

Name: \_\_\_\_\_

**GENERAL CHEMISTRY  
CHEM. 111 SEC. 001**

**EXAM III**

**These files are in Adobe Acrobat format, if you are using Netscape Navigator or Internet Explorer and have Adobe Acrobat Reader installed (If you do not: Acrobat Reader can be downloaded for free from Adobe) these files should open directly in your browser.**

**Spring, 2006**

Answer all the questions. **DO NOT** write on this examination paper; use the blank sheets at the end of the exam for your answers. Some questions may require you to construct a graph. You may either use a graphing calculator or the graph paper at the back of the exam. In either case, please make sure your answer indicates a table of the x and y values you plotted. Credit will not be given for numerical questions unless all relevant calculations are shown. Please give answers to all numerical questions to 3 significant figures.

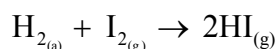
1. a) 0.127g of an unknown compound are dissolved in 150g of benzene. The resultant solution freezes at 5.461°C. If the freezing point of pure benzene is 5.51°C and  $k_f$  for benzene is 4.90°C.m<sup>-1</sup>. Calculate the molecular weight of the compound.

10 points

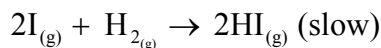
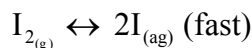
- b) 2.13g of barium chloride are dissolved in water to produce 200mLs of sodium. Calculate the osmotic pressure of the solution if its temperature is 30°C.

10 points

2. a) For the reaction:



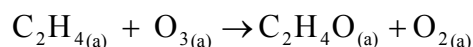
The mechanism is:



Write the rate equation for the reaction.

5 points

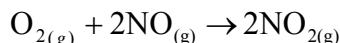
- b) For the reaction:



The following data were obtained in a lineless experiment:

<u>Time s</u>	<u>[O<sub>3</sub>] mole.L<sup>-1</sup></u>
0.0	3.20 x 10 <sup>-5</sup>
10.0	2.42 x 10 <sup>-5</sup>
20.0	1.95 x 10 <sup>-5</sup>
30.0	1.63 x 10 <sup>-5</sup>
40.0	1.40 x 10 <sup>-5</sup>

- i) What is the average rate of the reaction between 10 and 20 seconds?  
10 points
- ii) What is the rate of the reaction at exactly 25 seconds?  
5 points
- iii) If the reaction is 1<sup>st</sup> order in [C<sub>2</sub>H<sub>4</sub>] and 1<sup>st</sup> order in [O<sub>3</sub>]. If after 10 seconds the [C<sub>2</sub>H<sub>4</sub>] = 2.5 x 10<sup>-5</sup> moles.L<sup>-1</sup>. Calculate the rate constant of the reaction.  
10 points
- c) For the reaction:



The following data were obtained:

<u>[O<sub>2</sub>] mole.L<sup>-1</sup></u>	<u>[NO] moles.L<sup>-1</sup></u>	<u>Rate moles.L<sup>-1</sup>.s<sup>-1</sup></u>
1.10 x 10 <sup>-2</sup>	1.30 x 10 <sup>-2</sup>	3.21 x 10 <sup>-3</sup>
1.10 x 10 <sup>-2</sup>	2.60 x 10 <sup>-1</sup>	12.8 x 10 <sup>-3</sup>
1.10 x 10 <sup>-2</sup>	3.90 x 10 <sup>-2</sup>	28.8 x 10 <sup>-3</sup>
2.20 x 10 <sup>-2</sup>	3.90 x 10 <sup>-2</sup>	57.6 x 10 <sup>-3</sup>
3.30 x 10 <sup>-2</sup>	3.90 x 10 <sup>-2</sup>	86.4 x 10 <sup>-3</sup>

- i) What is the order of the reaction with respect to [O<sub>2</sub>]?  
5 points
- ii) What is the order of the reaction with respect to [NO]?  
5 points
- iii) Write the rate expression for the reaction.  
5 points
- iv) What is the rate constant for the reaction?  
5 points

In parts i) and ii) show or explain how you arrived at your answer.

3. a)

i) What is the Arrhenius definition of acids and bases?

5 points

ii) What is the Brønsted Lowery definition of acids and bases?

5 points

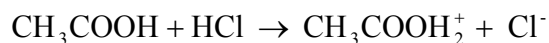
b) Calculate the pH and pOH of a 0.012M solution of calcium hydroxide.

10 points

c) A solution has a pH of 3.71, what is the hydronium concentration in solution?

5 points

d) In the following reactions using the Brønsted Lowery definition of acids and bases:



i) What is the base?

ii) What is the acid?

iii) What is the conjugate base?

iv) What is the conjugate acid?

5 points

**USEFUL INFORMATION**Freezing Point Depression

$$\Delta T = k_f m$$

Osmotic Pressure

$$\Pi = M R T$$

$$R = 0.0821 \text{ L.atm.mole}^{-1}.\text{K}^{-1}$$

pH

$$14 = \text{pH} + \text{pOH}$$

5  
ANSWERS

1. a) Mol. Wt =  $84.7 \text{ g.mole}^{-1}$

b)  $\Pi = 3.81 \text{ ats}$

2. a) Rate =  $k [I]^2 [H_2]$

b)

i) Rate =  $4.7 \times 10^{-7} \text{ moles. L}^{-1} \cdot \text{s}^{-1}$

ii) Rate =  $3.0 \times 10^{-7} \text{ moles. L}^{-1} \cdot \text{s}^{-1}$

iii)  $k = 1.12 \times 10^3 \text{ s}$

c) By inspection of the data when the  $[\text{NO}]$  doubles while the  $[\text{O}_3]$  remains constant the rate quadruples therefore order  $n = 2$

While the  $[\text{O}_3]$  double when  $[\text{NO}]$  remains constant the rate doubles therefore order  $n-1$

i) 1

ii) 2

iii) Rate =  $k [\text{NO}]^2 [\text{O}_3]^1$

iv)  $k = 1.72 \times 10^3 \text{ s}$

3. a)

i) An acid is any material that increases  $[\text{H}_3\text{O}^+]$  of the solution.

A base is any material that increases  $[\text{OH}^-]$  of solution.

ii) An acid is any material that donates a proton

A base is any material that accepts a proton.

b)  $\text{pOH} = 1.62$

$\text{pH} = 12.38$

c)  $[\text{H}_3\text{O}^+] = 1.95 \times 10^{-4} \text{ M}$

d)

