15, 16, & 17 CUMULATIVE PRACTICE

Kinetics

1. For the reaction $2H_2O\ (g) \rightarrow 2H_2(g) + O_2(g)$
    a. Express the rate of reaction using the change in concentration of both products and reactants
    b. 0.387 mols of H_2 are produced in a 0.5 L beaker after 10 seconds. Determine the average rate during this time interval
    c. Determine the rate of change for H_2O over the same time interval

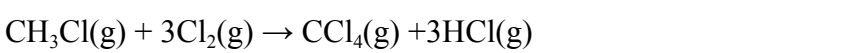
2. The data for the first minute of the reaction $C_4H_8(g) \rightarrow 2C_2H_4(g)$ is shown in the table below:

Time (s)	$[C_4H_8]$ (M)
0	1.000
10	0.937
20	0.862
30	0.753
40	0.696
50	0.532
60	0.411

a. What is the average rate of reaction between 10 and 20 seconds?

b. What is the rate of formation of C_2H_4 between 50 and 60 seconds?

3. The tabulated data table is created for the following reaction:



$CH_3Cl(g) + 3Cl_2(g) \rightarrow CCl_4(g) + 3HCl(g)$

Trial	$[CH_3Cl]$ (M)	$[Cl_2]$ (M)	Initial rate (M/s)
1	0.050	0.050	0.014
2	0.100	0.050	0.029
3	0.100	0.100	0.041
4	0.200	0.200	0.115

   a. What is the overall order of the reaction?

   b. Write the rate law expression

   c. Calculate the value of the rate constant k

4. A theoretical reaction has the form $AB \rightarrow A+B$

   A plot of 1/[AB] versus time has a linear slope of 0.25 M . s^{-1} and an $[AB_0] = 0.150$ M

   a. Write the rate law for this reaction

   b. Determine how much time it would take for $[AB_t] = 0.048$ M

   c. How much time is required for [AB] to fall to half of its initial concentration?

5. A certain medication decomposes with a rate constant of 1.42×10^{-4} s^{-1}

   a. Calculate the medications half life

   b. Determine the concentration remaining after 250 minutes if the initial concentration was 1.000 M

6. Calculate the half life second order reaction with a rate constant k=0.115 M . s^{-1} and $[A_0]$= 0.600 M.

7. The overall reaction between nitrogen monoxide and bromine is given by:

   $2NO(g) + Br_2(g) \rightarrow 2NOBr(g)$

   The following two-step mechanism is proposed

   1. $NO(g) + Br_2(g) \rightleftharpoons NOBr_2(g)$ fast
   2. $NOBr_2(g) + NO(g) \rightarrow 2NOBr(g)$ slow

      a. Determine if there are any intermediates present

      b. Write the predicted rate law

Equillibriua

1. At a given temp the following reaction has a Kp of 2.4×10^6

   $2COF_2(g) \rightleftharpoons CO_2(g) + CF_4(g)$

   Calculate the equilibrium constant for the target reaction below:

   $2CO_2(g) + 2CF_4(g) \rightleftharpoons 4COF_2(g)$

2. Calculate the Kp value for the reaction below:

   $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\quad$ $Kc = 2.8 \times 10^8$

3. $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ $K_c = 2.2 \times 10^{-4}$ at 1000k

   $[H_2S] = 0.600$ M $[H_2] = 0.052$ M $[S_2] = 0.040$ M

   a. Calculate the reaction quotient

   b. Determine which direction the reaction will proceed

4. $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ $K_c = 2.5 \times 10^{-4}$ at 1000k

   $[CO] = 1.00$ M $[H_2O] = 1.00$ M $[H_2] = 0.50$ M $[CO_2] = 0.50$ M

   a. Calculate the reaction quotient

   b. Solve for equilibrium concentrations

5. Describe equilibrium and explain how it relates to the reaction quotient

Acids/Bases

1. Explain the differences in identifying acids/bases for Brønstead-Lowry, Arrhenius, and Lewis definitions.

2. Which of the following is NOT a conjugate acid/base pair
    a. H_2O/OH^-
    b. NH_4^+/NH_3
    c. H_2CO_3/CO_3^{2-}
    d. HNO_3/NO_3^-

3. A 0.10 M solution of a weak acid has pH = 3.00. What is its Ka value?

    a. 1.0×10^{-3}

    b. 1.0×10^{-5}

    c. 1.0×10^{-7}

    d. 1.0×10^{-2}

4. What is the pH of 0.0785 M NaOH?

5. Determine the pH of 0.22 M NaF Ka for HF = 6.5×10^{-5}

6. Why do we ignore the auto-ionization of H_2O when calculating $[H_3O^+]$?