

Name: _____

Student #: _____

Section or TA's name: _____

Chem 162

Midterm 1

1. Please clear the memory of your calculator.
2. You may only use the notes on the 3" x 5" card you have brought as discussed in the syllabus.
3. This is a 50 minute exam, and is worth a total of 100 pts.
4. Please show all work.
5. A subset of the examinations will be xeroxed to guard against academic fraud. By taking this examination, you acknowledge that your exam may be xeroxed and used as evidence of fraud should this become an issue.

Potentially Useful Information:

$$R = 8.314 \text{ J/mol.K or } 0.0821 \text{ l.atm/mol.K}$$

$$N_a = 6.022 \times 10^{23} \text{ molec./mol}$$

$$1 \text{ liter} = 10^3 \text{ ml}$$

1. (3 pts. each) Multiple guess and/or short answer. Please blacken the letter next to the answer you believe to be correct as illustrated below:

Today is:

A. Friday B: Tuesday C: Saturday D: Sunday

- a) Given the following rate law expression:

$$R = k[NO]^2[O_2][CO]^{-1}$$

The overall order of the reaction is:

A: 1 B: 4 C: 2 D: -1

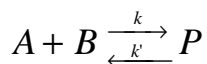
- b) The reference concentration for liquid water is:

A: 22.47 l.atm B: 55 M C: 1 atm D: 0 M

- c) In a multistep reaction, the rate limiting step is:

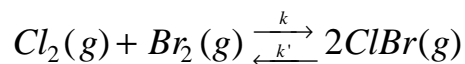
A: fastest B: slowest C: the most complex D: unknown

- d) What is the kinetic definition of equilibrium with respect to the following reaction:



A: $k = k'$ B: $[A]/[B] = [P]$ C: $k/k' = 1$ D: $R_{\text{fwd}} = R_{\text{rev}}$

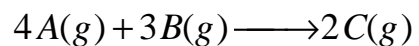
- e) For the following reaction:



A: $K_c = Q_c$ B: $K_c > Q_c$ C: $K_c = K_p$ D: $Q_c = k/k'$

_____ (15 pts)

2. (20 pts) For the reaction:



The following data is obtained

[A] ₀ (M)	[B] ₀ (M)	Initial Rate (M/min)
0.1	0.1	5.0
0.3	0.1	45.0
0.1	0.2	10.0
0.3	0.2	90.0

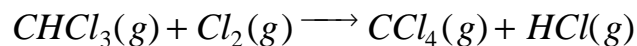
a. (8 pts.) What is the order of the reaction with respect to A and B? Be sure to show how you arrived at your answer!

b. (4 pts.) Write the rate law for this reaction.

c. (8 pts.) What is the value of k, the microscopic rate constant, for this reaction?

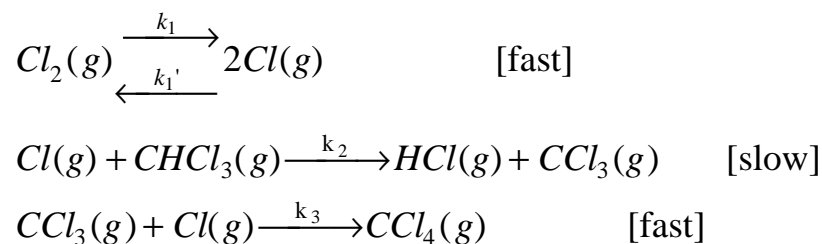
_____ (20 pts.)

3. (25 pts.) In the following reaction:



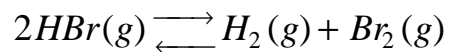
a. (5 pts.) If the reaction occurred by a single, bimolecular collision between CHCl_3 and Cl_2 , what is the expected rate law?

b. (20 pts.) Measurement of the rate concentration dependence demonstrates that the reaction is only one-half order in Cl_2 . Demonstrate that the following mechanism is consistent with this observation:



_____ (25 pts.)

4. (20 pts.) Consider the reaction ($K_c = 1.3 \times 10^{-4}$):



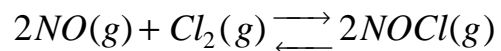
Initially, the system confined to 1 liter has 0.2 atm of reactant and 0.1 M of each product at a temperature of 300 K.

a. (10 pts.) What is K_p for this reaction?

b. (10 pts.) Is the reaction at equilibrium? If not, demonstrate which way the reaction is proceeding.

_____ (20 pts.)

5. (20 pts.) Consider the following reaction ($K_p = 6.5 \times 10^4$ at 308 K):



The reaction is initiated with $P_{NOCl} = 0.35$ atm and all reactant pressures equal to zero. What are the concentrations of all species at equilibrium? Show all work, and write answers in the spaces provided at the bottom of this page.

At equilibrium: $P_{NOCl} =$ _____

$P_{Cl_2} =$ _____

$P_{NO} =$ _____

_____ (20 pts.)