

Naming organic compounds and their isomers

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Worksheet

Name: _____ Date: _____ Class: _____

These 20 problems build your skill in IUPAC naming, drawing and counting isomers, assigning E and Z, and finding chiral centres. They mix recall, naming, calculation and explanation tasks. They suit A Level, IB Chemistry, CBSE Class 11-12 and WAEC or NECO senior students. Write condensed or skeletal formulae clearly.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB S3.2

Problem 1 Alkane names and formulae (easy)

1. Name the straight-chain alkanes with 1 to 6 carbon atoms.
2. State the general formula of the alkanes.
3. Write the molecular formula of heptane.

Problem 2 Name the straight chains (easy)

Name each compound.

1. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
2. $\text{CH}_3\text{CH}_2\text{CHO}$
3. $\text{CH}_3\text{COCH}_2\text{CH}_3$
4. $\text{CH}_3\text{CH}_2\text{COOH}$

Problem 3 Condensed formulae (easy)

1. Write the condensed formula of 2-methylbutane.
2. Write the condensed formula of 2,2-dimethylpropane.
3. State the molecular formula of both.

Problem 4 Identify functional groups (easy)

Name the functional groups in: $\text{CH}_2=\text{CHCH}_2\text{OH}$, $\text{CH}_3\text{COOCH}_3$, $\text{CH}_3\text{CH}_2\text{NH}_2$ and $\text{CH}_3\text{CH}_2\text{Cl}$.

Problem 5 Which type of isomerism (easy)

State the type of structural isomerism in each pair.

1. butan-1-ol and butan-2-ol
2. butane and 2-methylpropane
3. propanal and propanone

4. ethanol and methoxymethane

Problem 6 Branched names (medium)

Name each compound.

1. $(\text{CH}_3)_3\text{CCH}_2\text{CH}_3$
2. $\text{CH}_3\text{CHClCH}_2\text{CH}_3$
3. $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
4. $\text{CH}_3\text{CH}_2\text{CHBrCH}_2\text{CH}_3$

Problem 7 Isomers of $\text{C}_4\text{H}_9\text{Br}$ (medium)

Aarav in Pune draws the isomers of $\text{C}_4\text{H}_9\text{Br}$.

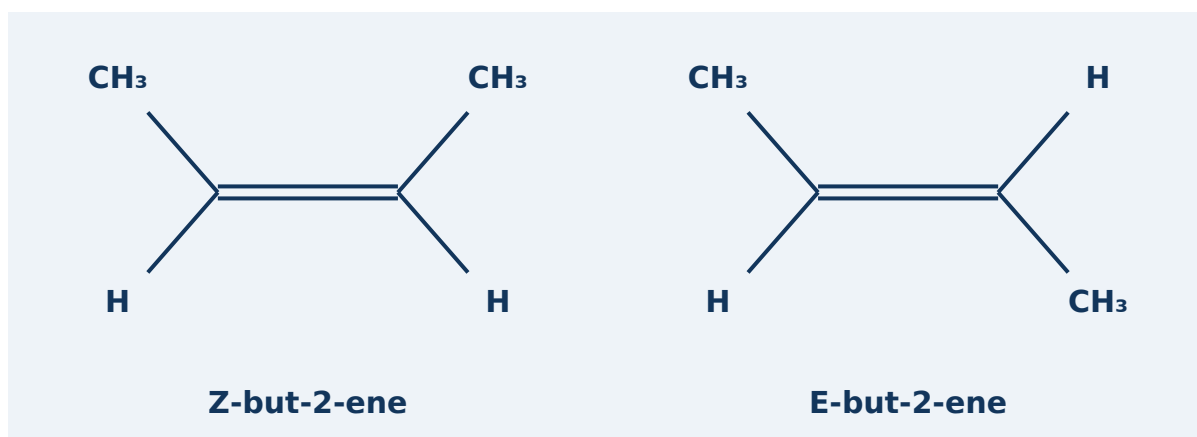
1. Name all four structural isomers.
2. Classify each as primary, secondary or tertiary.

Problem 8 Boiling points of C_5H_{12} isomers (medium)

The boiling points are pentane 36°C , 2-methylbutane 28°C and 2,2-dimethylpropane 10°C .

1. Calculate the difference between the highest and lowest.
2. Explain the trend in terms of branching and London forces.

Problem 9 E and Z but-2-ene (medium)



Two forms of but-2-ene.

The figure shows two forms of but-2-ene.

1. Label each as E or Z.
2. Explain why but-1-ene has no E/Z isomers.
3. Explain why rotation about $\text{C}=\text{C}$ is restricted.

Problem 10 Chiral or not (medium)

Decide which of these are chiral and mark the chiral centre: butan-1-ol, pentan-3-ol, 3-methylhexane, 1-chlorobutane, 2-bromopentane, 2-chloropropane.

Problem 11 Combustion analysis (medium)

A hydrocarbon (0.2200 g) burns to give 0.6600 g of CO₂ and 0.3600 g of H₂O (A_r: C 12.0, H 1.0, O 16.0).

1. Calculate $n(\text{C})$ and $n(\text{H})$.
2. Find the empirical formula.
3. State the number of structural isomers if $M_r = 44$.

Problem 12 Enantiomeric excess (medium)

A pure enantiomer rotates plane-polarised light by $+20.0^\circ$. A mixture of both enantiomers rotates it by $+5.0^\circ$.

1. Calculate the enantiomeric excess.
2. Calculate the percentage of each enantiomer.

Problem 13 Formula from percentages (medium)

Compound X has 54.5 % C, 9.1 % H and 36.4 % O by mass and $M_r = 88$.

1. Find the empirical formula.
2. Find the molecular formula.
3. Name any two isomers of X with a carboxylic acid or ester group.

Problem 14 Alkenes and alkynes (medium)

Name each compound.

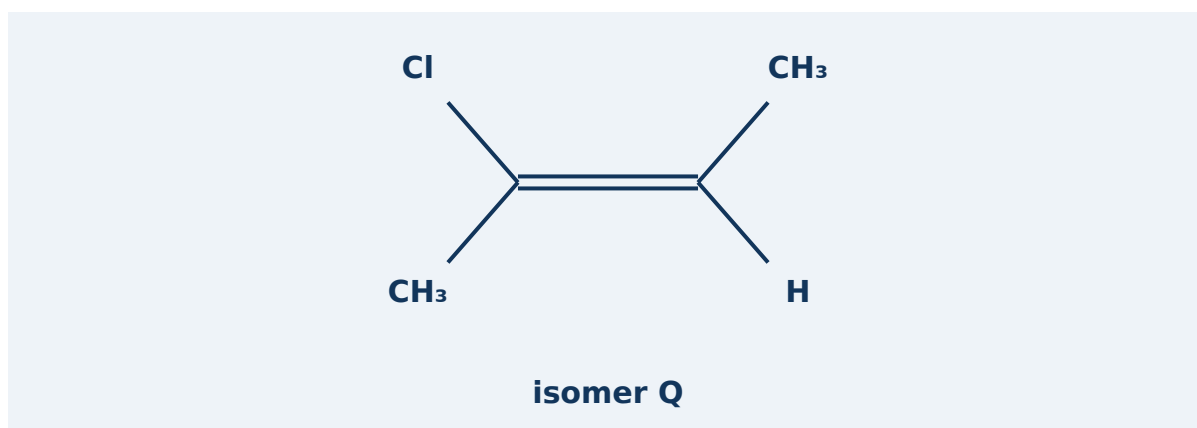
1. $\text{CH}_3\text{C}\equiv\text{CCH}_3$
2. $\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$
3. $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$
4. $\text{HC}\equiv\text{CCH}_2\text{CH}_3$

Problem 15 Spot the errors (medium)

Emma in Leeds wrote three statements. Identify and correct each error.

1. $\text{CH}_3\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}_2\text{CH}_3$ is 2-ethylbutane.
2. $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ is butan-3-ol.
3. In a Z isomer the higher-priority groups are on opposite sides.

Problem 16 Assign E or Z (hard)

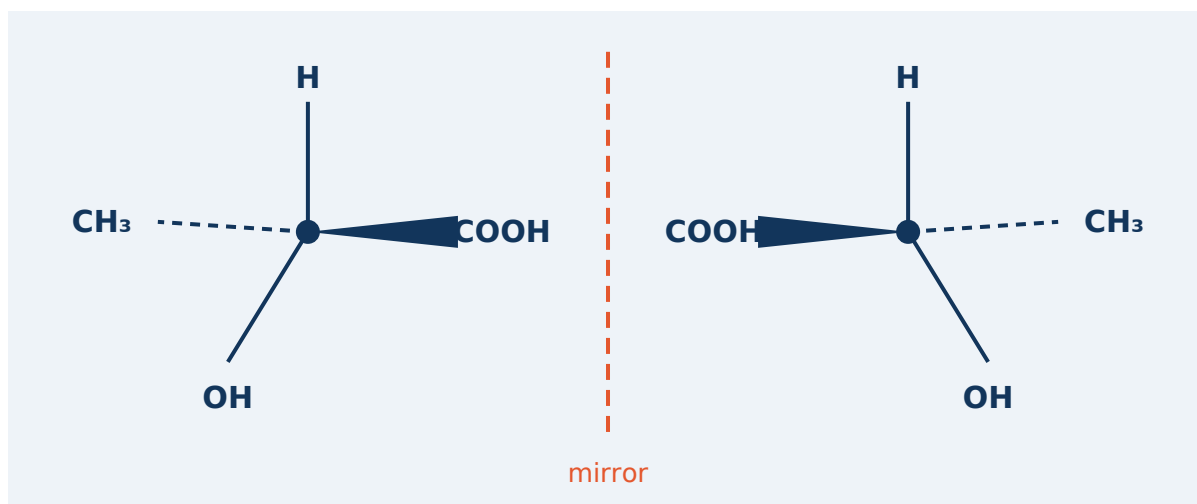


An isomer of 2-chlorobut-2-ene, labelled Q.

Isomer Q is drawn in the figure (2-chlorobut-2-ene).

1. Rank the groups on the left carbon and on the right carbon.
2. Decide whether Q is E or Z.
3. Draw (describe) the other isomer.

Problem 17 Lactic acid (hard)



Two enantiomers of lactic acid.

Lactic acid is 2-hydroxypropanoic acid, $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$.

1. Identify the chiral carbon and the four groups.
2. State two properties that are identical in the two enantiomers and one that differs.
3. Explain why a lab synthesis normally gives a racemic mixture.

Problem 18 Isomers of C_4H_8 (hard)

Diego in Texas investigates C_4H_8 .

1. Name three alkene isomers and one cycloalkane isomer.
2. State which alkene isomer shows E/Z isomerism.
3. Count the total number of stereo- and structural isomers, including cycloalkanes.

Problem 19 Isomers of $C_3H_6O_2$ (hard)

Mei in Singapore has a liquid of formula $C_3H_6O_2$ that effervesces with sodium carbonate.

1. Name the compound.
2. Name two isomers that do not effervesce, with the type of isomerism.
3. Explain a test to distinguish the acid from an ester.

Problem 20 Name complex structures (hard)

Name or draw.

1. $HOCH_2CH(CH_3)CH_2CHClCH_3$
2. $(CH_3)_2C=CHCH_2CH_3$
3. $CH_3CH(CH_3)CH_2COOH$
4. Write the condensed formula of 2,3-dichloro-3-methylpentane.
5. Calculate the maximum number of stereoisomers of 2,3-dibromopentane.