

Instructions

For each reaction below, provide the following information:

- Product(s) formed (draw structures or write formulas)
- Catalysts and/or conditions required (temperature, reagents, etc.)

Use a separate sheet to write your answers with clear structures, formulas, and conditions for each reaction.

Alkane Reactions

1. Combustion Reactions

- Complete combustion of propane (C_3H_8)
- Incomplete combustion of butane (C_4H_{10}) with limited oxygen
- Incomplete combustion of ethane (C_2H_6) with very limited oxygen

2. Halogen Substitution

- Methane reacts with chlorine gas
 - What type of bond fission occurs in the halogen molecule?
 - Name the first substitution product
- Ethane reacts with bromine vapor

Alkene Reactions

3. Hydrogenation

- Propene ($CH_3CH=CH_2$) undergoes hydrogenation

4. Halogenation

- Ethene reacts with bromine water
- But-2-ene reacts with chlorine gas

5. Addition of Hydrogen Halides

- Propene reacts with hydrogen bromide (HBr)
 - Name both possible products
- But-1-ene reacts with hydrogen chloride (HCl)

6. Hydration

- Ethene is converted to ethanol
- Propene undergoes hydration

7. Addition Polymerization

- Ethene undergoes polymerization
 - Draw the repeating unit
- Chloroethene (vinyl chloride) undergoes polymerization
 - Name the polymer formed

Alcohol Reactions

8. Combustion

- Complete combustion of ethanol (C_2H_5OH)

9. Oxidation and Reduction

- Ethanol (primary alcohol) is oxidized under mild conditions
- Ethanol is oxidized under strong/reflux conditions
- Propan-2-ol (secondary alcohol) is oxidized
- 2-methylpropan-2-ol (tertiary alcohol) is oxidized
- Ethanal is reduced

10. Esterification

- Ethanol reacts with ethanoic acid
- Methanol reacts with propanoic acid
- Ethanol reacts with ethanoyl chloride

Nucleophilic Substitution

11. Halogenoalkane Reactions

- Bromoethane reacts with aqueous sodium hydroxide
- 1-chloropropane reacts with ammonia (excess)
- 2-bromopropane reacts with potassium cyanide (KCN) in ethanol

Section E: Electrophilic Substitution of Benzene

12. Nitration

- Benzene undergoes nitration

13. Halogenation

- Benzene reacts with bromine
 - What catalyst is required?
- Benzene reacts with chlorine

Challenge Questions

14. Multi-step Synthesis

- Describe the reagents and conditions needed to convert:
 - Ethene \rightarrow Ethanol \rightarrow Ethanoic acid
- What products form when butan-2-ol is:
 - Oxidized with acidified potassium dichromate?
 - Reacted with ethanoic acid?
 - Dehydrated?

15. Identification

- A compound with molecular formula C_4H_8 decolorizes bromine water. Suggest what type of compound this is and give one possible structure.
- An alcohol does not react when warmed with acidified potassium dichromate. What type of alcohol is it? Give an example.