



Attempt all questions before checking the answer key. Write structures, major products and essential reaction conditions. Explain mechanistic answers with arrows where appropriate.

A. Very short answers - 1 mark each

1. Name $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$ by IUPAC rules.
2. Distinguish an alkyl halide from an aryl halide.
3. What is a chiral carbon atom?
4. Define a racemic mixture.
5. What is the order of an SN_1 reaction with respect to haloalkane?
6. Which bond is shorter: C-Cl in chlorobenzene or in chloroethane? State why.

B. Short answers / practice - 2 marks each

7. Write the reaction of bromoethane with aqueous KOH and with alcoholic KOH.
8. Explain why tertiary haloalkanes often react faster by SN_1 than primary ones under comparable conditions.
9. Why is chlorobenzene less reactive than chloroethane towards ordinary nucleophilic substitution?
10. Write Finkelstein and Swarts reactions with examples.
11. Explain why KCN and AgCN give different major products with a primary haloalkane.
12. Draw the two enantiomers of 2-bromobutane using wedge/dash notation.
13. Can chlorobenzene undergo an ordinary SN_2 reaction readily?
14. Name $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$.
15. Find number of constitutional monobromo products from propane.
16. Is 2-bromobutane chiral?
17. Predict major product of bromoethane with alcoholic KOH and heat.
18. Explain why an SN_1 reaction is favoured by a stable carbocation intermediate.

C. Short answers - 3 marks each

19. Explain the SN_2 mechanism for reaction of OH^- with bromomethane and show inversion at a chiral centre in a general example.
20. Explain the SN_1 mechanism for hydrolysis of tert-butyl bromide. Discuss carbocation formation and the rate-determining step.

21. Give conversions: ethanol to bromoethane, bromoethane to propanenitrile and chlorobenzene to phenol.

22. Arrange chloromethane, bromomethane and iodomethane by SN_2 reactivity under comparable conditions and explain bond-strength effects.

23. Write Wurtz, Fittig and Wurtz-Fittig reactions with one balanced example each.

24. Explain why p-dichlorobenzene has a higher melting point than its ortho and meta isomers despite similar molecular masses.

D. Long answers - 5 marks each

25. Compare SN_1 and SN_2 in rate law, intermediate/transition state, substrate preference, solvent effects and stereochemical outcome, with one example each.
26. Starting from benzene, give a route to chlorobenzene and then phenol; starting from ethene, give a route to bromoethane and then ethanol. Specify conditions for every step.
27. An optically active secondary haloalkane undergoes substitution in two conditions, one favouring SN_1 and one SN_2 . Explain possible stereochemical products, inversion and why SN_1 often gives substantial racemisation rather than guaranteed perfect 50:50 mixing.
28. An alkyl bromide $\text{C}_4\text{H}_9\text{Br}$ gives mainly but-2-ene with alcoholic KOH and butan-2-ol with aqueous KOH. Identify it, write both reactions and explain elimination versus substitution.
29. Explain the chemical or environmental concerns associated with chloroform, carbon tetrachloride, freons and DDT. Include safe-storage chemistry of chloroform and ozone-depletion chemistry of CFCs qualitatively.
30. Give reagents and equations for converting propene to 1-bromopropane and to 2-bromopropane. Compare hydrolysis products and explain the role of peroxide and carbocation stability in the respective addition pathways.

ANSWER KEY - Numerical / short answers

- 5) First order in haloalkane. 13) No; its aryl C-Cl bond resists backside substitution. 14) 1-Chloropropane. 15) 2. 16) Yes; C-2 has four different groups. 17) Ethene. 28) 2-bromobutane.