UNIT 3 SUMMARY

MAKE A SUMMARY

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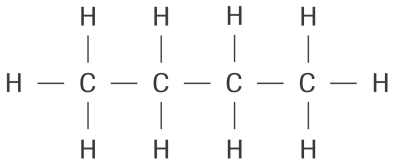
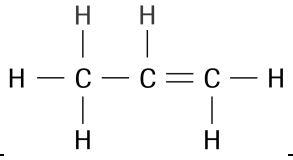
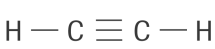
(a)
Front:

Family name and general formula	Examples		
	IUPAC name	**Common name**	**Structural formula**
Alkanes C_nH_{n+2}	butane	lighter fluid	
Alkenes C_nH_n	propene	propylene	
Alkynes C_nH_{n-2}	ethyne	acetylene	

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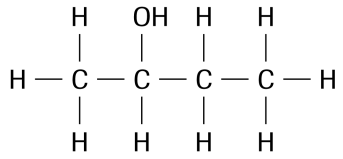
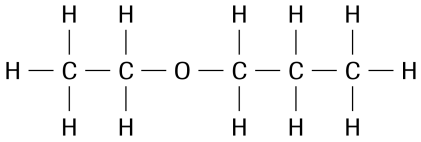
Family	Characteristic properties	Characteristic functional groups	Intermolecular forces
Alkanes	smaller molecules are gases at room temperature, larger molecules tend to be liquids or soft solids; soluble in nonpolar solvents; generally unreactive	no functional groups; all C–C bonds are saturated	van der Waals forces
Alkenes	smaller molecules are gases at room temperature, larger molecules tend to be liquids or soft solids; soluble in nonpolar solvents; undergo addition reactions	C=C	van der Waals forces
Alkynes	smaller molecules are gases at room temperature, larger molecules tend to be liquids or soft solids; soluble in nonpolar solvents; undergo addition reactions	C≡C	van der Waals forces

Front:

Family name and general formula	Examples		
	IUPAC name	Common name	Structural formula
Alcohols R–OH	2-butanol	none	
Ethers R–O–R′	ethoxypropane	none	

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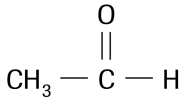
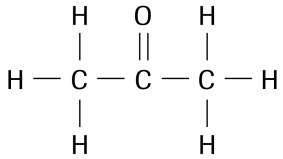
Family	Characteristic properties	Characteristic functional groups	Intermolecular forces
Alcohols	soluble in water and some nonpolar solvents; react with carboxylic acids to form esters	hydroxyl group	hydrogen bonds
Ethers	soluble in nonpolar solvents	oxygen atom bonded to two alkyl groups	van der Waals forces

Front:

Family name and general formula	Examples		
	IUPAC name	Common name	Structural formula
Aldehydes R–CHO	ethanal	acetaldehyde	
Ketones R–C(O)–R′	propanone	acetone	

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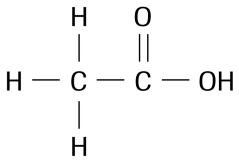
Family	Characteristic properties	Characteristic functional groups	Intermolecular forces
Aldehydes	boiling points intermediate between hydrocarbons and alcohols of similar size; soluble in polar and nonpolar solvents	carbonyl group at end of carbon chain	van der Waals forces; no hydrogen bonding but highly polar carbonyl group produces strong intermolecular forces
Ketones	boiling points intermediate between hydrocarbons and alcohols of similar size; soluble in polar and nonpolar solvents	carbonyl group in interior of carbon chain	van der Waals forces; no hydrogen bonding but highly polar carbonyl group produces strong intermolecular forces

Front:

Family name and general formula	Examples		
	IUPAC name	Common name	Structural formula
Carboxylic acids R–COOH	ethanoic acid	acetic acid (vinegar)	

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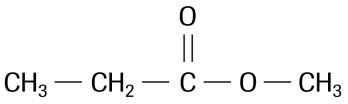
Family	Characteristic properties	Characteristic functional groups	Intermolecular forces
Carboxylic acids	soluble in water, turn litmus pink, react with alcohols to form esters	carboxyl group –COOH	hydrogen bonds, van der Waals forces

Front:

Family name and general formula	Examples		
	IUPAC name	Common name	Structural formula
Esters RCOOR′	methyl propanoate	(none)	

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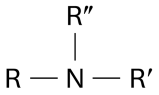
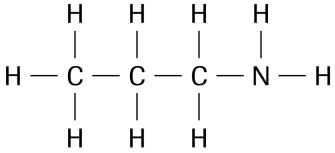
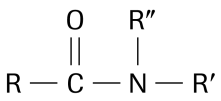
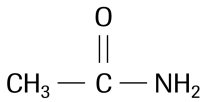
Family	Characteristic properties	Characteristic functional groups	Intermolecular forces
Esters	less soluble in water than their parent acids; lower melting and boiling points than parent acids; not acidic; often have distinctive odours, e.g., fruity, peppermint	R–COO–R′	van der Waals forces

Front:

Family name and general formula	Examples		
	IUPAC name	Common name	Structural formula
Amines 	1-aminopropane	(none)	
Amides 	ethanamide	(none)	

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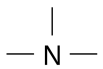
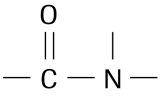
Family	Characteristic properties	Characteristic functional groups	Intermolecular forces
Amines	often have unpleasant odours; react with carboxylic acids to form amides; have higher boiling points and melting points than similar-sized hydrocarbons, lower boiling points and melting points than similar-sized alcohols; smaller amines are readily soluble in water		hydrogen bonds due to any –NH groups; van der Waals forces due to polar C–N bonds
Amides	generally insoluble in water		hydrogen bonds due to any –NH groups

UNIT 3 PERFORMANCE TASK: MAKING SOAP

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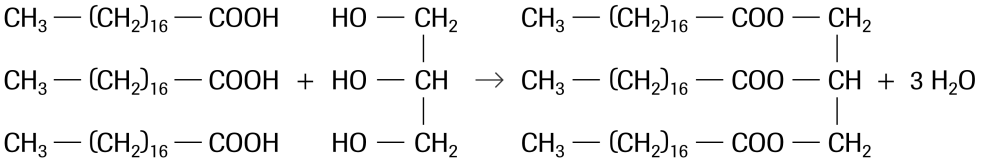
Analysis

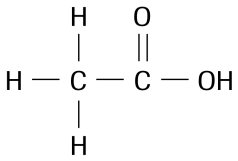
(a) The functional groups of glycerol are all hydroxyl groups, –OH. Glycerol is therefore an alcohol. It forms hydrogen bonds in addition to van der Waals forces.

(b) The functional group of stearic acid is the carboxyl group, –COOH, made up of a carbonyl group and a hydroxyl group. Stearic acid is a carboxylic acid. It forms hydrogen bonds in addition to van der Waals forces due to the polar carbonyl groups. Stearic acid has low solubility in water because its long hydrocarbon chain "nullifies" the polarity of the carboxyl group, rendering it a more nonpolar molecule that has low solubility in a polar solvent.

(c) Water is formed. Therefore, this reaction is a condensation reaction.



(d)



ethanoic acid (acetic acid)

$CH_3COOH_{(aq)} + NaOH_{(aq)} \rightarrow CH_3COONa_{(aq)} + H_2O_{(l)}$

Evaluation

(e) [Sample answer] The soap did not harden; it remained greasy. We perhaps need to use more $NaOH_{(aq)}$. The soap did not lather very well. It is possible that using distilled water in the procedure would solve this problem.

Synthesis

(f) We would predict that glycerol has a higher boiling point than 1-propanol because glycerol has three hydroxyl groups and 1-propanol has one. Glycerol would therefore form more hydrogen bonds than would 1-propanol, and thus more energy is required to separate the glycerol molecules to form a gaseous state.

(g) Glycerol is probably soluble in polar solvents because of the polar hydroxyl groups. It may be slightly soluble in nonpolar solvents because of the three-carbon backbone.

(h) Carbon dioxide and water would form as a result of the combustion of glycerol: