CHE 112 - Practice Exam 2 - Chapter 17 and 13 - ver 1 Score: _____/100

Name: _____ Class: _____ Date: _____

You may use your prepared spreadsheet on the exam. Before leaving the exam, show your spreadsheet to the instructor. Then email the spreadsheet and confirm that your instructor received it.

[8 pt] 1. Answer the following questions about the reaction: $NH_4^+(aq) + NO_2^-(aq) \longrightarrow N_2(g) + 2H_2O(l)$

Experiment	$[NH_4^+]$ (M)	$[NO_2^-]$ (M)	Rate (M/s)
1	1.25	3.25	1.91×10^4
2	4.0	3.25	6.13×10^4
3	4.0	1.75	1.78×10^4

(a) What is the rate law?
(b) What is the value of the rate constant?
(c) What is the reaction rate when both reactant concentrations are 1.86 M?

[6 pt] 2. The rearrangement of methyl isonitrile (CH_3NC) is a first-order reaction with rate constant $5.11 \times 10^{-5} s^-1$ at 472 K. The initial concentration of CH_3NC is 0.0340 M.

(a) What is the molarity after 2.00 hours? Explain. 2(a) _____

(b) How many minutes does it take for the concentration of CH_3NC to drop to 0.0300M? Explain. 2(b) _____

Kinetics and Equilibrium

[6 pt] 3. At elevated temperature nitrous oxide decomposes according to the following equation: $2N_2O(g) \longrightarrow 2N_2(g) + O_2(g)$. Given the following data is the reaction 0th, 1st or 2nd order? What is the value of the rate constant?

Time (min)	0	60	90	120	180
[N_2O] M	0.250	0.218	0.204	0.190	0.166

[6 pt] 4. Given the following data determine the Activation Energy (kJ/mol) for the following reaction by plotting the Arrhenius Equation. Show your graph to the instructor and email it after the exam. 4. _____

Temp (°C)	k ($M^{-1}s^{-1}$)]
15.0	6.40×10^3
35.0	4.32×10^3
60.0	2.82×10^3
80.0	2.10×10^3

[6 pt] 5. Given an initial reaction with $k = 8.50 \times 10^3\ s^{-1}$ at 250. K is heated to 350. K where the rate constant is measured as $7.75 \times 10^5\ s^{-1}$, calculate the activation energy in kJ/mol. Explain. 5. _____

Kinetics and Equilibrium

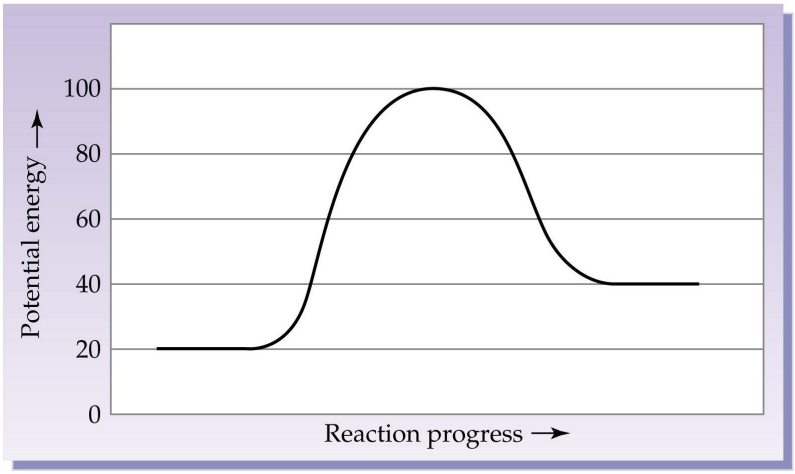
[6 pt] 6. In collision theory what three factors determine the value of the rate constant of a reaction? Explain why/how each effects the rate constant.

(a) Collision Frequency

(b) Collision Energy

(c) Orientation or Stearic

[7 pt] 7. The potential energy profile for the one-step reaction: $AB + CD \longrightarrow AC + BD$ is shown below. The energies are in kJ/mol relative to an arbitrary zero energy level. Label (1) the activation energy (E_A), (2) ΔE, (3) reactants, (4) products and (5) transition state and (6) draw an additional line representing the what a catalyzed reaction would look like. Is the reaction endothermic or exothermic?



[8 pt] 8. The following two step mechanism has been suggested for the reaction methane and Chlorine gas:

Step 1: $NO_2Cl(g) \xrightarrow{k_1} NO_2(g) + Cl(g)$

Step 2: $Cl(g) + NO_2Cl \xrightarrow{k_2} NO_2(g) + Cl_2(g)$

(a) What is the overall reaction?

(b) What is the predicted rate law if the first step is much slower than the second step?

(c) Define the term: reaction intermediate. List any in the reaction.

(d) Define the term: catalyst. List any in the reaction.

Kinetics and Equilibrium

[9 pt] 9. Write the equilibrium constant expression (K_c) for the following reactions. In addition state whether the reaction will favor the (R)eactants, (P)roducts or (B)oth if appreciable amounts of both will be present.

(a) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $K_c = 5.8 \times 10^{-2}$ at 425 K. 9(a) _____

(b) $NH_4SH(s) \longleftrightarrow NH_3(g) + H_2S(g)$ $K_c = 5.8 \times 10^{-5}$ at -25 °C. 9(b) _____

(c) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $K_c = 1.25 \times 10^{25}$ at 35 °F. 9(c) _____

[4 pt] 10. For reaction in A (above), what is the value of K_p. 10. _____

[5 pt] 11. Given the reaction: $H_2O(g) + CH_4(g) \longrightarrow CO(g) + 3H_2(g)$ is at 250 K and contains the following concentrations of reactants and products calculate K_c. $[H_2O] = 0.65$ M, $[CH_4] = 0.50$ M, $[CO] = 0.25$ M, $[H_2] = 0.40$ M. 11. _____

[6 pt] 12. At 25 °C the reaction $A + 2\,B \rightleftharpoons 2\,C$ has an equilibrium constant $K_{eq} = 1.85 \times 10^{-5}$. If the concentration of A, B, and C are 0.25 M, 0.5 M and 0.75 M respectively, is the reaction at equilibrium? Explain. If the reaction is not at equilibrium in which direction will the reaction proceed to reach equilibrium?

Kinetics and Equilibrium

[2 pt] 13. What is Le Chatleliers Principle?

[15 pt] 14. Answer the following questions about the reaction below. The reaction is endothermic. Assume the system is at equilibrium.

$$2C_2H_6(s) + 7O_2(g) \rightleftharpoons 6H_2O(g) + 4CO_2(g)$$

Complete the following table. Indicate changes in concentration of each product and reactant by entering (I)ncrease, (D)ecrease, (N)o change, or a ? for insufficient information to determine.

Stress Applied:	Direction Reaction Shifted	$[C_2H_6]$	$[O_2]$	$[H_2O]$	$[CO_2]$
Add O_2					
Remove CO_2					
Increase Volume					
Decrease Pressure					
Increase Temperature					

[6 pt] 15. At 25 ℃ the reaction $C_2H_4(g) + H_2(g) \longrightarrow C_2H_6(g)$ has an equilibrium constant $K_c = 0.98$. If the concentration of $C_2H_4 = 0.33$ M and $H_2 = 0.53$ M, what will the final equilibrium concentrations of all the reactants and products be? Explain.