

**General Chemistry I (CHM 11) Final Exam**  
**Fall 2007 Section D01BG**

**Part 1: Answer all 20 multiple-choice questions. 3.5 points each, 70 points in total.**

- How many centimeters are in 2.45 feet? (2.54 cm/inch, 12 inches/foot)  
a. 6.22      b. 0.518      c. 29.4      d. 74.7      e. 11.6
- The number of significant figures in the answer to the following calculation is \_\_\_\_.  
 $12.011 \text{ g} - 11.11 \text{ g} + 2.412 \text{ g} =$   
a. 1      b. 2      c. 3      d. 4      e. 5
- Write the chemical formula for the compound formed from  $\text{Cr}^{3+}$  and  $\text{SO}_4^{2-}$  ions.  
a.  $\text{Cr}_3\text{SO}_4$       b.  $\text{Cr}_3(\text{SO}_4)_2$       c.  $\text{Cr}_3\text{SO}_4$       d.  $\text{Cr}_2(\text{SO}_4)_3$   
e.  $\text{Cr}_2(\text{SO}_4)_2$
- Consider the balanced equation:  $2\text{CH}_4 + 4\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$   
If 2.50 mol of each reactant is mixed together, how many moles of  $\text{CO}_2$  will be produced?  
a. 2.50      b. 5.00      c. 1.25      d. 4.00      e. 2.00
- How many carbon atoms are in 115.00 g of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ ?  
a. 115      b.  $6.02 \times 10^{23}$       c. 0.638      d.  $3.84 \times 10^{23}$       e.  $2.30 \times 10^{24}$
- In the reaction,  $\text{K}_2\text{SO}_4(\text{aq}) + \text{Ba}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{KNO}_3(\text{aq})$ , which ions are the spectator ions?  
a.  $\text{Ba}^{2+}$  and  $\text{SO}_4^{2-}$       b.  $\text{Ba}^{2+}$  and  $\text{K}^+$   
c.  $\text{Ba}^{2+}$  and  $\text{NO}_3^-$       d.  $\text{K}^+$  and  $\text{SO}_4^{2-}$   
e.  $\text{K}^+$  and  $\text{NO}_3^-$
- 66.7 mL of 18.0 molar sulfuric acid solution was dissolved in enough water to make 500 mL of solution. The molarity of the diluted mixture is  
a. 2.40 molar      b. 0.135 molar  
c. 36.0 molar      d. 9.00 molar  
e. 0.00741 molar
- Which of these equations does *not* represent an oxidation-reduction reaction?  
a.  $3\text{Al} + 6\text{HCl} \rightarrow 3\text{H}_2 + \text{AlCl}_3$   
b.  $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$   
c.  $2\text{NaCl} + \text{Pb}(\text{NO}_3)_2 \rightarrow \text{PbCl}_2 + 3\text{NaNO}_3$   
d.  $2\text{NaI} + \text{Br}_2 \rightarrow 2\text{NaBr} + \text{I}_2$   
e.  $\text{Cu}(\text{NO}_3)_2 + \text{Zn} \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{Cu}$
- A 500.0 gram sample of aluminum is initially at 25.0 °C. It absorbs 32.60 kJ of heat from its surroundings. What is its final temperature, in °C? (specific heat =  $0.9930 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$  for aluminum)  
a. 40.4 °C      b. 64.7 °C      c. 65.7 °C      d. 89.7 °C  
e. 90.7 °C

10. According to the kinetic theory of gases, the average kinetic energy of the gas particles in a gas sample is directly proportional to the  
a. pressure   b. Volume   c. Temperature   d. molar mass  
e. number of moles of gas

11. What is the wavelength of electromagnetic radiation which has a frequency of  $4.464 \times 10^{14} \text{ s}^{-1}$ ?  
a.  $1.338 \times 10^{23} \text{ m}$    b.  $1.489 \times 10^{-6} \text{ m}$    c.  $6.716 \times 10^{-7} \text{ nm}$   
d.  $671.6 \text{ nm}$    e.  $7.472 \times 10^{-15} \text{ nm}$

12. What is the wavelength, in nm, of radiation which has an energy of  $3.371 \times 10^{-19}$  joules per photon?  
a.  $655.9 \text{ nm}$    b.  $152.5 \text{ nm}$    c.  $170.0 \text{ nm}$   
d.  $589.3 \text{ nm}$    e.  $745.1 \text{ nm}$

13. Given the following sets of quantum numbers for  $n \ l \ m_l \ m_s$ , which one of these sets is not a possible set for an electron in an atom?

	$n$	$l$	$m_l$	$m_s$
a.	3	2	2	$-\frac{1}{2}$
b.	3	1	-1	$\frac{1}{2}$
c.	4	3	2	$\frac{1}{2}$
d.	4	3	-2	$-\frac{1}{2}$
e.	5	2	3	$\frac{1}{2}$

14. The atoms in the oxygen molecule,  $\text{O}_2$ , are held together by  
a. a single covalent bond  
b. a double covalent bond  
c. a triple covalent bond  
d. an ionic bond  
e. a magnetic dipole bond

15. Based on the position in the periodic table, which one of the following atoms would you expect to be the most electronegative?  
a. Cl   b. Ge   c. P   d. Se   e. Sn

16. Indicate the type of hybrid orbitals used by the central atom in  $\text{PCl}_3$ .  
a.  $sp$    b.  $sp^2$    c.  $sp^3$    d.  $sp^3d$    e.  $sp^3d^2$

17. Which one of the following substances will have both dispersion forces and dipole-dipole forces?  
a. HCl   b.  $\text{BCl}_3$    c.  $\text{Br}_2$    d.  $\text{H}_2$    e.  $\text{CO}_2$

18. According to VSEPR theory, which one of the following molecules should be nonlinear?  
a.  $\text{CO}_2$    b.  $\text{C}_2\text{H}_2$    c.  $\text{SO}_2$    d.  $\text{BeCl}_2$    e.  $\text{KrF}_2$

19. Calculate the molality of a solution containing 14.3 g of NaCl in 42.2 g of water.  
a.  $2.45 \times 10^{-4} \text{ m}$    b.  $5.80 \times 10^{-4} \text{ m}$    c.  $2.45 \times 10^{-1} \text{ m}$    d.  $103 \text{ m}$   
e.  $5.80 \text{ m}$

20. According to the VSEPR theory, the geometry of the  $\text{SO}_3$  molecule is  
a. pyramidal    b. tetrahedral    c. trigonal planar    d. distorted tetrahedron (see-saw).  
e. square planar

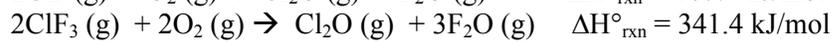
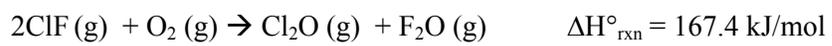
**Part 2: Answer 5 out of the 6 questions. 6 points each, 30 points in total.**

1. A compound containing carbon and hydrogen contains 4.75 g of carbon and 0.80 g of hydrogen. The molar mass of the compound is about 28 g/mol. What is (a) the empirical formula of the compound and (b) the molecular formula of the compound?

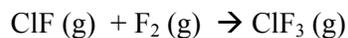
2. How many moles of magnesium (Mg) are there in 87.3 g of  $\text{Mg}_3\text{N}_2$ ? How many atoms of Mg are in 87.3 g of  $\text{Mg}_3\text{N}_2$ ? What is the molar mass of  $\text{Mg}_3\text{N}_2$ ?

3. The reaction,  $\text{MnO}_2(s) + 4 \text{HCl}(aq) \rightarrow \text{MnCl}_2(aq) + \text{Cl}_2(g) + \text{H}_2\text{O}(l)$  was being studied. 12.2 g of  $\text{MnO}_2$  were reacted with 70.0 ml of 2.50 M HCl solution. The chlorine produced was collected in a vessel. The pressure measured 0.971 atm at a temperature of 78.2 °C. Determine the volume of chlorine produced if the theoretical yield was obtained.

4. At 25 °C, the following heats of reaction are known:



At the same temperature, use Hess' law to calculate  $\Delta H^\circ_{\text{rxn}}$  for the following reaction:



5. What is the molar mass of toluene if 0.85 g of toluene depresses the freezing point of 100 g of benzene by  $0.47^\circ\text{C}$ ?  $K_f$  of benzene is  $5.12^\circ\text{C/m}$ .

6. This is not a multiple-choice question, answer all of parts:

1. According to the VSEPR theory, the geometrical structure of  $\text{PF}_5$  is \_\_\_\_\_
2. Draw a Lewis structure for  $\text{PF}_5$  that shows the correct atomic arrangement. \_\_\_\_\_
3.  $\text{PF}_5$  is (polar; nonpolar). (Circle one)