

## I am able to:

- 1 Explain what is meant by the term *homologous series*.
- 2 State the general formulae for the alkanes, alkenes and alkynes *homologous series*.
- 3 Sketch a graph of boiling point against number of carbons for the straight-chain alkane homologous series and explain the trend that is exhibited.
- 4 Draw full structural formulae, condensed structural formulae, skeletal formulae and state the names for the straight chain alkanes up to C<sub>6</sub>.
- 5 Work out the molecular formula and empirical formulae of
  - the alkane with 12 carbon atoms
  - the alkene with 10 carbon atoms
- 6 Explain what is meant by the term functional *group*.
- 7 Explain what you understand by *structural isomers*.
- 8 Draw structural formulae, skeletal formulae and state the names of all the compounds with the molecular formula C<sub>6</sub>H<sub>14</sub>.
- 9 Draw full structural formulae, condensed structural formulae, skeletal formulae and state the names of all alkenes with the molecular formula C<sub>5</sub>H<sub>10</sub>.
- 10 State the general formula of each of the following:

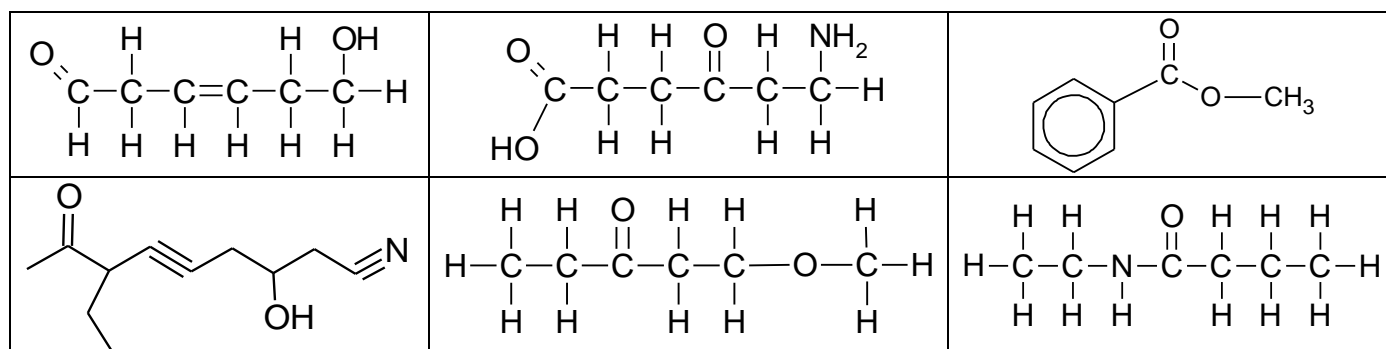
alkanes	alkenes	alkynes	alcohols
ketones	aldehydes	carboxylic acids	

- 11 Give one example (structural formula) of a molecule in each of the classes of compounds and state the name of the functional group present in each

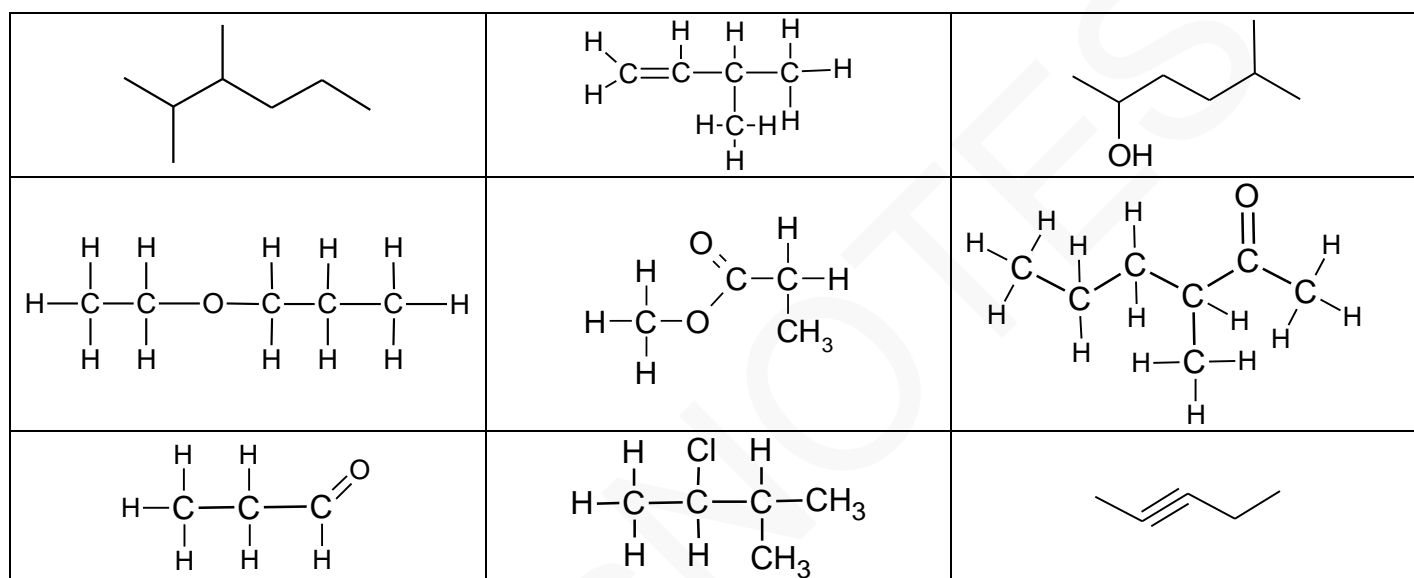
alkane	alkene	alkyne	halogenoalkane	alcohol
ether	aldehyde	ketone	ester	carboxylic acid
amine	amide	nitrile	arene	

# HL Organic Chemistry 2

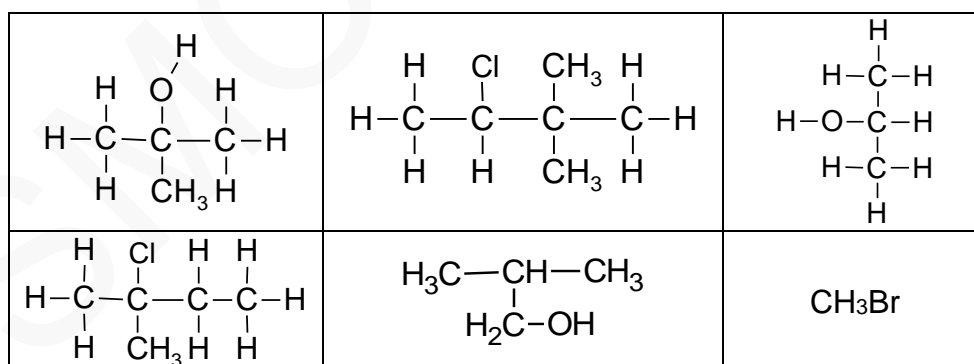
- 12 Write the molecular formula and identify the functional groups present in each of the following:



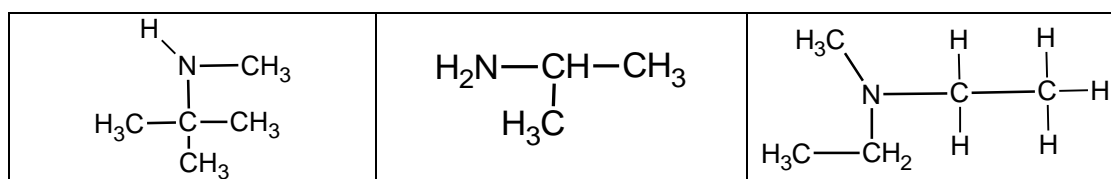
- 13 Name each of the following compounds



- 14 Identify which of the molecules in 13 are saturated and which are unsaturated.
- 15 Classify each of the following as a primary, secondary or tertiary halogenoalkane/alcohol:



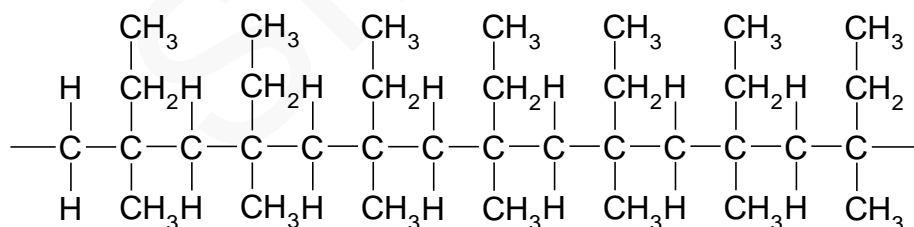
- 16 Classify each of the following amines as primary secondary or tertiary



- 17 Describe the structure of benzene
- 18 Explain
- two pieces of physical evidence for the structure of benzene
  - two pieces of chemical evidence for the structure of benzene

## HL Organic Chemistry 3

- 19 Explain why alkanes are unreactive.
- 20 Write balanced equations for the complete combustion of propane and butane.
- 21 Write a balanced equation for the incomplete combustion of propane producing CO
- 22 Write a balanced equation for the incomplete combustion of propane producing soot (C)
- 23 Write an equation for the reaction of methane with chlorine and state the conditions required for the reaction to occur.
- 24 Write an equation for the reaction of ethane with bromine
- 25 Write the mechanism for the reaction between methane and chlorine
- 26 Explain what is meant by *chain reaction*, *homolytic fission* and *free radical*
- 27 State the name of the two organic products of monochlorination of propane
- 28 Draw the full structural formulae for but-1-ene and but-2-ene
- 29 Write an equation, using full structural formulae, for the reaction of but-2-ene with hydrogen
- 30 Write an equation, using condensed structural formulae, for the reaction of but-2-ene with bromine
- 31 Write an equation using full structural formulae for the reaction of but-2-ene with hydrogen chloride
- 32 Write an equation for the reaction of ethene with water under appropriate conditions
- 33 Explain how alkanes may be distinguished from alkenes in the laboratory.
- 34 Explain the terms *saturated* and *unsaturated*.
- 35 Write an equation using structural formula to show the formation of a polymer from
- ethene
  - propene
- 36 What type of polymerisation reaction is involved in 35
- 37 Draw the repeating unit and monomer for the polymer shown



- 38 Write an equation for the complete combustion of ethanol
- 39 Draw full structural formulae and name all the isomers of C<sub>4</sub>H<sub>10</sub>O that are alcohols
- 40 Classify each of the alcohols in 39 as primary, secondary or tertiary
- 41 For the oxidation of alcohols, state the
- names and formulae of 2 different oxidising agents that can be used
  - the required conditions
  - the colour changes observed

## HL Organic Chemistry 4

- 42 Draw the structural formulae and name the products of complete and partial oxidation (if any) of the alcohols in 39.
- 43 Write balanced equations for the complete and partial oxidation of ethanol using [O] to represent the oxidising agent.
- 44 Write balanced redox equations for the partial and complete oxidation of ethanol using each of the oxidising agents named in 41.
- 45 Explain how the conditions for oxidation of a primary alcohol can be varied to allow for a better yield of the aldehyde or the carboxylic acid.
- 46 Write an equation for the reaction of ethanol with ethanoic acid and state the essential conditions for the reaction
- 47 Draw the structural formula of and name the ester formed when propanoic acid reacts with methanol
- 48 State the name of the type of reaction occurring in 46 and 47.
- 49 Write an equation for the reaction of 1-bromopropane with aqueous sodium hydroxide
- 50 State the name of the type of reaction occurring in 49
- 51 Explain why halogenoalkanes are more reactive than alkanes.
- 52 Explain what a *nucleophile* is.
- 53 State what type of reactions benzene undergoes.
- 54 Draw the structural formulae and name all the isomers of C<sub>4</sub>H<sub>9</sub>Cl
- 55 State whether each of the halogenoalkanes in 54 is primary, secondary or tertiary.
- 56 Explain whether each of the halogenoalkanes in 54 will react with aqueous sodium hydroxide via an S<sub>N</sub>1 or S<sub>N</sub>2 mechanism
- 57 Explain what is meant by S<sub>N</sub>1 and S<sub>N</sub>2 reactions
- 58 Draw out S<sub>N</sub>1 and S<sub>N</sub>2 mechanisms for suitable halogenoalkanes reacting with aqueous sodium hydroxide
- 59 Explain what is meant by the term *heterolytic fission* and explain how it is different to *homolytic fission*.
- 60 State and explain why the rate of S<sub>N</sub>2 reactions depends on whether the halogenoalkane is primary, secondary or tertiary
- 61 State and explain why the rate of S<sub>N</sub>1 reactions depends on whether the halogenoalkane is primary, secondary or tertiary
- 62 Match the rate equation with the type of reaction mechanism:  
Rate = k[halogenoalkane][hydroxide ion]      Rate = k[halogenoalkane]
- 63 One enantiomer of an optically active halogenoalkane reacts with aqueous sodium hydroxide and a racemic mixture is formed. Explain what type of mechanism occurred.

64 Classify each of the following solvents as *non-polar*, *aprotic polar* or *protic polar*

$(\text{CH}_3)_2\text{SO}$	$\text{NH}_3$	$(\text{CH}_3)_2\text{CO}$	$\text{H}_2\text{O}$
$\text{CCl}_4$	$\text{C}_6\text{H}_{14}$	$\text{CH}_3\text{OH}$	$\text{CH}_3\text{CN}$

65 State whether each of the solvents in 64 would favour  $\text{S}_{\text{N}}1$  or  $\text{S}_{\text{N}}2$  reactions

66 Explain, using one example of each *type* of solvent, your answer to question 65

67 State whether 1-chlorobutane or 2-chloro-2-methylpropane reacts faster with aqueous sodium hydroxide

68 Explain whether 1-chlorobutane or 1-iodobutane will react more quickly with aqueous sodium hydroxide

69 Explain whether water or the hydroxide ion will react more rapidly with 1-bromobutane

70 Explain what is meant by the term *electrophile*.

71 Explain whether an electrophile is a Lewis acid or Lewis base

72 State the name of the type of reaction mechanism that occurs when ethene reacts with hydrogen halides or halogens

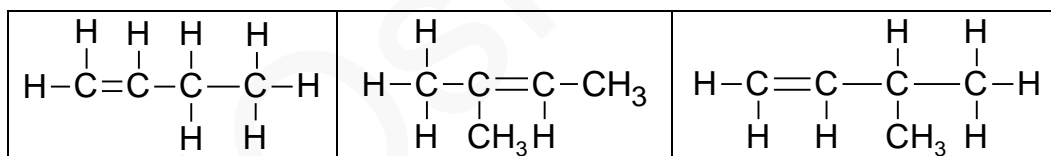
73 Draw out the mechanism for the reaction of ethene with hydrogen chloride

74 Draw out the mechanism for the reaction of ethene with bromine

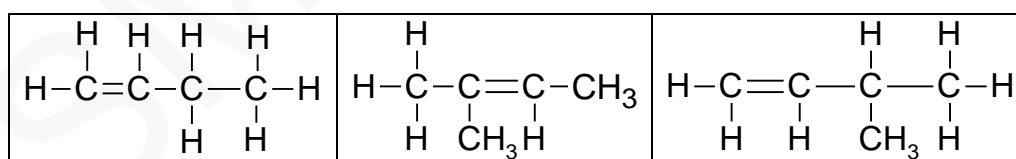
75 Draw structural formula of the major product when propene reacts with hydrogen bromide

76 Explain the formation of a major product when propene reacts with hydrogen bromide

77 Predict the major product when each of the following alkenes reacts with hydrogen bromide



78 Predict the major product when each of the following alkenes reacts with iodine monochloride (ICl)



79 Explain the bonding in benzene and state what the C-C bond order is.

80 For the nitration of benzene:

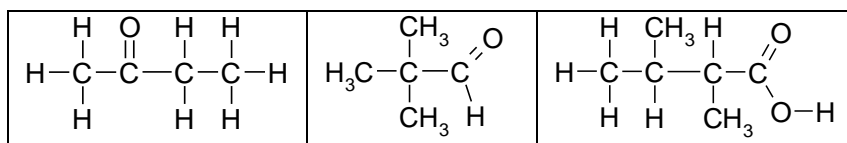
- state the reagents and conditions
- write a chemical equation for the reaction
- draw the mechanism for the reaction

81 State the *type* of mechanism that benzene undergoes

82 State the reagents and conditions for

- reduction of a carboxylic acid
- reduction of an aldehyde or ketone

83 Give the structural formulae of the products formed when each of the following is reduced using the reagents and conditions in 82.



84 Write a balanced equation showing structures, reagents and conditions for the conversion of nitrobenzene to phenylamine.

85 Explain what is meant by the *retro-synthetic* approach

86 Give a reaction scheme showing structures, reagents and conditions for making propanoic acid from a suitable alkane.

87 Give a reaction scheme showing structures, reagents and conditions for making butanone from an alkene.

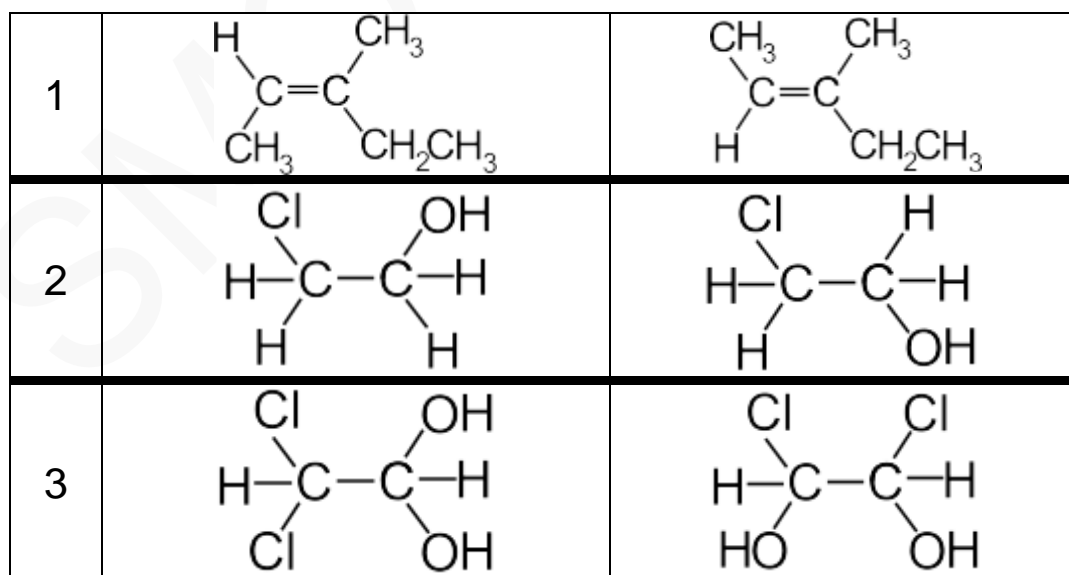
88 Give a reaction scheme showing condensed structural formulae, balanced equations and conditions for making methyl ethanoate from suitable hydrocarbons.

89 Give a reaction scheme showing structures, reagents and conditions for making phenylamine from benzene

90 Explain what is meant by the term *stereoisomerism*

91 Explain the difference between conformational and configurational stereoisomers

92 Explain whether each of the following pairs represent configurational or conformational stereoisomers or structural isomers



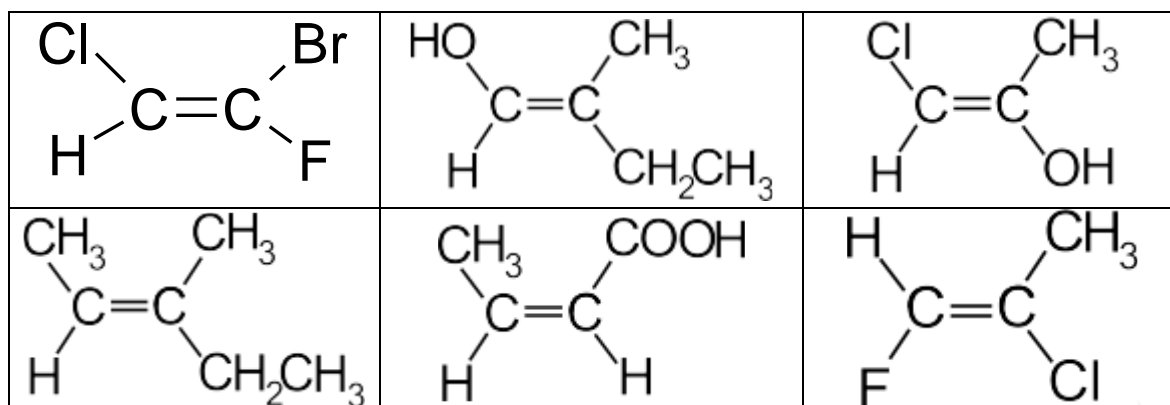
93 Explain what is meant by *cis-trans isomerism*.

94 Explain how *cis-trans isomerism* arises in alkenes.

95 Explain which of the following will exhibit *cis-trans* isomerism

but-2-ene    but-1-ene    3-methylpent-2-ene

- 96 Draw the structures of the *cis-trans* isomers of 1,2-dichlorocyclobutane and explain why they exist
- 97 Classify each of the following as *E* or *Z*



- 98 Explain what is meant by *optical isomerism*.
- 99 Draw clear 3-D diagrams showing the optical isomers of butan-2-ol
- 100 Explain which of the following will exhibit optical isomerism  
 1-bromobutane    2-bromobutane     $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{COOH}$
- 101 Explain what is meant by the terms *enantiomer* and *chiral centre*
- 102 Explain what is meant by plane-polarised light.
- 103 State how the two enantiomers of butan-2-ol interact with plane-polarised light
- 104 Explain how a polarimeter may be used to distinguish between optical isomers
- 105 Explain what a *racemic mixture* is
- 106 Describe the similarities and differences in the physical and chemical properties of enantiomers.
- 107 Explain whether *cis-* or *trans-*1,2-dichlorocyclopropane exhibits optical isomerism
- 108 Explain what *diastereomers* are
- 109 State whether each of the following pairs are enantiomers, diastereomers or identical

