



IB Chemistry – HL

Topic 10 Questions

1. Which statement about the reactions of halogenoalkanes with aqueous sodium hydroxide is correct?
- A. Primary halogenoalkanes react mainly by an S_N1 mechanism.
 - B. Chloroalkanes react faster than iodoalkanes.
 - C. Tertiary halogenoalkanes react faster than primary halogenoalkanes.
 - D. The rate of an S_N1 reaction depends on the concentration of aqueous sodium hydroxide.
- (Total 1 mark)**
2. Which compound can exist as optical isomers?
- A. H_2NCH_2COOH
 - B. CH_2ClCH_2Cl
 - C. CH_3CHBrI
 - D. $HCOOCH_3$
- (Total 1 mark)**
3. Which compound reacts most rapidly by a S_N1 mechanism?
- A. $(CH_3)_3CCl$
 - B. $CH_3CH_2CH_2CH_2Br$
 - C. $(CH_3)_3CBr$
 - D. $CH_3CH_2CH_2CH_2Cl$
- (Total 1 mark)**
4. Which compound can exist as optical isomers?
- A. $CH_3CHBrCH_3$
 - B. $CH_2ClCH(OH)CH_2Cl$
 - C. $CH_3CHBrCOOH$
 - D. $CH_3CCl_2CH_2OH$
- (Total 1 mark)**



5. Which pair of compounds can be used to prepare $\text{CH}_3\text{COOCH}_3$?

- A. Ethanol and methanoic acid
- B. Methanol and ethanoic acid
- C. Ethanol and ethanoic acid
- D. Methanol and methanoic acid

(Total 1 mark)

6. Which pair of compounds can be used to prepare $\text{CH}_3\text{COOCH}_3$?

- A. Ethanol and methanoic acid
- B. Methanol and ethanoic acid
- C. Ethanol and ethanoic acid
- D. Methanol and methanoic acid

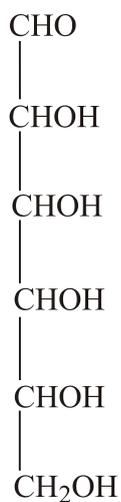
(Total 1 mark)

7. Nylon is a condensation polymer made up of hexanedioic acid and 1,6-diaminohexane. Which type of linkage is present in nylon?

- A. Amide
- B. Ester
- C. Amine
- D. Carboxyl

(Total 1 mark)

8. How many chiral carbon atoms are present in a molecule of glucose?

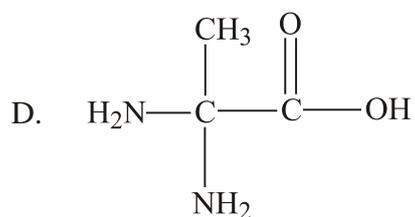
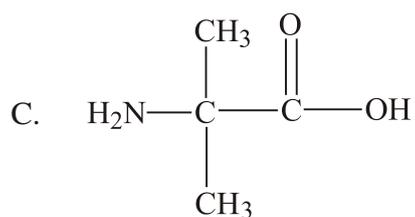
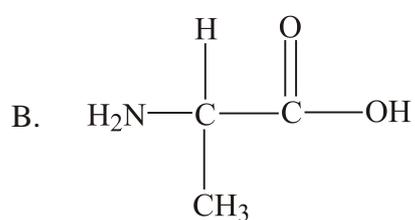
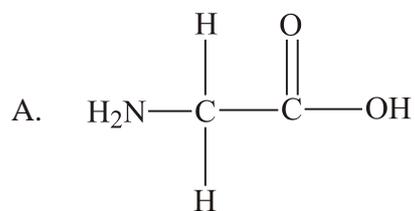


- A. 1
- B. 2
- C. 3
- D. 4



(Total 1 mark)

9. Which amino acid can exist as optical isomers?



(Total 1 mark)

10. What is the product of the following reaction?



- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
- B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

(Total 1 mark)



11. What is the correct IUPAC name for the following compound?



- A. 4-methylbutanenitrile
- B. 4-methylpentanenitrile
- C. 2-methylbutanenitrile
- D. 2-methylpentanenitrile

(Total 1 mark)

12. What is the organic product of the reaction between ethanol and ethanoic acid in the presence of sulfuric acid?

- A. CH_3CHO
- B. $\text{CH}_3\text{COOCH}_3$
- C. $\text{CH}_3\text{CH}_2\text{COOCH}_3$
- D. $\text{CH}_3\text{COOCH}_2\text{CH}_3$

(Total 1 mark)

13. Which compound can exist as optical isomers?

- A. $\text{H}_2\text{NCH}_2\text{COOH}$
- B. H_3CCONH_2
- C. H_3CCHBrI
- D. HCOOCH_3

(Total 1 mark)

14. One of the alcohols containing four carbon atoms exists as optical isomers.

Give the structural formula and name of this alcohol and explain why it exists as optical isomers. Outline how these two isomers could be distinguished.

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(Total 4 marks)

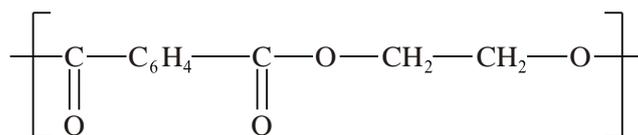
15. Many organic compounds can exist as isomers. Draw and name an isomer of ethanoic acid, CH_3COOH .

(Total 2 marks)

16. Explain why butan-2-ol, $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$, exists as *enantiomers*, and describe how pure samples of the enantiomers can be distinguished experimentally.

(Total 3 marks)

17. Polyesters are formed in a condensation reaction. The structure of the repeat unit of a polyester is



- (i) Draw the structures of the two monomers that react to form this polyester.

(2)

- (ii) Identify the essential feature of the monomers in (i) that enable them to form a condensation polymer.

(1)

(Total 3 marks)

18. (i) State the meaning of the term *isomers*.

(1)

- (ii) Draw the functional group isomers of $\text{C}_3\text{H}_6\text{O}$.

(2)

- (iii) State the meaning of the term *optical isomers*. Draw the alcohol with the molecular formula $\text{C}_4\text{H}_{10}\text{O}$ which exhibits optical isomerism and identify the chiral carbon atom.

(3)

(Total 6 marks)

19. (i) State the meaning of the term *isomers*.

(1)

- (ii) Draw the functional group isomers of $\text{C}_3\text{H}_6\text{O}$.

(2)

- (iii) State the meaning of the term *optical isomers*. Draw the alcohol with the molecular formula $\text{C}_4\text{H}_{10}\text{O}$ which exhibits optical isomerism and identify the chiral carbon atom.

(3)



- (iv) Other than the optical isomers in (iii), draw the other **three** alcohol isomers of molecular formula $C_4H_{10}O$ and identify the isomer that does not undergo oxidation.

(2)

(Total 8 marks)

20. (i) Draw the structural formula of the ester propyl ethanoate.

(1)

- (ii) Deduce the name and draw the structural formula of the alcohol and carboxylic acid that react to form this ester.

Name of alcohol:

Structural formula:

Name of carboxylic acid:

Structural formula:

(4)

(Total 5 marks)

21. The compound, 2-bromobutane, $CH_3CHBrCH_2CH_3$, can react with sodium hydroxide to form compounds **F**, **G** and **H**.

Compound **F**, $C_4H_{10}O$, exists as a pair of optical isomers. Compounds **G** and **H**, C_4H_8 , are



structural isomers, and compound **H** exists as a pair of geometrical isomers.

(i) Draw the structures of the two optical isomers of **F**. (2)

(ii) Outline the use of a polarimeter in distinguishing between the optical isomers. (2)

(iii) Draw diagrams to show the shapes of the two geometrical isomers of **H**. (2)

(iv) Draw the mechanism, using curly arrows to represent the movement of electron pairs, to show the formation of **G**. (3)
(Total 9 marks)

22. A compound, **J**, has the molecular formula $C_2H_4O_2$ and is obtained from a reaction between methanoic acid and methanol. Write an equation for this reaction and state the name of compound **J**. (Total 3 marks)

23. (a) Compounds of formula C_4H_7Cl exhibits both geometrical and optical isomerism.
(i) Explain why C_4H_7Cl shows geometrical isomerism.
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..... (1)

(ii) Draw the *cis* and *trans* isomers of C_4H_7Cl . (2)

(iii) Draw the structural formula of C_4H_7Cl that shows only optical isomerism. Show the chiral carbon atom with “ * ”. (2)

(b) Explain why 1,2-dichlorocyclopropane has *cis* and *trans* isomers. Draw the structural formulas of the two isomers.
.....
..... (3)



(Total 8 marks)

24. (a) There are **geometrical** isomers of the cyclic compound $C_4H_6Cl_2$. Draw the structural formula of two isomers and explain why these two isomers exist.

cis-isomer

trans-isomer

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(3)

- (b) (i) Draw the structural formulas of **two** isomers of but-2-ene-1,4-dioic acid.

(2)

- (ii) State and explain which isomer will have a lower melting point.

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(2)

- (iii) Describe how the two isomers can be distinguished by a chemical test.

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(2)

- (c) Consider the following compounds:
1-chloropentane, 2-chloropentane, 3-chloropentane

- (i) Identify the compound which exhibits optical isomerism and draw the structures of the **two** isomers.

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(3)

- (ii) Describe how these **two** isomers can be distinguished experimentally.

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(1)

(Total 13 marks)



25. Compounds with the molecular formula $C_3H_4Cl_2$ exist as several structural isomers, some of which are cyclic. Some of these structural isomers exist as geometric isomers.

(a) Explain why geometrical isomerism is possible in the non-cyclic isomers.

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(1)

(b) Draw the structure of a non-cyclic structural isomer that does not exist as geometric isomers, and explain why geometrical isomerism is not possible in this compound.

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(2)

(c) 1,3-Dichloropropene exists as geometric isomers. Draw and label the structures of its cis and trans isomers.

(2)

(d) Draw structures to show the two geometric isomers of 1,2-dichlorocyclopropane.

(2)

(Total 7 marks)

26. This question is about structural isomers and stereoisomers with the molecular formula $C_4H_6Cl_2$.

(a) The compound 1,3-dichlorobut-1-ene can be used to illustrate two types of stereoisomerism. For each type of stereoisomerism, draw two structures to show the relationship between the two.

two geometrical isomers

two optical isomers

(4)

(b) Explain the term *racemic mixture*.

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(1)

(c) Outline how the two optical isomers of 1,3-dichlorobut-1-ene can be distinguished from each other and from a racemic mixture.

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(3)

- (d) 1,3-dichlorocyclobutane exists as geometrical isomers. Draw the 3-dimensional structures of these isomers.

(2)

(Total 10 marks)

27. The molecular formula, $C_3H_4Cl_2$ represents several isomeric compounds. Some isomers are cyclic and some are unsaturated.

- (a) Draw the structures of two cyclic compounds that are structural isomers and state the names of both isomers.

(2)

- (b) Two of the non-cyclic compounds have geometrical isomers. Draw the structures of these compounds and their geometrical isomers.

(2)

(Total 4 marks)