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(a) Homologous series

(i) Systematic carbon chemistry

77 A homologous series is a family of compounds with the same general formula and similar chemical properties.

Patterns are often seen in the physical properties of the members of a homologous series.
78 The subsequent members of a homologous series show a general increase in their melting and boiling points. This pattern is attributed to increasing strength of the intermolecular forces as the molecular size increases. The type of intermolecular force does not need to be identified.

79 Hydrocarbons are compounds containing only hydrogen and carbon atoms.

Compounds containing only single carbon–carbon bonds are described as saturated.
80 Compounds containing at least one carbon–carbon double bond are described as unsaturated.

81 It is possible to distinguish an unsaturated compound from a saturated compound using bromine solution. Unsaturated compounds decolourise bromine solution quickly.

82 The structure of any molecule can be drawn as a full or a shortened structural formula.

83 Isomers:

- are compounds with the same molecular formula but different structural formulae
- may belong to different homologous series
- usually have different physical properties

84 Given a structural formula for a compound, an isomer can be drawn.

85 Isomers can be drawn for a given molecular formula.

(ii) Alkanes

86 Alkanes:

- are a homologous series of saturated hydrocarbons
- are commonly used as fuels
- are insoluble in water
- can be represented by the general formula C_nH_{2n+2}

a) b)

87 Straight-chain and branched alkanes can be systematically named from structural formulae containing no more than 8 carbons in the longest chain.

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88 Molecular formulae can be written and structural formulae can be drawn, from the systematic names of straight-chain and branched alkanes, containing no more than 8 carbons in the longest chain. a) b)

(iii) Cycloalkanes

89 Cycloalkanes:

- are a homologous series of saturated, cyclic hydrocarbons
- are used as fuels and solvents
- are insoluble in water
- can be represented by the general formula C_nH_{2n}

90 Cycloalkanes (C_3–C_8) can be systematically named from structural formulae. Branched cycloalkanes are not required.

91 Molecular formulae can be written and structural formulae can be drawn from the systematic names of un-branched cycloalkanes.

(iv) Alkenes

92 Alkenes:

- are a homologous series of unsaturated hydrocarbons
- are used to make polymers and alcohols
- are insoluble in water
- contain the C=C double bond functional group
- can be represented by the general formula C_nH_{2n}

a) b)

93 Straight-chain and branched alkenes can be systematically named indicating the position of the double bond, from structural formulae containing no more than 8 carbon atoms in the longest chain.

94 Molecular formulae can be written and structural formulae can be drawn, from the systematic names of straight-chain and branched alkenes, containing no more than 8 carbons in the longest chain. a) b)

95 Chemical equations can be written for the addition reactions of alkenes, using molecular or structural formulae.

96 Alkenes undergo addition reactions:

a) - with hydrogen forming alkanes, known as hydrogenation
b) - with halogens forming dihaloalkanes
c) - with water forming alcohols, known as hydration

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(b) Everyday consumer products

(i) Alcohols

97 Alcohols are used as fuels as they are highly flammable and burn with very clean flames. Alcohols are often used as solvents.

98 Methanol, ethanol and propanol are miscible with water, thereafter the solubility decreases as size increases.

99 As alcohols increase in size their melting and boiling points increase due to the increasing strength of the intermolecular forces. The type of intermolecular force does not need to be identified.

100 An alcohol is a molecule containing a hydroxyl functional group, –OH group.

101 Saturated, straight-chain alcohols can be represented by the general formula $C_nH_{2n+1}OH$.

102 Straight-chain alcohols can be systematically named indicating the position of the hydroxyl group from structural formulae containing no more than 8 carbon atoms.

103 Molecular formulae can be written and structural formulae can be drawn, from the systematic names of straight-chain alcohols, containing no more than 8 carbons.

(ii) Carboxylic acids

104 Carboxylic acids are used in the preparation of preservatives, soaps and medicines. Vinegar is a solution of ethanoic acid, with molecular formula CH_3COOH. Vinegar is used in household cleaning products as it is a non-toxic acid so can be used safely in household situations.

105 Methanoic, ethanoic, propanoic and butanoic acid are miscible in water, thereafter the solubility decreases as size increases.

106 As carboxylic acids increase in size their melting and boiling points increase due to the increasing strength of the intermolecular forces. The type of intermolecular force does not need to be identified.

107 Carboxylic acids can be identified by the carboxyl functional group, –COOH.

108 Saturated, straight-chain carboxylic acids can be represented by the general formula $C_nH_{2n+1}COOH$.

109 Straight-chain carboxylic acids can be systematically named from structural formulae containing no more than 8 carbons.

110 Molecular formulae can be written and structural formulae drawn, from the systematic names of straight-chain carboxylic acids, containing no more than 8 carbons.

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Solutions of carboxylic acids have a pH less than 7 and like other acids, can react with metals, metal oxides, hydroxides and carbonates forming salts. Salts formed from straight-chain carboxylic acids containing no more than 8 carbons, can be named.
(c) Energy from fuels
A reaction or process that releases heat energy is described as exothermic. A reaction or process that takes in heat energy is described as endothermic.
In combustion, a substance reacts with oxygen releasing energy.
Hydrocarbons and alcohols burn in a plentiful supply of oxygen to produce carbon dioxide and water. Equations can be written for the complete combustion of hydrocarbons and alcohols.
Fuels burn releasing different quantities of energy.
The quantity of heat energy released can be determined experimentally and calculated using, $E_h = cm\Delta T$.
The quantities E_h, c, m or ΔT can be calculated, in the correct units, given relevant data. Calculations can involve heating substances other than water. It is not necessary to calculate the enthalpy per mole of substance burned.