15 Hydrocarbons

Alkanes

Chemical Reactivity

Alkanes do not react with many reagents.

This is because the C-C bond and the C-H bond are relatively strong and so cannot form stronger bonds with other elements that easily and there are no polar side groups .

There main reactions are combustion reactions in air although they can react with halogens in the presence of UV light

Combustion

Complete Combustion

In excess oxygen alkanes will burn with complete combustion

The products of complete combustion are CO, and H,O.

 $C_2H_2(g) + 3.5 O_3(g) \rightarrow 2CO_3(g) + 3 H_3O(l)$

Alkanes readily burn in the presence of oxygen. This combustion of alkanes is highly exothermic, explaining their use as fuels.

Reaction of alkanes with bromine / chlorine in UV light

Synthesis of chloroalkanes

In the presence of UV light alkanes react with chlorine to form a mixture of products with the halogens substituting hydrogen atoms.



This is the overall reaction, but a more complex mixture of products is actually formed

To understand this reaction fully we must look in detail at how it proceeds step by step. This is called its mechanism

The MECHANISM for this reaction is called a FREE RADICAL SUBSTITUTION

It proceeds via a series of steps: STEP ONE: Initiation STEP TWO: Propagation STEP THREE: Termination

STEP ONE Initiation

Essential condition: UV light

Cl₂ → 2Cl⁻

: CI: CI: + × CI:

The UV light supplies the energy to break the CI-CI bond. It is broken in preference to the others as it is the weakest.

The bond has broken in a process called homolytic fission.

When a bond breaks by homolytic fission it forms Free Radicals.

Free Radicals do not have a charge and are represented by a

each atom gets one electron from the covalent bond

A Free Radical is a reactive species which possess an unpaired electron

STEP TWO Propagation

-CH² + Cl⁵ → CH²Cl + Cl.

The chlorine free radicals are very reactive and remove an H from the methane leaving a methyl free radical

The methyl free radical reacts with a Cl₂ molecule to produce the main product and another Cl free radical

All propagation steps have a free radical in the reactants and in the products.

As the CI free radical is regenerated, it can react with several more alkane molecules in a CHAIN REACTION

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John Krenos, Joseph Potenza, Carl Hoeger

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Table of Contents Hydrocarbon Compounds Study Guide Answers

- 1. Understanding the eBook Hydrocarbon Compounds Study Guide Answers
 - The Rise of Digital Reading Hydrocarbon Compounds Study Guide Answers
 - Advantages of eBooks Over Traditional Books
- 2. Identifying Hydrocarbon Compounds Study Guide Answers
 - Exploring Different Genres
 - o Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Hydrocarbon Compounds Study Guide Answers
 - User-Friendly Interface
- 4. Exploring eBook Recommendations from Hydrocarbon Compounds Study Guide Answers
 - Personalized Recommendations
 - Hydrocarbon Compounds Study Guide Answers User Reviews and Ratings

- Hydrocarbon Compounds Study Guide Answers and Bestseller Lists
- 5. Accessing Hydrocarbon Compounds Study Guide Answers Free and Paid eBooks
 - Hydrocarbon Compounds Study Guide Answers Public Domain eBooks
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- 7. Enhancing Your Reading Experience
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 - Highlighting and Note-Taking Hydrocarbon Compounds Study Guide Answers
 - Interactive Elements Hydrocarbon Compounds Study Guide Answers
- 8. Staying Engaged with Hydrocarbon Compounds Study Guide Answers
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Hydrocarbon Compounds Study Guide Answers
- 9. Balancing eBooks and Physical Books Hydrocarbon Compounds Study Guide Answers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Hydrocarbon Compounds Study Guide Answers
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Hydrocarbon Compounds Study Guide Answers
 - Setting Reading Goals Hydrocarbon Compounds Study Guide Answers
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Hydrocarbon Compounds Study Guide Answers
 - Fact-Checking eBook Content of Hydrocarbon Compounds Study Guide Answers
 - Distinguishing Credible Sources

- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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