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Approximate Timeline

Students are expected to keep up with class work when absent.

	CHAPTER 12 – CHEMICAL KINETICS	
Day	**Plans for the day**	**Assignment(s) for the day**
1	• 12.1 – Reaction Rates ○ Definition ○ Differentiated Rate Laws • Two ways to write them • 12.2 – Rate Laws – An Introduction ○ Two Types of Rate Laws • Differentiated • Integrated	• Assignment 12.0 • Assignment 12.1 • Read section(s) 12.3
2	• 12.3 – Determining the Form of the Rate Law ○ Reactions with one reactant ○ Reactions with two or more reactants	•
3	• 12.3 – Determining the Form of the Rate Law ○ Reactions with one reactant ○ Reactions with two or more reactants	• Assignment 12.2 • Read section(s) 12.4
4	• 12.4 – The Integrated Rate Law	•
5	• 12.4 – The Integrated Rate Law	• Assignment 12.3 • Read section(s) 12.5
6	• 12.5 – Rate Laws: A Summary	• Read section(s) 12.6 – 12.7
7	• 12.6 – A Model for Chemical Kinetics • 12.7 – Catalysis ○ Homogenous catalysts ○ Heterogeneous catalysts ○ How they work	• Assignment 12.4
8	• Grade & discuss assignment • Review for Chapter 12 Test	•
9	• Chapter 12 Test	• Read section(s) 13.1

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Study Guides
Chapter 12 Quizzes

Quiz 12.1 – 12.2

12.1 - Reaction Rates

1. Define the term "reaction rate".
2. For most chemical reactions, what happens to the rate of reaction as time passes?

12.2 – Rate Laws: An Introduction

3. Consider the generic rate law: $rate = k[A]^x$
    a. The "*k*" stands for the _____.
    b. The "*x*" stands for the _____.
4. A differential rate law relates how _____ depends on _____.
5. An integrated rate law relates how _____ depends on _____.

Quiz 12.5 Rate Laws: A summary

6. For a reaction involving only one reactant:
    a. calculate the order of reaction
    b. write the differential rate law
    c. calculate the rate constant
7. For a reaction involving more than one reactant:
    a. calculate the order of reaction for each reactant
    b. write the differential rate law
    c. calculate the rate constant

Quiz 12.7 – 12.8

12.7 – A Model for Chemical Kinetics

8. According to the collision model, what two requirements must be met in order for two molecules to react with each other?
9. Define "activation energy".

12.8 – Catalysis

10. Define *catalyst*.
11. How does a catalyst accomplish its purpose?
12. Contrast a homogeneous catalyst and a heterogeneous catalyst.

Study Guide
Chapter 12 Test
Advanced Chemistry

At the completion of chapter 12 you should…

1. Know the definitions of the following terms.
    a. Reaction Rate
    b. Rate Constant
    c. Order (of reaction)
    d. (Differentiated) Rate Law
    e. Integrated Rate Law
    f. Half-Life
    g. Activation Energy
    h. Catalyst
    i. Homogeneous Catalyst
    j. Heterogeneous Catalyst
    k. Enzyme
2. Understand what is meant by reaction rate.
3. Be able to write (differentiated) rate laws.
4. Be able to determine the order of reaction for individual reactants and the overall order of reaction.
5. Be able to calculate the half-life for a chemical reaction.
6. Be able to use the half-life to determine the amount of a chemical at any point in time.
7. Know how to use a graph to determine the order of reaction and to write both types of rate laws for the reaction.
8. Know what conditions must be met before a chemical reaction takes place.
9. Understand how a catalyst speeds up a reaction.

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Assignment 12.0 – Vocabulary

Define each of the following terms.

1. Reaction Rate

2. Rate Law

3. Rate Constant

4. Order (of reaction)

5. (Differentiated) Rate Law

6. Integrated Rate Law

7. Half-Life

8. Activation Energy

9. Catalyst

10. Homogeneous Catalyst

11. Heterogeneous Catalyst

12. Enzyme

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Assignment 12.1 – Reaction Rates

1) Table 12.2 illustrates how the average rate of reaction decreases with time.
   A) Why does the average rate decrease with time?

   B) Why are the initial rates used by convention?

2) The central idea of the collision model is that molecules must collide in order to react. Give two reasons why not all collisions of reactant molecules result in product formation.

   A) _____

   B) _____

3) Consider the reaction below. During a specific time period, 0.0048 mol of PH_3 is consumed in a 2.0 L container during each second of reaction, what are the rates of production of P_4 and H_2 in this experiment?

$$4\ PH_3\ (g) \rightarrow P_4\ (s) + 6\ H_2\ (g)$$

4) Consider the general reaction:

$$aA + bB \rightarrow cC$$

and the following average rate data over some time period, Δt:

$$-\frac{\Delta A}{\Delta t} = 0.0080 \text{ mol/L•s}$$

$$-\frac{\Delta B}{\Delta t} = 0.0120 \text{ mol/L•s}$$

$$\frac{\Delta C}{\Delta t} = 0.0160 \text{ mol/L•s}$$

Determine a set of possible coefficients to balance this general reaction.

5) What are the units for each of the following if the concentrations are expressed in moles per liter and the time in seconds?

A) rate of a chemical reaction

B) rate constant for a zero-order rate law

C) rate constant for a first-order rate law

D) rate constant for a second-order rate law

E) rate constant for a third-order rate law

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Assignment 12.2 – Rate Laws from Experimental Data: Initial Rates Method

1) The reaction

$2\ I^-(aq) + S_2O_8^{2-}(aq) \rightarrow I_2(s) + 2\ SO_4^{2-}(aq)$

was studied at 25°C. The following results were obtained.

$[I^-]$ (mol/L)	$[S_2O_8^{2-}]$ (mol/L)	Initial Rate (mol/L•s)
0.080	0.040	12.5×10^{-6}
0.040	0.040	6.25×10^{-6}
0.080	0.020	6.25×10^{-6}
0.032	0.040	5.00×10^{-6}
0.060	0.030	7.00×10^{-6}

A) Determine the order of reaction with respect to each ion.

B) Write the rate law.

C) Calculate the value of the rate constant, k, for trial 1.

2) The decomposition of nitrosyl chloride was studied:

$2\ NOCl\ (g) \leftrightarrows 2\ NO\ (g) + Cl_2\ (g)$

the following data were obtained.

$[NOCl]_0$ (molecules/cm^3)	Initial Rate (molecules/cm^3•s)
3.0×10^{16}	5.98×10^4
2.0×10^{16}	2.66×10^4
1.0×10^{16}	6.64×10^3
4.0×10^{16}	1.06×10^5

A) Determine the order of reaction.

B) Write the rate law.

C) Calculate the value of the rate constant, k.

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3) The following data were obtained for the reaction:

$$2\ ClO_2\ (aq) + 2\ OH^-\ (aq) \rightarrow ClO_3^-\ (aq)\ ClO_2^-\ (aq) + H_2O\ (l)$$

$[ClO_2]$ (mol/L)	$[OH^-]$ (mol/L0	Initial Rate (mol/L•s)
0.0500	0.100	5.75×10^{-2}
0.100	0.100	2.30×10^{-1}
0.100	0.0500	1.15×10^{-1}

A) Determine the order of reaction with respect to each reactant.

B) Write the rate law.

C) Calculate the value of the rate constant, k.

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Assignment 12.3 – Integrated Rate Laws

1) The decomposition of hydrogen peroxide was studied and the following data were obtained at a particular temperature:

Time (s)	$[H_2O_2]$ (mol/L)
0	1.00
120	0.91
300	0.78
600	0.59
1200	0.37
1800	0.22
2400	0.13
3000	0.082
3600	0.050

Determine the

A) rate law

B) integrated rate law

C) value of the rate constant.

D) Calculate $[H_2O_2]$ at 4000. s.

2) A certain reaction has the following general form:

$aA \rightarrow bB$

At a particular temperature and $[A]_0 = 2.00 \times 10^{-2}$ M, concentration versus time data were collected for this reaction, and a plot of ln[A] versus time resulted in a straight line with a slope value of -2.97×10^{-2}/min.

A) Determine the rate law.

B) Determine the integrated rate law.

C) Determine the value of the rate constant.

D) Calculate the half-life of this reaction.

E) How much time is needed for the concentration of A to decrease to 2.50×10^{-3} M?

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3) A certain reaction has the following general form:

$aA \rightarrow bB$

At a particular temperature and $[A]_0 = 2.80 \times 10^{-3}$ M, concentration versus time data were collected for this reaction, and a plot of 1/[A] versus time resulted in a straight line with a slope value of 3.60×10^{-2}/s.

A) Determine the rate law.

B) Determine the integrated rate law.

C) Determine the value of the rate constant.

D) Calculate the half-life of this reaction.

E) How much time is needed for the concentration of A to decrease to 7.00×10^{-4} M?

4) The radioactive isotope ^{32}P decays by first-order kinetics and has a half-life of 14.3 days. How long does it take for 95% of a sample of ^{32}P to decay?

5) A first-order reaction is 75% complete in 320. s.

A) What is the half-life for this reaction?

B) How long does it take for 90.0% completion?

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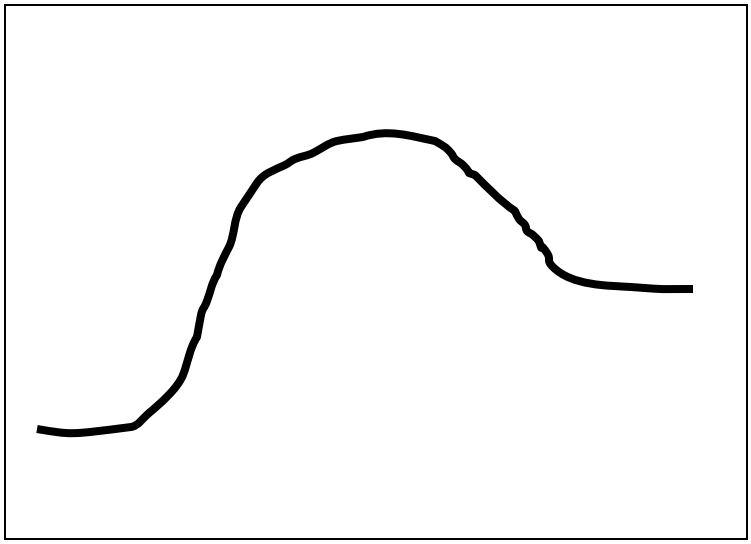
Assignment 12.4 – Temperature Dependence of Rate Constants & the Collision Model

1) On the drawing below, indicate the:
   A) positions of the reactants and products
   B) the activation energy
   C) ΔE for the reaction



2) Draw a rough sketch of the energy profile for each of the following cases:
   A) $\Delta E = +10$ kJ/mol, $E_a = 25$ kJ/mol

   B) $\Delta E = -10$ kJ/mol, $E_a = 50$ kJ/mol

   C) $\Delta E = -50$ kJ/mol, $E_a = 50$ kJ/mol

3) A first order reaction has rate constant of 0.046/s and 0.081/s at 0°C and 20.°C respectively. What is the value of the activation energy?

4) A certain reaction has an activation energy of 54.0 kJ/mol. As the temperature is increased from 22°C to a higher temperature, the rate constant increases by a factor of 7.00. Calculate the higher temperature.