

CHM 152
Exam I

Spring 2008
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Name _____

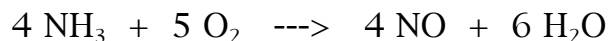
Question	Points
1 - 7	35 (5 pts each)
8	15
9	8
10	10
11	8
12	10
13	14
total	100

The back page contains useful information and may be detached.

1. Consider the rate law: $\text{Rate} = k [\text{A}]^x [\text{B}]^y$
How are x and y determined?

- a) by inspecting the balanced overall reaction
- b) by using the subscripts in the chemical formulas
- c) by examining the coefficients of the balanced overall equation
- d) by doing an experiment

2. At a given time, the rate of disappearance of NH_3 in the following reaction is 1.10 M/minute. At that same point in time, what would be the rate of appearance of H_2O ?



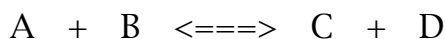
- a) 1.10 M/minute
- b) .733 M/minute
- c) 1.65 M/minute
- d) 2.20 M/minute

3. The K-value for the reaction is 7.9×10^{11} . $\text{H}_{2(g)} + \text{Br}_{2(g)} \rightleftharpoons 2 \text{HBr}_{(g)}$
Determine the K-value for the following reaction at the same temperature:



- a) 7.9×10^{11}
- b) 1.26×10^{-12}
- c) 7.9×10^{-11}
- d) 1.60×10^{-24}

4. Consider the following reaction with $K_c = 2.60$:



If 2.00 moles of each substance A, B, C, and D are placed in a 1.00 L vessel, then which is true?

- a) $Q < K$ initially
- b) The reaction will shift left.
- c) The system is initially at equilibrium.
- d) $Q = 2$ initially

5 - 7 Consider the following system at equilibrium:



5. Addition of X_2 to the above system ...

- a) will cause a shift to the left.
- b) will cause a shift to the right.
- c) will have no effect.
- d) will cause $[\text{H}_2]$ to increase.

6. Addition of argon gas (Ar is inert) to a closed chamber containing the above equilibrium system will ...

- a) cause a shift to the left.
- b) cause a shift to the right.
- c) have no effect.
- d) cause $[\text{H}_2]$ to increase.

7. Increasing the temperature of the above system will ...

- a) cause a shift to the left.
- b) cause a shift to the right.
- c) have no effect.
- d) cause $[\text{H}_2\text{X}]$ to increase.

8.(15) Data were collected for the reaction: $\text{A} + \text{B} \rightarrow \text{products}$

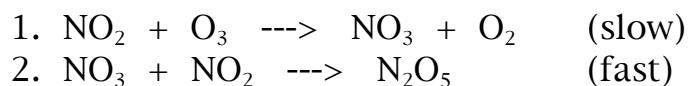
Experiment	[A] initial	[B] initial	Initial rate
1	0.10 M	0.10 M	0.0090 M/sec
2	0.20 M	0.10 M	0.036 M/sec
3	0.10 M	0.20 M	0.018 M/sec
4	0.10 M	0.30 M	0.027 M/sec

- a) Determine the rate law for the reaction.
- b) Determine the value of k , including the units. Show your work.
- c) Identify the overall order of the reaction.

9. (8) The rate constant for the first order decomposition of nitrogen dioxide is 1.70 min^{-1} . $2 \text{ NO}_2 \text{ ---> } 2 \text{ NO} + \text{ O}_2$

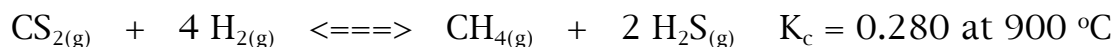
Find the time needed to decrease a 2.00 M sample of NO_2 to a concentration of 1.25 M. Show your work.

10.(10) The mechanism for a reaction is shown:

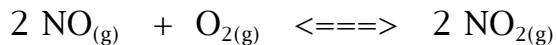


- Show the equation for the overall reaction
- Identify any intermediates.
- Identify the expected rate law for this reaction.

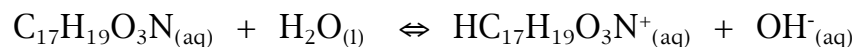
11.(8) Calculate K_p for the reaction at $900 \text{ }^\circ\text{C}$ given K_c . Show your work.



12.(10) A container is filled with NO and O₂. The initial concentrations are 0.0200 M NO and 0.0300 M O₂. When the system reaches equilibrium at 727 °C, the concentration of NO₂ is 0.0022 M. Calculate K_c at 727 °C. Show your work.



13.(14) Morphine (C₁₇H₁₉O₃N) reacts with liquid water to produce OH⁻ ions. Calculate the equilibrium concentrations of C₁₇H₁₉O₃N, OH⁻, and HC₁₇H₁₉O₃N⁺, when 1.00 mole of C₁₇H₁₉O₃N is dissolved in enough water to make 1.00 L of solution, and the system is allowed to reach equilibrium. Assume the volume does not change. Show your work.



$$K_c = 7.4 \times 10^{-7}$$

INFORMATION PAGE

$$\ln [A]_t = -kt + \ln [A]_0$$

$$t_{1/2} = .693/k$$

$$1/[A]_t = kt + 1/[A]_0$$

$$t_{1/2} = 1/k[A]_0$$

$$[A]_t = -kt + [A]_0$$

$$t_{1/2} = [A]_0/2k$$

$$\ln k = \ln A - E_a / (RT)$$

$$\ln (k_1/k_2) = - E_a/R (1/T_1 - 1/T_2)$$

$$k = Ae^{-E_a/(RT)}$$

$$R = 0.0821 \text{ L} \cdot \text{atm}/(\text{mole} \cdot \text{K})$$

$$K_p = K_c (RT)^{\Delta n}$$

$$R = 8.314 \text{ J}/(\text{mole} \cdot \text{K})$$