

**City College, Chemistry Department**  
**Chemistry 10301, sections T, T2, T3. Prof. T. Lazaridis**  
**Final exam, Dec 20, 2007**

**Name (last name first):** \_\_\_\_\_

**I.D. Number last 4:** \_\_\_\_\_

**Note: There are 18 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.**

**A Data Sheet with useful information is at the end.**

1. (4) Write the names of the elements below next to their atomic symbols:

Ar

Al

S

Cu

2. (4) Write the molecular formula next to the names of the following compounds:

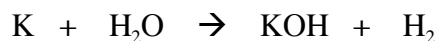
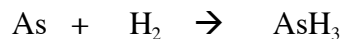
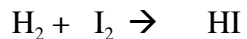
Sodium Nitrate

Barium Carbonate

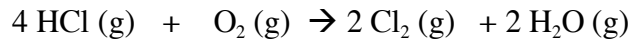
Magnesium Sulfate

Potassium Hydroxide

3. (8) Balance the following chemical equations:



4. (7) The equation for preparing chlorine gas from HCl is



How many kilograms of HCl are required to produce 1750 kilograms of Cl<sub>2</sub>?

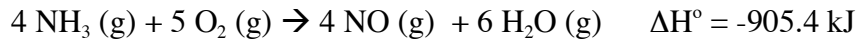
5. (7) Chlorobenzene is prepared from benzene by the following reaction:



A 10.0-Kg sample of benzene treated with excess chlorine gas yields 10.4 Kg of chlorobenzene. Calculate the percent yield of chlorobenzene.

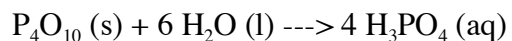
6. (7) How many L of oxygen, measured at 0 °C and 1.00 atm, are required for the complete combustion of 5.00 g of ethane (C<sub>2</sub>H<sub>6</sub>)?

7. (7) Oxidation of ammonia gives nitric oxide and water:



Use this equation and data from your data sheet to calculate the enthalpy of formation of NO.

8. (7) 30.0 g of  $\text{P}_4\text{O}_{10}$  is mixed with 75.0 g of water to form phosphoric acid:



- a) (3) Which one is the limiting reactant?
- b) (3) How many grams of phosphoric acid will form?

9. (4) Calculate the molarity of each of the following solutions:

a) (2) 45.0 g of NaCl in 250 mL of solution

b) (2) 40.0 g of H<sub>2</sub>SO<sub>4</sub> in 2.00 L of solution

10. (4) How many orbitals are there in

a) (2) the n=3 shell?

b) (2) the 3d subshell?

11. (4) Write an abbreviated (noble gas core) electron configuration for the following:

Si

Cl<sup>-</sup>

Cd

Fe<sup>3+</sup>

12. (2) Place the atoms B, K, Ga in order of increasing ionization energy.

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13. (5) Draw the orbital diagram for the partially filled subshells of Cr.

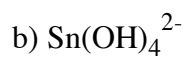
14. (10) Draw Lewis structures that satisfy the octet rule for CO, CO<sub>2</sub>, and CO<sub>3</sub><sup>-2</sup> and predict the order of the C-O bond lengths (which molecule will have the shortest, the longest, and the intermediate bond lengths).

15. (5) Use Lewis structures and the VSEPR method to predict the molecular geometry and the bond angles of ClO<sub>3</sub><sup>-</sup>

16. (5) Compare the shapes and bond angles of  $\text{H}_2\text{O}$  and  $\text{H}_3\text{O}^+$ .

17. (5) Write the structural formula for propene ( $\text{C}_3\text{H}_6$ ), determine the hybridization of each central atom, and estimate all bond angles.

18. (5) Give the oxidation number of each element in the following compounds:



## DATA SHEET

Speed of light :  $2.9979 \times 10^8$  m/s

Planck's constant :  $6.626 \times 10^{-34}$  Js

$E_n = -2.179 \times 10^{-18} \text{ J/n}^2$

Mass of a proton:  $1.67262 \times 10^{-24}$  g

Mass of an electron:  $9.10939 \times 10^{-28}$  g

$R = 0.082058 \text{ L atm / (mol K)} = 62.364 \text{ L torr / (mol K)} = 8.3145 \text{ J / (mol K)}$

Substance       $\Delta H_f^\circ$ , kJ/mol

$\text{NH}_3$  (g)      -46.11

$\text{H}_2\text{O}$  (g)      -241.8

$\text{NH}_4\text{Cl}$  (s)    -314.4

$\text{HCl}$  (g)      -92.31

$\text{C}_2\text{H}_4$  (g)      52.26

$\text{C}_2\text{H}_6$  (g)      -84.68

