}$
1s 2s 2p 3s

e) $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow}$ $\underline{\quad}$ $\underline{\quad}$
1s 2s 2p 3s

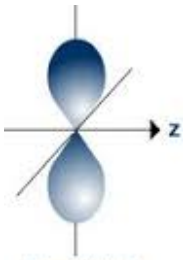
9. (11 points) Each drawing represents a type of atomic orbital.



a 2s orbital [1]



$3d_{z^2}$ [2]



$2p_z$ Orbital [3]

a. (3 points) Give the angular momentum value (l) for each orbital.

b. (3 points) Give an appropriate value for ml for orbital each orbital

c. (2 points) Provide two sets of quantum numbers for an electron in the 2s orbital

10. (3 points) Rank the orbital in order of stability, from most stable to least.6 points)

11. Give the name or electron configuration for the following elements or ions. [You can give noble gas core]:
    a. Ga

    b. Antimony

    c. Iron(II)

    d. $[Ar]4s^1 3d^{10}$

    e. $[Xe]4f^{14}5d^{10}6s^2$
    f. Cr^{2+}
    g. Element number 116 (yes even if it doesn't yet exist)

[1] http://www.chemguide.co.uk/atoms/properties/2sorbital.GIF
[2] http://www.chemguide.co.uk/inorganic/complexions/dorbitals3.gif
[3] http://image.tutorvista.com/content/atomic-structure/orbital-2pz-shape.jpeg

12. (6 points) Give the name or electron configuration for the following elements or ions. [You can give noble gas core]:

    a. Sn^{4+}

    b. Thallium (element 81)

    c. Iron(II)

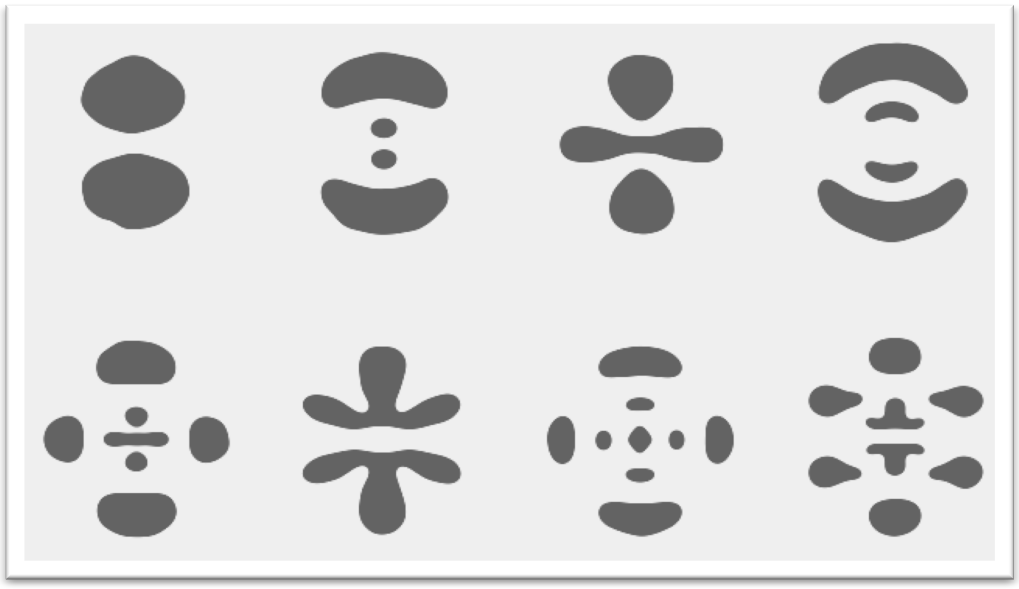
    d. $[Ar]4s^{1}3d^{10}$

    e. $[Xe]4f^{14}5d^{10}6s^{2}6p^{4}$

    f. Co^{2+}

13. (13 points) Each drawing represents a type of atomic orbital.[4]

Row 1:	2p,	3p,	3d,	4p
Row 2:	4d,	4f,	5d,	5f



[4] http://hendrix2.uoregon.edu/~imamura/102/images/orbitals.jpg, I adjusted the contrast so that my students can see the image better.

d. (4 points) Give the angular momentum value (l) for each orbital in row 1.

e. (3 points) Give an appropriate value for ml for a 5d orbital and a 5f orbital

f. (2 points) Provide two sets of quantum numbers for an electron in the 4p orbital

(4 points) Rank the orbitals in row 2 in order of stability, from most stable to least.

14. (5 points) Atomic sodium emits light at 389nm when an excited electron moves from a 4s orbital to a 3s orbital (this emission is very weak), and at 300. nm when an electron moves from a 4p orbital to the same 3s orbital.
    a. Draw an energy level diagram depicting the process. (You can leave out the core levels of n=1 and n= 2)
    b. What is the energy of these two wavelengths?
    c. What is the energy separation (in kilojoules/mole) when an electron moves between the 4s and the 4p orbital?

15. (10 points) Microwave ovens use microwave radiation to heat food. The energy is absorbed by water molecules (and other small molecules) in food, and transferred to other components of the food.
    (a) Suppose that the microwave radiation has a wavelength of 11.2 cm. How many photons are required to heat 200.0 mL of coffee from 23.0°C to 60.0°C? (7 points)
    (b) Suppose the microwave's power is 900.W (1 Watt = 1 joule/sec). How long would you have to heat the coffee based on the energy from part a? (3 points)

16. (7 points) Complete the following statements:

a. Two electrons in the same _____ must have opposite spin.

b. The presence of un paired electrons in an atom gives rise to _____

c. When l= 3, ml may have values from _____ to _____ .

d. The neutral fourth period atom having a total of six d electrons is _____ .

e. Orbital with the same energy are said to be _____ .

f. The 2p orbitals of an atom have identical shapes but differ in there _____ .

g. A nodal surface is one at which the probability of finding and electron is _____

d