

# Reactions of Amines and Epoxides

## Preparation of Amines

Amines are colorless, basic, and have a strong, fishy odor. They are prepared by the reduction of nitriles.



A summary of Ring-Opening Reactions of Epoxides with Strong and Weak Nucleophiles



Regioselectivity and Stereochemistry

## Bond Types, Strength, Length, Polarity and Dipole Moment

### Two types of bond strength

There are two types of bond strength: bond dissociation energy (BDE) and bond enthalpy (BE).

- Bond dissociation energy (BDE) is the energy required to break a bond homolytically, producing two radicals.
- Bond enthalpy (BE) is the average energy required to break a bond heterolytically, producing an ion pair.



- Covalent bonds are formed by sharing of electrons between two atoms.



### The Relative Strength of $\sigma$ and $\pi$ Bonds



### Bond and Bond Energy



### Bond Energy



### There are two types of bond energy

Definition of bond energy



## Sigma and pi bonds

Covalent bonds are classified into sigma ( $\sigma$ ) and pi ( $\pi$ ) bonds.

- Sigma bonds are formed by head-on overlap of orbitals.
- Pi bonds are formed by side-on overlap of orbitals.
- Sigma bonds are stronger than pi bonds.
- Sigma bonds are formed by the overlap of s, sp, and p orbitals.



$\sigma$  bonds are stronger than  $\pi$  bonds.

## Polar and Nonpolar Covalent Bonds

Depending on the difference in the electronegativity of the two atoms, covalent bonds can be polar or nonpolar.



- If the difference in electronegativity is less than 0.5, the bond is nonpolar.
- If the difference in electronegativity is between 0.5 and 1.7, the bond is polar.
- If the difference in electronegativity is greater than 1.7, the bond is ionic.

A difference of 1.7 or higher is a high value for the electronegativity difference, and a lower value is a low value.

## Dipole Moment

The polarity of a bond is described by the dipole moment ( $\mu$ ).



- The dipole moment is a vector pointing from the less electronegative atom to the more electronegative atom.
- The net dipole moment of a molecule is the vector sum of the individual bond dipole moments.
- If the net dipole moment is zero, the molecule is nonpolar.
- If the net dipole moment is non-zero, the molecule is polar.

## Molecular Dipole

To determine the molecular dipole, the vector sum of the bond dipoles is used.

The polarity of the molecule is determined by the vector sum of the bond dipoles. A positive value indicates a net dipole moment, and a negative value indicates no net dipole moment.



Given the vector sum of the bond dipoles, the net dipole is zero.

## Bond Length and Bond Strength

The bond length is the distance between the two nuclei of the bonded atoms.

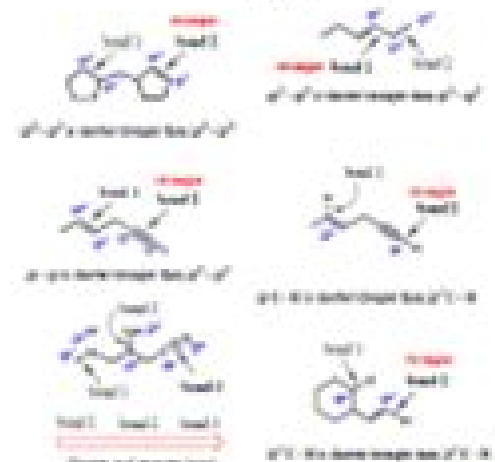


The bond length is the distance between the two nuclei of the bonded atoms.

Average values of C-C and C-H bonds depending on hybridization			
C-C Bond	$sp^3-sp^3$	$sp^2-sp^2$	$sp-sp$
Hybridization	$sp^3-sp^3$	$sp^2-sp^2$	$sp-sp$
Length	1.54 Å	1.34 Å	1.20 Å
Strength	33 kcal/mol	47 kcal/mol	58 kcal/mol
Hybridization	$sp^3-sp^3$	$sp^2-sp^2$	$sp-sp$
C-H Bond	$sp^3-sp^3$	$sp^2-sp^2$	$sp-sp$
Length	1.09 Å	1.08 Å	1.06 Å
Strength	99 kcal/mol	112 kcal/mol	120 kcal/mol

Higher s character means stronger bond

## Examples



# Organic Reactions Study Guide

**Robert J. Ouellette, J. David Rawn**



## Organic Reactions Study Guide:

*Organic Chemistry Reactions: A Study Guide* Cybellium, 2024-10-26 Designed for professionals students and enthusiasts alike our comprehensive books empower you to stay ahead in a rapidly evolving digital world Expert Insights Our books provide deep actionable insights that bridge the gap between theory and practical application Up to Date Content Stay current with the latest advancements trends and best practices in IT AI Cybersecurity Business Economics and Science Each guide is regularly updated to reflect the newest developments and challenges Comprehensive Coverage Whether you re a beginner or an advanced learner Cybellium books cover a wide range of topics from foundational principles to specialized knowledge tailored to your level of expertise Become part of a global network of learners and professionals who trust Cybellium to guide their educational journey [www.cybellium.com](http://www.cybellium.com) *Study Guide to Organic Chemical Reactions* Milin Kurup, 2020-01-06 This Organic Study Guide and workbook was created by the author in hopes to help students have an organized collection of all reactions studied in Organic 1 and Organic 2 With multiple reactions in different categories an organized study guide can help students focus on certain reactions as needed Many students in this class also have hopes of using this study guide as an MCAT review guide this organized set can be useful for students to review before class exams and standardized test With comprehensive notes reactions and tips this study guide will help everyone succeed This was created by a renowned student Milin Kurup at the University of Florida double majoring in Microbiology and Cognitive and Behavioral Neuroscience As a student of Professor Dr Laura Peterson UF Chemistry Organic Division this guide included all notes a series of 140 chemical reactions and key mechanisms necessary for a comprehensive understanding of the subject

**Organic Chemistry Study Guide with Solutions Manual** Neil E. Schore, 2007 The guide includes chapter introductions that highlight new material chapter outlines detailed comments for each chapter section a glossary and solutions to the end of chapter problems presented in a way that shows students how to reason their way to the answer **A Self-study Guide to the Principles of Organic Chemistry** Jiben Roy, 2013 A Self Study Guide to the Principles of Organic Chemistry Key Concepts Reaction Mechanisms and Practice Questions for the Beginner will help students new to organic chemistry grasp the key concepts of the subject quickly and easily as well as build a strong foundation for future study Starting with the definition of atom the author explains molecules electronic configuration bonding hydrocarbons polar reaction mechanisms stereochemistry reaction varieties organic spectroscopy aromaticity and aromatic reactions biomolecules organic polymers and a synthetic approach to organic compounds The over one hundred diagrams and charts contained in this volume will help students visualize the structures and bonds as they read the text and make the logic of organic chemistry clear and easily understood Each chapter ends with a list of frequently asked questions and answers followed by additional practice problems Answers are included in the Appendix **Organic Chemistry Reactions** Speedy Publishing, 2014-09-03 Students of organic chemistry are expected to consume much information in a relatively short period

of time Most have had no clue to the expanse of knowledge that organic chemistry explores Students are required to memorize elements and molecules that are commonly used in organic chemistry Additionally they are required to memorize formulas and chemical reactions which is clearly the most difficult part of the course Having an organic chemistry reaction study guide can help the student by supplying a quick reference to the most commonly used reactions The guide can be reviewed when the student has some down time

**Organic Chemistry Study Guide and Solutions Manual** Marc Loudon, Jim Parise, Lisa Bonner, 2024-08-09 The Study Guide and Solutions Manual offers several study tools for students Study Guide Links are brief supplements to text material and provide hints for study shortcuts approaches to problem solving or additional explanations of topics that typically cause difficulty Further Explorations are short discussions that provide additional depth on content in the text Reaction Reviews present the reactions in the chapter in detailed outline form This summary consolidates the reactions of the chapter in one place and presents not only the reactions themselves but also the essential features of their mechanisms and stereochemistry for cases in which these issues are discussed in the text Solutions are provided for all of the over 1600 problems in the text Many include worked out examples in which not only the answer is given but also the detailed approach to the solution is discussed

*Student Study Guide/Solutions Manual for Essentials of General, Organic, and Biochemistry* Denise Guinn, Rebecca Brewer, Rachel C. Lum, 2009-09-15 The Student Study Guide and Solutions Manual provides students with a combined manual designed to help them avoid common mistakes and understand key concepts After a brief review of each section s critical ideas students are taken through stepped out worked examples try it yourself examples and chapter quizzes all structured to reinforce chapter objectives and build problem solving techniques The solutions manual includes detailed solutions to all odd numbered exercises in the text

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*Organic Chemistry, Student Study Guide and Solutions Manual* David R. Klein, 2017-01-04 This is the Student Study Guide and Solutions Manual to accompany Organic Chemistry 3e Organic Chemistry 3rd Edition is not merely a compilation of principles but rather it is a disciplined method of thought and analysis Success in organic chemistry requires mastery in two core aspects fundamental concepts and the skills needed to apply those concepts and solve problems Readers must learn to become proficient at approaching new situations methodically based on a repertoire of skills These skills are vital for successful problem solving in organic chemistry Existing textbooks provide extensive coverage of the principles but there is far less emphasis on the skills needed to actually solve problems

*Study Guide and Solutions Manual for Organic Chemistry* Susan McMurry, 1992 John McMurry s best selling text presents organic chemistry in a new edition that is up to date beautifully written visually striking and pedagogically sound Described by many of its users as an eminently teachable text McMurry sets the standard in the field The writing style has received almost universal acclaim from its users McMurry

introduces new concepts only as needed and immediately illustrates them with concrete examples And wherever possible he ties material together with brief reviews overviews and reaction summaries The result is a text that helps students mentally organize the material a text that helps them understand concepts not just memorize facts and a text that helps them make sense of the voluminous amount of material they encounter in the study of organic chemistry McMurry uses a simple but important polar reaction the addition of HBr to an alkene as the lead off reaction to illustrate the general principles of organic reactions Users of former editions found this an excellent choice because of its relative simplicity no prior knowledge of chirality or kinetics is required and its importance as a polar reaction on a common functional group that offers students the key to understanding hundreds of thousands of ionic reactions By selecting this particular model McMurry is able to offer an unusually early presentation of organic reactions

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Organic Chemistry, 4e Student Solution Manual and Study Guide David R. Klein, 2021-01-07 Success in organic chemistry requires mastery in two core aspects fundamental concepts and the skills needed to apply those concepts and solve problems With Organic Chemistry Student Solution Manual and Study Guide 4th Edition students can learn to become proficient at approaching new situations methodically based on a repertoire of skills These skills are vital for successful problem solving in organic chemistry

*Organic Chemistry, 5e Student Study Guide and Solutions Manual* David R. Klein, Laurie S. Starkey, 2025-03-18 Success in organic chemistry requires mastery in two core aspects fundamental concepts and the skills needed to apply those concepts and solve problems With Organic Chemistry Student Study Guide and Solutions Manual 5th Edition students can learn to become proficient at approaching new situations methodically based on a repertoire of skills These skills are vital for successful problem solving in organic chemistry

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reinforce critical material from the primary book and enhance mastery of this complex subject Organic chemistry is a constantly evolving field that has great relevance for all scientists not just chemists For chemical engineers understanding the properties of organic molecules and how reactions occur is critically important to understanding the processes in an industrial plant For biologists and health professionals it is essential because nearly all of biochemistry springs from organic chemistry Additionally all scientists can benefit from improved critical thinking and problem solving skills that are developed from the study of organic chemistry Organic chemistry like any skill is best learned by doing It is difficult to learn by rote memorization and true understanding comes only from concentrated reading and working as many problems as possible In fact problem sets are the best way to ensure that concepts are not only well understood but can also be applied to real world problems in the work place

**Organic 1 and 2 Chemical Reactions Study Guide** Milin Kurup,2020-04-22 This Organic Study Guide and workbook was created by the author in hopes to help students have an organized collection of all reactions studied in Organic 1 and Organic 2 Many students in this class also have hopes of using this study guide as an MCAT review guide this organized set can be useful for students to review before class exams and standardized test This was created by a renowned student Milin Kurup at the University of Florida double majoring in Microbiology and Cognitive and Behavioral Neuroscience As a student of Professor Dr Laura Peterson UF Chemistry Organic Division this guide included all notes a series of 140 chemical reactions and key mechanisms necessary for a comprehensive understanding of the subject *Study Guide and Solutions Manual for McMurry's Organic Chemistry, Fifth Edition* Susan McMurry,2000 Provides answers and explanations to all in text and end of chapter exercises Also includes summaries of name reactions functional group synthesis and reactions lists of reagents and abbreviations and articles on topics ranging from infrared absorption frequencies to the Nobel Prize winners in Chemistry This edition now includes all new artwork expanded in text problems summary quizzes approximately every three chapters more detailed explanations in solutions and chapter outlines **Chemical Principles**

**Study Guide/Solutions Manual** John Krenos,Joseph Potenza,Carl Hoeger,2007-01-18 Written for general chemistry courses Chemical Principles helps students develop chemical insight by showing the connection between chemical principles and their applications **Chemical Principles Student's Study Guide & Solutions Manual** John Krenos,Joseph

Potenza,Loretta Jones,Lynn Koplitz,Thomas Spence,2004-03-19 This combination manual is designed to help students avoid common mistakes and understand the material better The solutions manual section includes detailed answers and explanations to the odd numbered exercises in the text **Solutions Manual and Study Guide to Accompany**

**Introduction to Organic Chemistry, 4th Ed** Paul A. Bartlett,Judith G. Koch,1992

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