

**City College, Chemistry Department
Chemistry 10301, sections T, T2, T3, Prof. T. Lazaridis
Third Midterm exam, Nov 29, 2007**

Name (last name first): _____

I.D. Number last 4: _____

Workshop leader: _____

Note: There are 11 questions in this exam. Fill in your answer in the blank space provided immediately following each question. 1/2 point will be subtracted every time you report a numerical result with an incorrect number of significant figures.

Useful data: **Speed of light : 2.9979×10^8 m/s**
 Planck's constant : 6.626×10^{-34} Js
 $E_n = -2.179 \times 10^{-18}$ J/n²

1. (4) Which of the following symbols represent possible orbitals, and which do not? Explain what is wrong with each incorrect symbol.

- a) 2s **possible**
- b) 3p **possible**
- c) 2d **impossible (n=2, l=2)**
- d) 3g **impossible (n=3, l=4)**

2. (6) The human eye can detect 3.15×10^{-17} J of 510-nm radiation. How many photons does this correspond to?

$$E = h c / \lambda = 6.626 \times 10^{-34} \text{ Js} \times 2.9979 \times 10^8 \text{ m/s} / 510 \times 10^{-9} \text{ m} = 0.0389 \times 10^{-17} \text{ J}$$

That's the energy of one photon.

$$\text{Number of photons: } 3.15 \times 10^{-17} \text{ J} / 0.0389 \times 10^{-17} \text{ J} = 81$$

3. (10) A hydrogen electron makes a transition from n=2 to n=3.

a) (3) Is a photon emitted or absorbed during the transition?

Energy increases --> photon is absorbed

b) (4) Calculate the energy, frequency, and wavelength of the photon

$$\Delta E = -2.179 \times 10^{-18} \text{ J} (1/3^2 - 1/2^2) = 0.3026 \times 10^{-18} \text{ J}$$

$$\Delta E = h\nu \Rightarrow \nu = 0.3026 \times 10^{-18} \text{ J} / 6.626 \times 10^{-34} \text{ Js} = 0.04567 \times 10^{16} \text{ s}^{-1}$$

$$\lambda = c/\nu = 2.9979 \times 10^8 \text{ m/s} / 0.04567 \times 10^{16} \text{ s}^{-1} = 656.4 \text{ nm}$$

c) (3) In what region of the electromagnetic spectrum would you look for the photon?

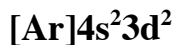
visible (red)

4. (10) What is the electron configuration of the following elements or ions (use noble gas core abbreviated notation):

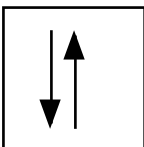
a) Sn^{2+}



b) Ti



5. (5) Show the orbital diagram for Calcium and say whether it is diamagnetic or paramagnetic.



4s

diamagnetic

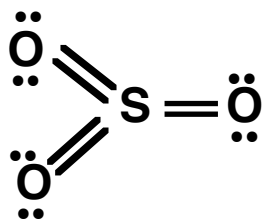
6. (5) Rank the elements P, Ga, Fe from lower to higher electronegativity:



7. (10) Draw resonance structures for the nitrite ion (NO_2^-) and indicate the formal charge on each atom

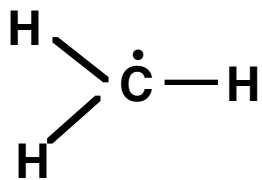


8. (10) Draw a Lewis structure with zero formal charges for SO_3 . Indicate any exceptions to the octet rule.

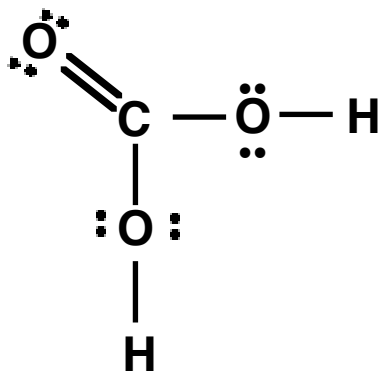


S has an expanded octet

9. (10) Draw a Lewis structure for the free radical CH_3 .

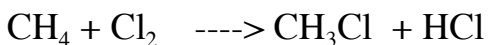


10. (15) Draw a Lewis structure for H_2CO_3 that satisfies the octet rule and has the lowest formal charge (remember: acidic H binds to oxygen). Indicate which C-O bond will be shorter than the others.



**All formal charges are zero.
The double bond is shorter**

11. (15) Use bond energy data to estimate the enthalpy change for the following reaction:



Is it exothermic or endothermic?

One Cl-Cl bond and one C-H bond break, one H-Cl and one C-Cl bond form. Using data from table 9.1:

$$\Delta H = -\{\text{bond energy of products}\} + \{\text{bond energy of reactants}\} =$$

$$= -\{339 + 431\} + 243 + 414 = -113 \text{ kJ} \quad (\text{exothermic})$$