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Haloalkanes and Haloarenes — CBSE Class 12 Chemistry Chapter Test

FREE CHAPTER TEST · CLASS XII · CHEMISTRY (043) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case-based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 1 question in Section D, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Use of log tables and calculators is not allowed.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Chemistry (043) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Haloalkanes and Haloarenes · **Topics:** Nomenclature and the C–X bond · Methods of preparation · Physical properties · Nucleophilic substitution (SN1, SN2) and stereochemistry · Elimination and reactions with metals · Reactions of haloarenes

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. Which of the following undergoes an S_N1 reaction fastest? 1

(A) CH_3Br (B) CH_3CH_2Br

(C) $(CH_3)_3CBr$ (D) $(CH_3)_2CHBr$

2. Bromoethane is heated with sodium iodide in dry acetone. The organic product is 1

(A) CH_3CH_2I (B) CH_3CH_2OH

(C) $CH_2=CH_2$ (D) $CH_3CH_2CH_2CH_3$

3. The number of structural isomers of C_4H_9Br is 1

(A) 2 (B) 3

(C) 5 (D) 4

4. The carbon–halogen bond is longest in 1

(A) CH_3F (B) CH_3I

(C) CH_3Cl (D) CH_3Br

5. 2-Bromobutane is heated with alcoholic KOH. The major product is 1

(A) but-2-ene (B) but-1-ene

(C) butan-2-ol (D) butane

6. Which of the following is an allylic halide? 1

(A) $CH_3CH_2CH_2Cl$ (B) C_6H_5Cl

(C) $CH_2=CHCH_2Cl$ (D) $CH_2=CHCl$

7. **Assertion (A) :** Iodoalkanes are the most reactive haloalkanes in nucleophilic substitution reactions. 1
Reason (R) : Iodomethane is denser than water.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, and R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

8. **Assertion (A) :** tert-Butyl bromide undergoes S_N2 reactions faster than methyl bromide. 1
Reason (R) : Bulky groups around the carbon atom hinder the approach of the nucleophile in an S_N2 reaction.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, and R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. Write the IUPAC names of (i) $(CH_3)_2CHCH(Cl)CH_3$ and (ii) $CH_3CH{=}CHC(Br)(CH_3)_2$. 2

10. (a) Why do haloalkanes have higher boiling points than alkanes of comparable molecular mass? Arrange CH_3Cl, CH_3Br and CH_3I in order of increasing boiling point. 2

OR

(b) Why do haloalkanes react with KCN to give alkyl cyanides as the main product, but with AgCN to give isocyanides?

11. Write the equations for the reactions of chloroethane with (i) sodium methoxide and (ii) silver nitrite, and name the organic products. 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. (a) Give three differences between the S_N1 and S_N2 mechanisms of nucleophilic substitution. 3

OR

(b) Give reasons:
(i) Haloalkanes, though polar, are only very slightly soluble in water.
(ii) Chlorobenzene has a smaller dipole moment than cyclohexyl chloride.
(iii) The boiling points of isomeric haloalkanes decrease with branching.

13. Write the equation for each of the following: 3
(i) the preparation of chloroethane from ethanol using thionyl chloride (state why this method is preferred);
(ii) the addition of HBr to propene, in the absence and in the presence of a peroxide;
(iii) the preparation of fluoromethane from bromomethane (Swarts reaction).

14. Chlorobenzene undergoes electrophilic substitution reactions. (i) Write the products of its reaction with Cl_2 in the presence of anhydrous $FeCl_3$, and with CH_3Cl in the presence of anhydrous $AlCl_3$. (ii) Explain why the chlorine atom directs the incoming group to the ortho and para positions, although it deactivates the ring. 3

SECTION D

This section comprises 1 case-based question of 4 marks, with sub-parts of 1, 1 and 2 marks.

15. Alkyl and aryl halides react with magnesium in dry ether to form Grignard reagents, R–MgX, which are among the most useful reagents in organic synthesis. The carbon–magnesium bond is strongly polar, so the alkyl group behaves like a carbanion. Grignard reagents react with any compound that can supply a proton, so even traces of moisture must be kept away.

(I) Write the formula of the Grignard reagent formed from bromoethane. [1]

(II) Write the equation for the reaction of this Grignard reagent with water, and name the organic product. [1]

(III) Starting from 1-bromopropane, show how propane can be obtained through a Grignard reagent. Why must the ether be perfectly dry? [2]

OR

(III) Write the equation for the Wurtz reaction of bromomethane, name the product, and explain why the Wurtz reaction is not a good method for preparing alkanes with an odd number of carbon atoms. [2]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) (i) What is meant by optical activity? Define chirality and enantiomers. 5

(ii) Explain why the S_N1 hydrolysis of an optically active haloalkane gives a racemic mixture, while its S_N2 reaction gives a product of inverted configuration.

(iii) Which of the following is optically active: 2-bromopropane or 2-bromobutane? Give a reason.

OR

(b) (i) State Saytzeff's rule. Name the products of the dehydrohalogenation of 2-bromopentane with alcoholic KOH, saying which is the major product.

(ii) What conditions favour elimination rather than substitution?

(iii) Write the equations for the reactions of bromoethane with aqueous KOH and with alcoholic KOH, and name the organic products.

17. (a) (i) Give three reasons why aryl halides are much less reactive than alkyl halides towards nucleophilic substitution. 5

(ii) Chlorobenzene is converted into phenol only by heating with NaOH at 623 K and 300 atm, but 1-chloro-4-nitrobenzene reacts at 443 K. Explain the effect of the nitro group.

OR

(b) (i) Write one method each for preparing chlorotoluene from toluene and chlorobenzene from benzenediazonium chloride.

(ii) Which of the three dichlorobenzenes has the highest melting point, and why?

(iii) Write the equation for the Fittig reaction of chlorobenzene and name the product.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
(C)	(A)	(D)	(B)	(A)	(C)	(B)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (C). S_N1 goes through a carbocation; the tertiary carbocation is the most stable.

Q2. Answer (A). Finkelstein reaction: NaBr is insoluble in dry acetone and precipitates, driving the exchange forward.

Q3. Answer (D). 1-bromobutane, 2-bromobutane, 1-bromo-2-methylpropane and 2-bromo-2-methylpropane.

Q4. Answer (B). The bond length grows with the size of the halogen atom: C–F < C–Cl < C–Br < C–I.

Q5. Answer (A). Saytzeff (Zaitsev) rule: the more substituted alkene is the major product.

Q6. Answer (C). In an allylic halide the halogen is on an sp^3 carbon next to a C=C double bond. CH_2=CHCl is a vinylic halide and C_6H_5Cl an aryl halide.

Q7. Answer (B). Both are true. The reactivity comes from the weak C–I bond (I^- is the best leaving group), not from the density. Answer B.

Q8. Answer (D). Because of the crowding described in R, the order of S_N2 reactivity is methyl > 1° > 2° > 3°: A is false, R is true. Answer D.

Q9. (2 marks) Answer: 2-chloro-3-methylbutane; 4-bromo-4-methylpent-2-ene.
(i) 2-Chloro-3-methylbutane. [1]
(ii) 4-Bromo-4-methylpent-2-ene. [1]

Q10. (2 marks) Answer: (a) dipole and van der Waals forces; $CH_3Cl < CH_3Br < CH_3I$; (b) ambidentate CN^-.
(a) The polar C–X bond gives dipole-dipole attractions, and the larger, more polarisable halogen atoms give stronger van der Waals forces. [1] $CH_3Cl < CH_3Br < CH_3I$ (larger size and mass give stronger van der Waals forces). [1]
OR (b) The cyanide ion is ambidentate. KCN is ionic, and the nucleophile attacks through carbon (the C–C bond formed is stronger) to give R–CN. [1] AgCN is mainly covalent, so only the nitrogen lone pair is free to attack, giving the isocyanide R–NC. [1]

Q11. (2 marks) Answer: methoxyethane; nitroethane.
(i) $CH_3CH_2Cl + CH_3ONa \rightarrow CH_3CH_2OCH_3 + NaCl$; methoxyethane (an ether). [1]
(ii) $CH_3CH_2Cl + AgNO_2 \rightarrow CH_3CH_2NO_2 + AgCl$; nitroethane. [1]

Q12. (3 marks) Answer: (a) one step/two steps; order 2/1; inversion/racemisation; (b) H-bonds of water; sp^2 carbon and resonance; smaller surface area.

(a) Any three [3]: S_N2 is one step through a single transition state, S_N1 is two steps through a carbocation; S_N2 is second order (rate = k[RX][Nu^-]), S_N1 first order (rate = k[RX]); S_N2 gives inversion of configuration, S_N1 mainly racemisation; S_N2 is favoured by primary halides (CH_3X > 1° > 2° > 3°), S_N1 by tertiary halides (3° > 2° > 1°); S_N1 is favoured by polar protic solvents.

OR (b) (i) To dissolve, the hydrogen bonds between water molecules must be broken, and the weaker attractions between the haloalkane and water release less energy than this. [1]

(ii) In chlorobenzene the carbon bearing Cl is sp^2 (more electronegative), and resonance moves electron density from Cl towards the ring, so the C–Cl bond is less polar. [1]

(iii) Branching makes the molecule more compact (more nearly spherical), which reduces its surface area and so the van der Waals forces. [1]

Q13. (3 marks) Answer: equations; 2-bromopropane and 1-bromopropane.

(i) $CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + SO_2 + HCl$; the other products are gases that escape, leaving fairly pure chloroethane. [1]

(ii) $CH_3CH{=}CH_2 + HBr \rightarrow CH_3CHBrCH_3$ (Markovnikov); with peroxide, $CH_3CH_2CH_2Br$ (anti-Markovnikov). [1]

(iii) $CH_3Br + AgF \rightarrow CH_3F + AgBr$. [1]

Q14. (3 marks) Answer: o- and p-dichlorobenzene; o- and p-chlorotoluene; +R directs, −I deactivates.

(i) 1,2-Dichlorobenzene and 1,4-dichlorobenzene (para major). [½] 2-Chlorotoluene and 4-chlorotoluene (Friedel-Crafts alkylation). [½]

(ii) Resonance (+R) of the chlorine lone pair raises the electron density more at the ortho and para positions, so attack occurs there. [1] The strong −I effect of chlorine withdraws electrons from the whole ring, so the ring reacts more slowly than benzene. [1]

Q15. (4 marks) Answer: (I) CH_3CH_2MgBr; (II) ethane; (III) propane, or ethane by Wurtz.

(I) CH_3CH_2MgBr. [1]

(II) $CH_3CH_2MgBr + H_2O \rightarrow CH_3CH_3 + Mg(OH)Br$; ethane. [1]

(III) $CH_3CH_2CH_2Br + Mg \rightarrow CH_3CH_2CH_2MgBr$ (dry ether), then $CH_3CH_2CH_2MgBr + H_2O \rightarrow CH_3CH_2CH_3 + Mg(OH)Br$. [1] Moisture would destroy the Grignard reagent as soon as it is formed (giving the alkane too early). [1]

OR (III) $2CH_3Br + 2Na \rightarrow CH_3CH_3 + 2NaBr$ (dry ether); ethane. [1] An odd-numbered alkane needs two different halides, which give a mixture of three alkanes (R–R, R′–R′ and R–R′) that is hard to separate. [1]

Q16. (5 marks) Answer: (a) planar carbocation; backside attack; 2-bromobutane; (b) pent-2-ene major; ethanol and ethene.

(a) (i) The ability of a compound to rotate the plane of plane-polarised light. [½] A chiral molecule is not superimposable on its mirror image (e.g. it has a carbon with four different groups). [½] Enantiomers are a pair of such non-superimposable mirror-image molecules. [1]

(ii) S_N1: the carbocation formed is planar, so the nucleophile can attack from either face equally, giving both enantiomers in equal amounts. [1] S_N2: the nucleophile attacks from the side opposite to the leaving group in one step, so the configuration is inverted. [1]

(iii) 2-Bromobutane: C-2 carries four different groups (H, Br, CH_3, C_2H_5); in 2-bromopropane C-2 carries two CH_3 groups. [1]

OR (b) (i) In dehydrohalogenation the preferred alkene is the one with more alkyl groups on the double-bonded carbons (Saytzeff rule). [1] 2-Bromopentane gives pent-2-ene (major) and pent-1-ene (minor). [1]

(ii) Elimination is favoured by a strong, bulky base (alcoholic KOH, alkoxides), higher temperature and tertiary halides; substitution by primary halides and good nucleophiles in water. [1]

(iii) $CH_3CH_2Br + KOH$ (aq) $\rightarrow CH_3CH_2OH + KBr$: substitution, ethanol. [1] $CH_3CH_2Br + KOH$ (alc) $\rightarrow CH_2{=}CH_2 + KBr + H_2O$: elimination, ethene. [1]

Q17. (5 marks) Answer: (a) resonance, sp² carbon, unstable phenyl cation, repulsion; $–NO_2$ withdraws electrons; (b) Sandmeyer; para isomer; biphenyl.

(a) (i) Resonance gives the C–X bond partial double bond character; the carbon is sp² (more s-character, so the bond is shorter and stronger); the phenyl cation is very unstable, so S_N1 is not possible; the electron-rich ring repels the approaching nucleophile. [3]

(ii) The $–NO_2$ group at the ortho or para position withdraws electrons from the ring, making the carbon bearing chlorine more positive, and stabilises the negatively charged intermediate by delocalising the charge onto the nitro group. [2] (A nitro group at the meta position has no such resonance effect.)

OR (b) (i) Toluene + Cl_2 (anhydrous $FeCl_3$, dark) → 2-chlorotoluene + 4-chlorotoluene. [1] Benzenediazonium chloride + Cu_2Cl_2/HCl → chlorobenzene + N_2 (Sandmeyer reaction). [1]

(ii) 1,4-Dichlorobenzene: it is symmetrical and packs better in the crystal lattice. [1]

(iii) $2C_6H_5Cl + 2Na \rightarrow C_6H_5–C_6H_5 + 2NaCl$ (dry ether, Fittig reaction); biphenyl. [2]

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