CHEM 188 – Spring, 2012

Hour Exam 1 (Red)

February 16, 2012

Instructions:

Your scantron answer sheet must show your **NAME**, **7-DIGIT KU ID NUMBER**, and **LAB SECTION**. (Begin these entries at the LEFT end of the space provided.)

In answering the questions, be careful to fill in the corresponding circles on the answer sheet according to the number of the question on the exam. **USE A SOFT (No. 2) PENCIL**.

Useful information:

Gas constant, $R = 8.314\ J/K \cdot mol$
$= 0.08206\ L \cdot atm/K \cdot mol$

Integrated Rate Laws:

Zero-order: $[A] = [A]_0 - kt$

First-order: $[A] = [A]_0 e^{-kt}$

Second-order: $\frac{1}{[A]} = \frac{1}{[A]_0} + kt$

Arrhenius equation: $k = Ae^{-E_a/RT}$

$$\ln\frac{k_1}{k_2} = \frac{E_a}{R}\left(\frac{T_1 - T_2}{T_1T_2}\right)$$

Relation of K_P to K_C: $K_P = K_C(RT)^{\Delta n}$

Quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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1. Consider the reaction

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

Suppose that the rate of loss of molecular nitrogen, $-d[N_2]/dt$, is 0.060 M/s at a particular time during the reaction. What is the rate of formation of ammonia, **$d[NH_3]/dt$**?

A. 0.020 M/s   B. 0.030 M/s   C. 0.060 M/s   D. 0.12 M/s   E. 0.18 M/s

2. For the overall chemical equation,

$$2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(l)$$

which one of the following can you rightly assume?

A. The reaction is third-order overall.
B. The reaction is second-order overall.
C. The rate law is, rate = $k[H_2S][O_2]$
D. The rate law is, rate = $k[H_2S]^2[O_2]$
E. The rate law cannot be determined from the information given.

3. The reaction A + 2B $\rightarrow$ products was found to have the rate law, rate = $k[A]\,[B]^2$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled and the concentration of B is also doubled.

A. 2   B. 4   C. 6   D. 8   E. 9

4. Consider the hypothetical reaction A + 2B $\rightarrow$ products. Use the following data to determine the **rate** of the reaction when [A] = 0.10 M and [B] = 0.15 M.

Expt. #	$[A]_0$	$[B]_0$	Initial rate
1	0.20	0.20	0.76 M/s
2	0.20	0.40	0.76 M/s
3	0.40	0.20	1.52 M/s

A. 0.19 M/s   B. 0.38 M/s   C. 0.57 M/s   D. 0.95 M/s   E. none of these

5. If concentration is expressed in units of moles per liter (mol/L) and time in units of seconds (s), the **units of a third-order rate constant** are

A. $L\ mol^{-1}\ s^{-1}$ B. $L^2\ mol^{-2}\ s^{-1}$ C. s^{-1}
D. s^{-2} E. $mol\ L^{-1}\ s^{-1}$

6. A certain first-order reaction A $\rightarrow$ B is 75% complete in 8.0 minutes at 25°C. What is the **half-life** of the reaction?

A. 4.0 min   B. 8.0 min   C. 16 min   D. 19 min   E. 39 min

7. For a certain reaction, A $\rightarrow$ products, it was found that 20 minutes were required for the concentration of A to decrease from 1.0 M to 0.50 M, and that an additional 20 minutes were required for [A] to decrease from 0.50 M to 0.25 M. What is the **rate law** for this reaction?

A. rate = $k[A]^{-1}$
B. rate = k
C. rate = k[A]
D. rate = $[A]^2$
E. cannot be determined from the information given

8. The rate constant for the second-order reaction

$$2NO_2(g) \rightarrow 2NO(g) + O_2(g)$$

is 0.54 $M^{-1}s^{-1}$ at 300°C. If the initial concentration of NO_2 was 0.50 M, what would the **concentration of NO_2** be after 10 sec?

A. 0.10 M B. 0.14 M C. 0.21 M D. 0.28 M E. 0.39 M

9. A certain zero-order reaction A $\rightarrow$ B for which $[A]_o$ = 1.0 M is 45% complete in 13 seconds 25°C. What the **rate constant, k,** for this reaction at 25°C?

A. 0.012 M/s B. 0.023 M/s C. 0.035 M/s D. 0.046 M/s E. 0.058 M/s

10. The isomerization of cyclopropane follows first-order kinetics. The rate constant at 600 K is 2.72×10^{-7} min^{-1}, and the activation energy for the reaction is 270 kJ/mol. Calculate the value of the **rate constant** (in min^{-1}) at 900 K.

A. 6.20×10^{-4} B. 2.05×10^{-1} C. 1.86×10^{1}
D. 6.87×10^{2} E. 1.32×10^{4}

11. For a certain second-order reaction, rate constant (k) at 25°C is 0.235 M^{-1} s^{-1}. At 50°C the rate constant is 0.959 $M^{-1}s^{-1}$. What is the **frequency factor, A**, for this reaction in units of $M^{-1}s^{-1}$?

A. 4.26×10^4 B. 3.21×10^5 C. 2.41×10^6 D. 1.82×10^7 E. 1.37×10^8

12. If a catalyst could be found that would lower the activation energy by 15.0 kJ/ mol for a particular reaction, by what **factor** would the rate constant for this reaction be increased at 25°C? (Assume the frequency factor remains the same.)

A. 5.66×10^1 B. 4.26×10^2 C. 3.20×10^3 D. 2.41×10^4 E. 1.81×10^5