**AP Chemistry Unit 11 Tentative Agenda** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Kinetics

| **Date** | **Agenda** |
| --- | --- |
| Tuesday 2/25 | * Go over U10 Test. * Begin kinetics notes. * Homework   + Reread Chapter 14. |
| Wednesday 2/26 | * Continue Kinetics Notes (Sample Problems Embedded) * Homework   + Mastering 1-10 |
| Thursday 2/27 | * Continue Kinetics Notes (Sample Problems Embedded) * Homework   + Mastering 11-20 |
| Friday 2/28 | * Finish Kinetics Notes (Sample Problems Embedded) * Homework   + Mastering 21-30   + Prelab for Kinetics of Crystal Violet Fading Lab. |
| Monday 3/2 | * **LAB:** Kinetics of Crystal Violet Fading * Homework   + Mastering 31-40 |
| Tuesday 3/3 | * Continue: **LAB:** Kinetics of Crystal Violet Fading * Labs Due * Homework   + Mastering 41-50 |
| Wednesday 3/4 | * Kinetics Quiz (Determine rate law and k given a data set) * Mastering Day/Finish Lab * Homework   + Mastering 50-62 |
| Thursday 3/5 | * Review * Hint of the day: Review Unit 10. I will include 5 questions from the solutions test on this test. * Homework   + Mastering Due 11:59 PM |
| Friday 3/6 | * Unit 11 Test |
| Monday 3/9 | * Go over test * Begin Equilibrium Unit |

**Learning Objectives:**

Enduring understanding 4.A: Reaction rates that depend on temperature and other environmental factors are determined by measuring changes in concentrations of reactants or products over time. The rate of a reaction is the rate at which reactants are converted to products, and is given in terms of the change in concentrations with time. Rates of reactions span a wide range, and generally increase with reactant concentrations and with temperature. The rate may be measured by monitoring concentrations as a function of time, and the results of many experiments may be summarized with a mathematical expression known as the rate law. The rate law gives the dependence of the rate on reactant concentrations, and contains a proportionality constant called the rate constant.

Essential knowledge 4.A.1: The rate of a reaction is influenced by the concentration or pressure of reactants, the phase of the reactants and products, and environmental factors such as temperature and solvent.

a. The rate of a reaction is measured by the amount of reactants converted to products per unit of time.

b. A variety of means exist to experimentally measure the loss of reactants or increase of products as a function of time. One important method involves the spectroscopic determination of concentration through Beer’s law.

c. The rate of a reaction is influenced by reactant concentrations (except in zeroorder processes), temperature, surface area, and other environmental factors.

**LO 4.1 The student is able to design and/or interpret the results of an experiment regarding the factors (i.e., temperature, concentration, surface area) that may influence the rate of a reaction. [See SP 4.2, 5.1]**

Essential knowledge 4.A.2: The rate law shows how the rate depends on reactant concentrations.

a. The rate law expresses the rate of a reaction as proportional to the concentration of each reactant raised to a power. The power of each reactant in the rate law is the order of the reaction with respect to that reactant. The sum of the powers of the reactant concentrations in the rate law is the overall order of the reaction. When the rate is independent of the concentration of a reactant, the reaction is zeroth order in that reactant, since raising the reactant concentration to the power zero is equivalent to the reactant concentration being absent from the rate law.

b. In cases in which the concentration of any other reactants remain essentially constant during the course of the reaction, the order of a reaction with respect to a reactant concentration can be inferred from plots of the concentration of reactant versus time. An appropriate laboratory experience would be for students to use spectrophotometry to determine how concentration varies with time.

c. The method of initial rates is useful for developing conceptual understanding of what a rate law represents, but simple algorithmic application should not be considered mastery of the concept. Investigation of data for initial rates enables prediction of how concentration will vary as the reaction progresses.

**LO 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction. [See SP 5.1, 6.4, connects to 4.A.3]**

Essential knowledge 4.A.3: The magnitude and temperature dependence of the rate of reaction is contained quantitatively in the rate constant.

a. The proportionality constant in the rate law is called the rate constant.

b. The rate constant is an important measurable quantity that characterizes a chemical reaction.

c. Rate constants vary over many orders of magnitude because reaction rates vary widely.

d. The temperature dependence of reaction rates is contained in the temperature dependence of the rate constant.

e. For first-order reactions, half-life is often used as a representation for the rate constant because they are inversely proportional, and the half-life is independent of concentration. For example, radioactive decay processes provide real-world context.

**LO 4.3 The student is able to connect the half-life of a reaction to the rate constant of a first-order reaction and justify the use of this relation in terms of the reaction being a first-order reaction. [See SP 2.1, 2.2]**

Enduring understanding 4.B: Elementary reactions are mediated by collisions between molecules. Only collisions having sufficient energy and proper relative orientation of reactants lead to products.

Reactions proceed through elementary steps involving one or more reactants. In a unimolecular reaction, collisions with other molecules activate the reactant such that it is converted into product. In bimolecular and higher-order reactions, collisions between reactants lead to formation of products, provided both the energy of the collision and the relative orientation of reactants are favorable for reaction. A successful collision can be viewed as proceeding along some single reaction coordinate. The energy profile along this reaction coordinate provides a useful construct for reasoning about the connection between the energetics of a reaction and the rate of the reaction. In particular, this profile includes the activation energy required to overcome the energy barrier between reactants and products.

Essential knowledge 4.B.1: Elementary reactions can be unimolecular or involve collisions between two or more molecules.

a. The order of an elementary reaction can be inferred from the number of molecules participating in a collision: unimolecular reactions are first order, reactions involving bimolecular collisions are second order, etc.

b. Elementary reactions involving the simultaneous collision of three particles are rare.

**LO 4.4 The student is able to connect the rate law for an elementary reaction to the frequency and success of molecular collisions, including connecting the frequency and success to the order and rate constant, respectively. [See SP 7.1, connects to 4.A.3, 4.B.2]**

Essential knowledge 4.B.2: Not all collisions are successful. To get over the activation energy barrier, the colliding species need sufficient energy. Also, the orientations of the reactant molecules during the collision must allow for the rearrangement of reactant bonds to form product bonds.

a. Unimolecular reactions occur because collisions with solvent or background molecules activate the molecule in a way that can be understood in terms of a Maxwell-Boltzmann thermal distribution of particle energies.

b. Collision models provide a qualitative explanation for order of elementary reactions and the temperature dependence of the rate constant.

c. In most reactions, only a small fraction of the collisions leads to a reaction. Successful collisions have both sufficient energy to overcome activation energy barriers and orientations that allow the bonds to rearrange in the required manner.

d. The Maxwell-Boltzmann distribution describes the distribution of particle energies; this distribution can be used to gain a qualitative estimate of the fraction of collisions with sufficient energy to lead to a reaction, and also how that fraction depends on temperature.

**LO 4.5 The student is able to explain the difference between collisions that convert reactants to products and those that do not in terms of energy distributions and molecular orientation. [See SP 6.2]**

Essential knowledge 4.B.3: A successful collision can be viewed as following a reaction path with an associated energy profile.

a. Elementary reactions typically involve the breaking of some bonds and the forming of new ones. It is usually possible to view the complex set of motions involved in this rearrangement as occurring along a single reaction coordinate.

b. The energy profile gives the energy along this path, which typically proceeds from reactants, through a transition state, to products.

c. The Arrhenius equation can be used to summarize experiments on the temperature dependence of the rate of an elementary reaction and to interpret this dependence in terms of the activation energy needed to reach the transition state.

✘✘ Calculations involving the Arrhenius equation are beyond the scope of this course and the AP Exam.

Rationale: The conceptual aspects of the Arrhenius equation and the interpretation of graphs is part of the course. However, inclusion of algorithmic calculations was not viewed as the best way to deepen understanding of the big ideas.

**LO 4.6 The student is able to use representations of the energy profile for an elementary reaction (from the reactants, through the transition state, to the products) to make qualitative predictions regarding the relative temperature dependence of the reaction rate. [See SP 1.4, 6.4]**

Enduring understanding 4.C: Many reactions proceed via a series of elementary reactions. Many reactions proceed through a series of elementary reactions or steps, and this series of steps is referred to as the reaction mechanism. The steps of the mechanism sum to give the overall reaction; the balanced chemical equation for the overall reaction specifies the stoichiometry. The overall rate of the reaction is an emergent property of the rates of the individual reaction steps. For many reactions, one step in the reaction mechanism is sufficiently slow so that it limits the rate of the overall reaction. For such reactions, this rate-limiting step sets the rate of the overall reaction. Reaction intermediates, which are formed by a step in the reaction mechanism and then consumed by a following step, play an important role in multistep reactions, and their experimental detection is an important means of investigating reaction mechanisms.

**LO 4.7 The student is able to evaluate alternative explanations, as expressed by reaction mechanisms, to determine which are consistent with data regarding the overall rate of a reaction, and data that can be used to infer the presence of a reaction intermediate. [See SP 6.5, connects to 4.C.1, 4.C.2, 4.C.3]**

Essential knowledge 4.C.1: The mechanism of a multistep reaction consists of a series of elementary reactions that add up to the overall reaction.

a. The rate law of an elementary step is related to the number of reactants, as accounted for by collision theory.

b. The elementary steps add to give the overall reaction. The balanced chemical equation for the overall reaction specifies only the stoichiometry of the reaction, not the rate.

c. A number of mechanisms may be postulated for most reactions, and experimentally determining the dominant pathway of such reactions is a central activity of chemistry.

Essential knowledge 4.C.2: In many reactions, the rate is set by the slowest elementary reaction, or rate-limiting step.

a. For reactions in which each elementary step is irreversible, the rate of the reaction is set by the slowest elementary step (i.e., the rate-limiting step).

Essential knowledge 4.C.3: Reaction intermediates, which are formed during the reaction but not present in the overall reaction, play an important role in multistep reactions.

a. A reaction intermediate is produced by some elementary steps and consumed by others, such that it is present only while a reaction is occurring.

b. Experimental detection of a reaction intermediate is a common way to build evidence in support of one reaction mechanism over an alternative mechanism.

✘✘ Collection of data pertaining to 4.C.3b is beyond the scope of this course and the AP Exam.

Rationale: Designing an experiment to identify reaction intermediates often requires knowledge that is beyond the scope of a general chemistry course.

Enduring understanding 4.D: Reaction rates may be increased by the presence of a catalyst.

Catalysts, such as enzymes in biological systems and the surfaces in an automobile’s catalytic converter, increase the rate of a chemical reaction. Catalysts may function by lowering the activation energy of an elementary step in a reaction, thereby increasing the rate of that elementary step, but leaving the mechanism of the reaction otherwise unchanged. Other catalysts participate in the formation of a new reaction intermediate, thereby providing a new reaction mechanism that provides a faster pathway between reactants and products.

Essential knowledge 4.D.1: Catalysts function by lowering the activation energy of an elementary step in a reaction mechanism, and by providing a new and faster reaction mechanism.

a. A catalyst can stabilize a transition state, lowering the activation energy and thus increasing the rate of a reaction.

b. A catalyst can increase a reaction rate by participating in the formation of a new reaction intermediate, thereby providing a new reaction pathway or mechanism.

**LO 4.8 The student can translate among reaction energy profile representations, particulate representations, and symbolic representations (chemical equations) of a chemical reaction occurring in the presence and absence of a catalyst. [See SP 1.5]**

Essential knowledge 4.D.2: Important classes in catalysis include acidbase catalysis, surface catalysis, and enzyme catalysis.

a. In acid-base catalysis, a reactant either gains or loses a proton; this changes the rate of the reaction.

b. In surface catalysis, either a new reaction intermediate is formed, or the probability of successful collisions is modified.

c. Some enzymes accelerate reactions by binding to the reactants in a way that lowers the activation energy. Other enzymes react with reactant species to form a new reaction intermediate.

**LO 4.9 The student is able to explain changes in reaction rates arising from the use of acid-base catalysts, surface catalysts, or enzyme catalysts, including selecting appropriate mechanisms with or without the catalyst present. [See SP 6.2, 7.2]**

**Mastering Chemistry Assignment Breakdown**

| [**#**](http://session.masteringchemistry.com/myct/yui-dt0-href-ordinal) | [**TITLEShow Descriptions**](http://session.masteringchemistry.com/myct/yui-dt0-href-title) | **DIFFICULTY** | **MEDIAN TIME** |
| --- | --- | --- | --- |
| [**System**](http://session.masteringchemistry.com/myct/yui-dt0-href-systemDifficulty) | [**System**](http://session.masteringchemistry.com/myct/yui-dt0-href-formattedSystemTime) |
| 1 | [± Average and Instantaneous Reaction Rates](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33957997) | 3 | 14m |
| 2 | [± Reaction Rates](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33957954) | 1 | 8m |
| 3 | [Give It Some Thought: 14.1](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958023) | 1 | 1m |
| 4 | [Problem 14.1](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33957957) | 1 | 1m |
| 5 | [Chapter 14 Question 1 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958005) | 1 | 1m |
| 6 | [Go Figure 14.3](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958007) | 2 | 3m |
| 7 | [Problem 14.21](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958050) | 2 | 21m |
| 8 | [Problem 14.2](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958054) | 1 | 4m |
| 9 | [Problem 14.5](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958090) | 1 | 3m |
| 10 | [Problem 14.6](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958153) | 2 | 1m |
| 11 | [Problem 14.7](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958141) | 1 | 3m |
| 12 | [Problem 14.8](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958197) | 1 | 3m |
| 13 | [Problem 14.9](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958199) | 1 | 1m |
| 14 | [Problem 14.10](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958200) | 1 | 4m |
| 15 | [Problem 14.12](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958263) | 1 | 7m |
| 16 | [Problem 14.13](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958226) | 1 | 1m |
| 17 | [Problem 14.15](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958180) | 3 | 6m |
| 18 | [Problem 14.26](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958270) | 1 | 8m |
| 19 | [Chapter 14 Question 1 - True/False](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958283) | 1 | <1m |
| 20 | [Chapter 14 Question 2 - Bimodal](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958284) | 1 | 1m |
| 21 | [Chapter 14 Question 2 - True/False](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958232) | 1 | <1m |
| 22 | [Chapter 14 Question 3 - Algorithmic](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958233) | 1 | 1m |
| 23 | [Rate Law](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958234) | 1 | 4m |
| 24 | [Rate Laws and Reaction Order](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958278) | 3 | 5m |
| 25 | [± Experimental Determination of a Rate Law](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958298) | 3 | 11m |
| 26 | [± Reaction Order](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958320) | 2 | 13m |
| 27 | [Interactive Activity—Rate and the Rate Law Expression](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958402) | 3 | 12m |
| 28 | [Give It Some Thought: 14.5](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958358) | 1 | 2m |
| 29 | [Problem 14.31](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958371) | 1 | 5m |
| 30 | [Chapter 14 Question 12 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958399) | 2 | 2m |
| 31 | [Chapter 14 Question 13 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958414) | 2 | 3m |
| 32 | [Chapter 14 Question 14 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958416) | 1 | 1m |
| 33 | [Chapter 14 Question 18 - Bimodal](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958429) | 1 | 1m |
| 34 | [Chapter 14 Question 19 - Bimodal](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958452) | 1 | <1m |
| 35 | [Chapter 14 Question 20 - Bimodal](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958482) | 1 | 1m |
| 36 | [Chapter 14 Question 21 - Bimodal](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958457) | 2 | 1m |
| 37 | [Introduction to Integrated Rate Laws](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958503) | 4 | 14m |
| 38 | [± Zero-Order Reactions](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958477) | 2 | 17m |
| 39 | [± Half-life (kinetics) for First Order Reactions](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958543) | 2 | 9m |
| 40 | [± Half-life for First and Second Order Reactions](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958511) | 3 | 11m |
| 41 | [± Integrated Rate Laws](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958569) | 3 | 9m |
| 42 | [± Using Integrated Rates Laws](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958532) | 4 | 24m |
| 43 | [Interactive Activity – The Kinetics of a Second-Order Reaction](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958539) | 3 | 23m |
| 44 | [Go Figure 14.8](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958645) | 1 | 1m |
| 45 | [Chapter 14 Question 6 - True/False](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958591) | 1 | 1m |
| 46 | [Chapter 14 Question 15 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958592) | 1 | 1m |
| 47 | [Chapter 14 Question 19 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958626) | 2 | 2m |
| 48 | [Chapter 14 Question 27 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958628) | 1 | 1m |
| 49 | [Chapter 14 Question 33 - Bimodal](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958597) | 2 | 2m |
| 50 | [Activation Energy and Catalysts](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958600) | 2 | 7m |
| 51 | [± Reaction Rates and Temperature](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958672) | 2 | 9m |
| 52 | [Theoretical Models for Chemical Kinetics and Reaction Profiles](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958707) | 3 | 9m |
| 53 | [Chapter 14 Question 29 - Multiple-Choice](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958724) | 1 | 2m |
| 54 | [Rate-Determining Step](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958709) | 3 | 6m |
| 55 | [Mechanisms and Molecularity](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958711) | 2 | 7m |
| 56 | [Reaction Mechanisms](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958770) | 3 | 6m |
| 57 | [Problem 14.75](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958751) | 1 | 2m |
| 58 | [Problem 14.76](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958752) | 1 | 2m |
| 59 | [Catalysts](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958753) | 1 | 2m |
| 60 | [Animation—Multistep Catalytic Reactions and the Atmosphere](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958731) | 2 | 8m |
| 61 | [Chapter 14 Reading Quiz Question 9](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958755) | 1 | 1m |
| 62 | [Chapter 14 Reading Quiz Question 10](http://session.masteringchemistry.com/myct/itemView?showStatsForCourse=1110976&view=solution&showStats=1&assignmentProblemID=33958733) | 1 | <1m |
|  | | **Average:**    **--**  **1.7** | **Total:**    **--**  **324m** |
| **62 items (62.00 points)** | |