

Name: _____

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

EXAM III

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Spring, 2003

Answer all the questions. **DO NOT** write on this examination paper; use the blank sheets at the back of the exam for your answers. 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) An aqueous solution that is 0.1M in Calcium Chloride is prepared. Calculate the osmotic pressure that this solution would exert.

10 points

- b) 4.963g of an unknown substance is dissolved in water to produce 100 mL of solution. (The solution density is 1.00g.mL^{-1}). If the resultant solution freezes at -0.51°C calculate the molecular weight of the compound. Given k_f for water is $1.86^{\circ}\text{C m}^{-1}$.

10 points

- c) The actual molecular weight of the material is 362g.mole^{-1} . What can you say about its behavior in solution?

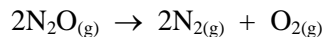
5 points

2. a)

- i) Explain what a catalyst is and how it functions?
- ii) Explain what an inhibitor is and how it functions?
- iii) What is meant by Activation Energy?
- iv) What is meant by Transition State Complex?

8 points

b) The following experimental data was obtained for the reaction:

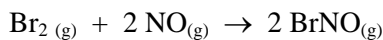


<u>Experiment</u>	<u>Temperature k</u>	<u>k (L.mole⁻¹.s)</u>
1	1125	11.59
2	1053	1.67
3	1001	0.380
4	838	0.0011

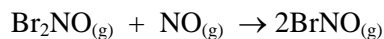
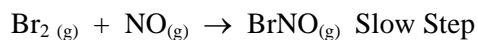
Calculate the activation energy for the reaction. (*Graph paper is provided at the end of the exam.*)

10 points

3. a) For the reaction:



the mechanism is:



write the rate expression for the reaction.

5 points

b) The following data were collected for the reaction:



<u>[N₂O₅] mole.L⁻¹</u>	<u>t (min)</u>
2.08	3.07
1.67	8.77
1.36	14.45
0.72	31.28

i) Calculate the average rate of reaction between 3.07 and 8.77 min.

5 points

ii) Calculate the rate of the reaction after exactly 6.0 min.

(Graph paper is provided at the end of the exam paper.)

10 points

iii) If the reaction is first order, calculate the rate constant.

5 points

4. a) Define pH.

5 points

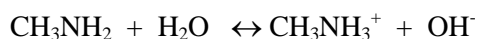
b) For the following reaction using Brønsted Lowery acid base theory, indicate:

i) The acid

ii) The base

iii) The conjugate acid

iv) The conjugate base



5 points

c) Draw the pH scale.

2 points

d) If a solution has a pH = 3.3:

i) Is it acidic or basic?

ii) What is the pOH?

iii) What is the hydronium ion concentration?

iv) What is the hydroxide ion concentration?

10 points

e) 0.123g of potassium hydroxide are dissolved in water to form 150mLs of solution. What is the pH of the solution?

10 points

Useful Information

Osmotic Pressure

$$\Pi = MRT$$

Π = Pressure

M = Molarity

R = 0.08206 L .atm. K.⁻¹ mole⁻¹

T = Temperature K

Freezing Point Depression

$$\Delta T = k_f m$$

Activation Energy

$$k = Ae^{-\frac{E_a}{RT}} \text{ or } \log k = \log A - \frac{E_a}{2.303RT}$$

pH

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

ANSWERS

1. a) 7.34 atms.
 b) 191 g.mole^{-1}
 c) In solution the compound must dissociate into two components.

2. a)
 - i) A catalyst is a material that increases the rate of a reaction without being consumed in the reaction. It does this by lowering the activation energy of the reaction.
 - ii) An inhibitor decreases the rate of a reaction. It does this by raising the activation energy.
 - iii) This is the energy barrier that the reactants have to overcome in order for the reaction to proceed.
 - iv) This is the intermediate 'complex' of the reactants that is formed as they are proceeding towards products.
 b) $E_a = 319 \text{ kJ.mole}^{-1}$

3. a) $\text{Rate} = k [\text{Br}_2] [\text{NO}]$
 b)
 - i) $7.19 \times 10^{-2} \text{ moles.L}^{-1}.\text{min.}^{-1}$
 - ii) $7.03 \times 10^{-2} \text{ moles.L}^{-1}.\text{min.}^{-1}$
 - iii) $4.14 \times 10^{-2} \text{ min.}^{-1}$

4. a) $\text{pH} = \log [\text{H}_3\text{O}^+]$
 b) CH_3NH_2 – base
 H_2O – acid
 CH_3NH_3^+ – conjugate acid
 OH^- – conjugate base

 c)

4.0	5.0	6.0	7.0	8.0	9.0	10.0
acid			neutral		base	

 d)
 - i) Acidic
 - ii) $\text{pOH} = 10.7$
 - iii) $5.01 \times 10^{-4} \text{ M}$
 - iv) $1.99 \times 10^{-11} \text{ M}$
 e) $\text{pH} = 12.2$