

Unit 2 Learning Objectives and Problem Assignment
Chemistry 1442
Chapters 16 and 17
Principles of General Chemistry, by Silberberg

Chapter 16. Kinetics; Rates and Mechanisms of Chemical Reactions.

- Review logarithms (see Appendix A., pages A1 – A2).
- Express the rate of a reaction in terms of the relative rates of disappearance of reactants and formation of products for a chemical reaction.
- Know the difference between “average rate” and “instantaneous rate”. Given the appropriate experimental information, be able to determine the average or instantaneous rate.
- Derive the rate law for a reaction from experimental data.
- Understand and be able to use the term “rate constant”. Know the units associated with rate constants.
- Use the rate law (also called rate equation) to calculate the rate, rate constants, or reactant concentrations.
- Determine the order of a reaction.
- Use the integrated rate laws for zero, first, and second order reactions to determine:
 - the concentration of a reactant or product at any time after a reaction has started
 - the time required for a given fraction of sample to react
 - the time required for a reactant concentration to reach a certain level
- Know how the integrated rate laws can be used graphically to determine the order of a reaction.
- Understand and correctly use the concept of half-life.
- Understand how the collision model accounts for reaction rates.
- Understand the concept of activation energy, and know how it relates to the variation of reaction rate with temperature.
- Be able to draw a reaction energy profile (also called a potential energy profile) for a given reaction, identifying:
 - reaction coordinate (the x axis; sometimes labeled “reaction pathway” or “reaction progress”)
 - transition state (activated complex)
 - activation energy (E_a)
 - endothermic/exothermic reactions
- Use the Arrhenius equation to determine the activation energy for a reaction.
- Understand what is meant by the mechanism of a reaction using the terms *elementary steps*, *rate-determining step*, and *reaction intermediate*.
- Determine the molecularity of an elementary step.
- Given the mechanism of a reaction, including the rate-determining step, determine the rate law for that reaction.
- Understand how catalysts work, and be able to identify the roles played by heterogeneous and homogeneous catalysts.

Chapter 16 Problem Assignment:

14, 16, 19, 20, 21, 22, 24, 26, 29, 31, 33, 36, 38, 42, 45, 46, 48, 50, 52, 53, 57, 58, 59, 60, 61, 63, 66

Chapter 17. Equilibrium: The Extent of Chemical Reactions.

- Review solving quadratic equations by using the quadratic formula (Appendix A, page A-3).
- Be able to write the equilibrium expression for a balanced chemical equation, whether heterogeneous or homogeneous.
- Be able to calculate the value of K_c (or K_p) from a knowledge of equilibrium concentrations (or pressures) of reactants or products, or from the initial concentrations and the equilibrium concentration of at least one substance.
- Know the relationship:

$$K_p = K_c(RT)^{\Delta n}$$
 and be able to use this relationship to interconvert K_p and K_c .
- Use the equilibrium constant to qualitatively predict the extent of the reaction.
- Calculate the reaction quotient, Q . Determine whether a reaction is at equilibrium. If it is not at equilibrium, predict in which direction it will shift to reach equilibrium.
- Use the equilibrium constant to calculate equilibrium concentrations.
- Know and be able to apply Le Châtelier’s Principle.
- Explain how the relative equilibrium quantities of reactants and products are shifted by changes in:
 - concentration of reactants and/or products
 - pressure or volume
 - temperature
 - presence or absence of a catalyst
- Know how the change in equilibrium constant with change in temperature is related to the enthalpy change in the reaction.

Chapter 17 Problem Assignment:

11, 13, 15, 18, 20, 21, 22, 24, 26, 27, 31, 32, 34, 36, 38, 40, 42, 44, 50, 51, 53, 55, 57, 60

The equations below will be provided on Test 1.

$\ln \frac{[A]_t}{[A]_0} = -kt$	$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$
$t_{1/2} = \frac{\ln 2}{k}$	$t_{1/2} = \frac{1}{k[A]_0}$
$k = Ae^{-E_a/RT}$	$\ln \frac{k_2}{k_1} = -\frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$