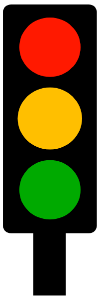
JABchem

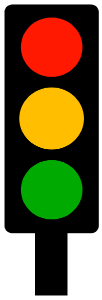
Name: ………………………………………………………………………………	
Class: ………………	Teacher: ………………………………

Self-Evaluation

Higher Chemistry



Unit 2



Nature's Chemistry

Section	Title	Completed
2.1	Systematic Carbon Chemistry	
2.2	Alcohols	✓
2.3	Carboxylic Acids	✓
2.4	Esters, Fats & Oils	✓
2.5	Soaps, Detergents & Emulsions	✓
2.6	Proteins	✓
2.7	Oxidation of Food	✓
2.8	Fragrances	✓
2.9	Skin Care	✓

Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.1 Systematic Carbon Chemistry	Page	Traffic Light: Red	Amber	Green

46 Compounds containing only single carbon-carbon between carbons are described as saturated.

- Alkanes and cycloalkanes are homologous series of saturated hydrocarbons

☹ 😐 ☺

47 Compounds containing at least one carbon-carbon double bond are described as unsaturated.

- alkenes and alkynes (with C≡C triple bonds) are homologous series of unsaturated hydrocarbons
- compounds containing C=C double bonds take part in addition reaction where two molecules combine to make one molecule.

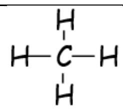
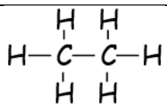
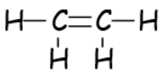
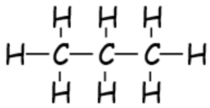
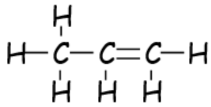
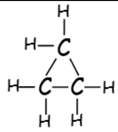
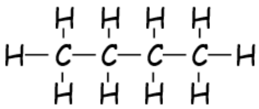
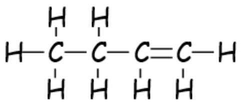
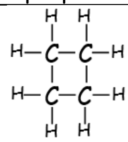
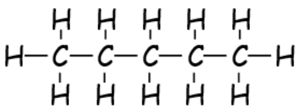
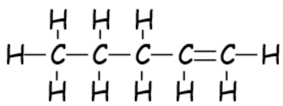
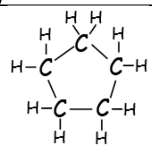
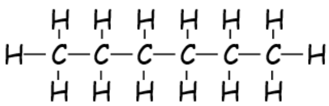
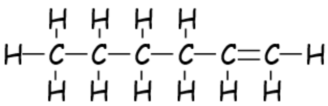
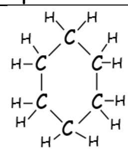
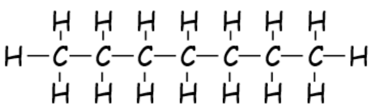
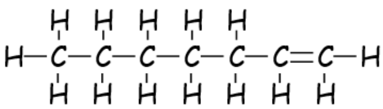
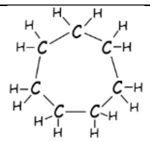
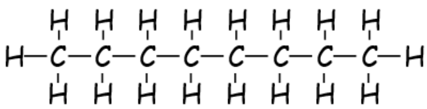
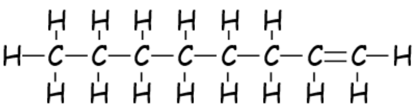
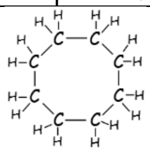
☹ 😐 ☺

48 Bromine solution is used to distinguish saturated compounds from unsaturated compounds

- Saturated compounds do not decolourise bromine solution
- Unsaturated compounds decolourise bromine solution quickly.

☹ 😐 ☺

49 The structure of any substance can be drawn as a full or shortened formulae:

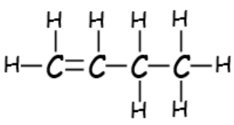
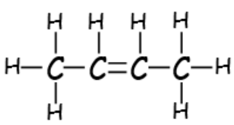
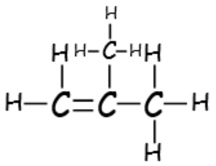
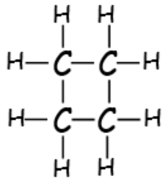
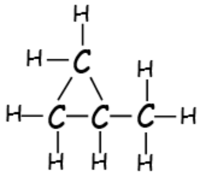
Alkane	Alkene	Cycloalkane
 Methane CH_4	-	-
 Ethane CH_3CH_3	 Ethene CH_2CH_2	-
 Propane $CH_3CH_2CH_3$	 Propene CH_3CHCH_2	 Cyclopropane C_3H_6
 Butane $CH_3CH_2CH_2CH_3$	 But-1-ene $CH_3CH_2CHCH_2$	 Cyclobutane C_4H_8
 Pentane $CH_3CH_2CH_2CH_2CH_3$	 Pent-1-ene $CH_3CH_2CH_2CHCH_2$	 Cyclopentane C_5H_{10}
 Hexane $CH_3CH_2CH_2CH_2CH_2CH_3$	 Hex-1-ene $CH_3CH_2CH_2CH_2CHCH_2$	 Cyclohexane C_6H_{12}
 Heptane $CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	 Hept-1-ene $CH_3CH_2CH_2CH_2CH_2CHCH_2$	 Cycloheptane C_7H_{14}
 Octane $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	 Oct-1-ene $CH_3CH_2CH_2CH_2CH_2CH_2CHCH_2$	 Cyclooctane C_8H_{16}

☹ 😐 ☺

50
51

Isomers can be drawn given the name, molecular formula or structural formula of a substance.

- isomers are compounds with same molecular formula but different structural formulae
- isomers may be in different homologous series and have different physical properties

C_4H_8	C_4H_8	C_4H_8	C_4H_8	C_4H_8
				
but-1-ene	but-2-ene	2-methylpropene	cyclobutane	methylcyclopropane

☹ 😐 ☺

52
53

The physical properties of compounds can be predicted by considering:

Presence of -OH or -NH Bonds

-OH bonds and -NH bonds would give rise to hydrogen bonding between molecules.

Solubility	Boiling Point	Volatility
Hydrogen bonding would increase solubility	Hydrogen Bonding increases boiling point	Hydrogen bonding decreases volatility as molecules closer together

Spatial Arrangement of Polar Covalent Bonds

Polar covalent bonds in the correct arrangement gives rise to permanent dipole-permanent dipole attractions.

Solubility	Boiling Point	Volatility
Polar molecules more likely to me soluble in polar solvents	PD-PD attractions bring molecules closer together and raises b.pt.	Closer together molecules are less volatile and less likely to turn into a gas

Molecular Size of Molecules

The bigger the molecule, the greater the number of electrons. This increases London dispersion forces between molecules.

Solubility	Boiling Point	Volatility
Solubility often decreases as molecules get bigger	Bigger molecules have stronger LDF raising the boiling point	Bigger molecules are closer together and decreases volatility

Polarities of Solute and Solvent

Polar covalent and ionic substances tend to be soluble in polar solvents. Non-polar compounds tend to dissolve in non-polar solvents.

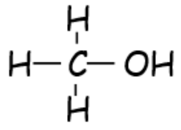
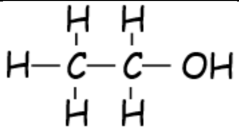
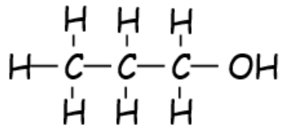
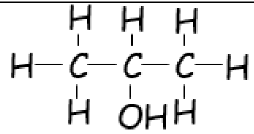
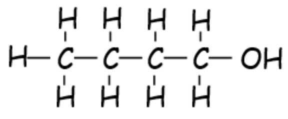
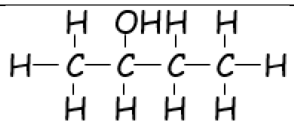
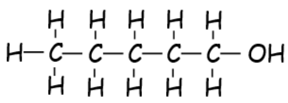
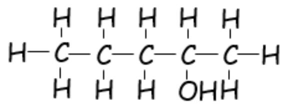
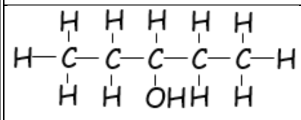
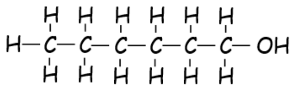
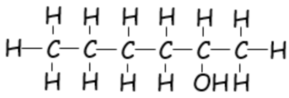
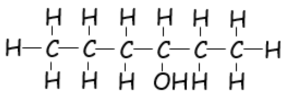
Solubility	Boiling Point	Volatility
If substance has polar groups, it is more likely to be soluble in water	No effect on boiling point	No effect on volatility

☹ 😐 ☺

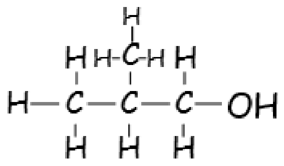
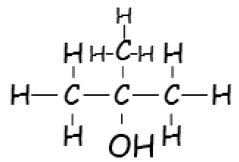
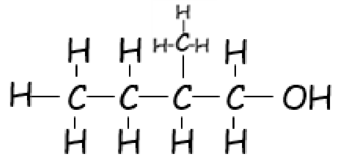
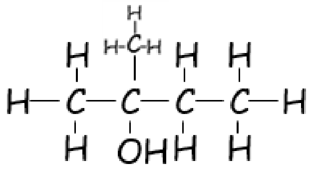
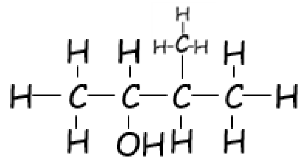
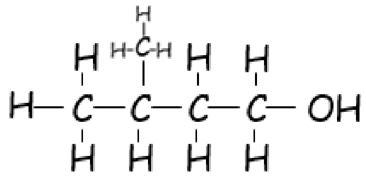
Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.2 Alcohols	Page	Traffic Light: Red	Amber	Green

54 An alcohol is a molecule containing the hydroxyl -OH functional group — OH

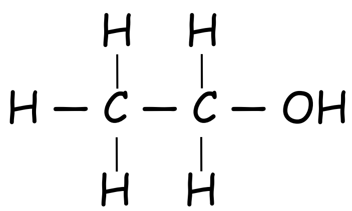
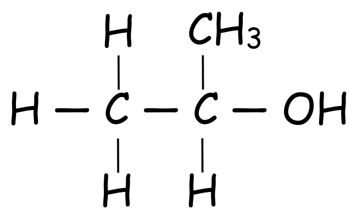
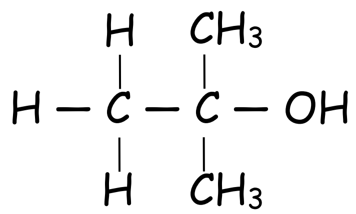
55a 56a Straight-chain alcohols can be drawn and named:

 methanol	 ethanol	 propan-1-ol	 propan-2-ol
 butan-1-ol	 butan-2-ol	 pentan-1-ol	 pentan-2-ol
 pentan-3-ol	 hexan-1-ol	 hexan-2-ol	 hexan-3-ol

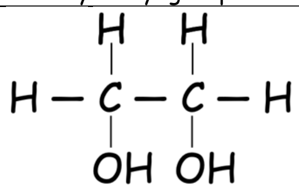
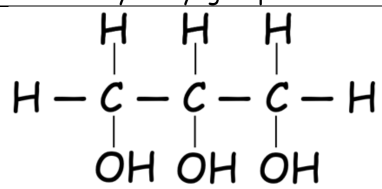
55b 56b Branched-chain alcohols can be drawn and named:

 2-methylpropan-1-ol	 2-methylpropan-2-ol	 2-methylbutan-1-ol
 2-methylbutan-2-ol	 3-methylbutan-2-ol	 3-methylbutan-1-ol

57 (52) Alcohols can be classified as primary, secondary or tertiary:

Primary Alcohols	Secondary Alcohols	Tertiary Alcohols
1 carbon directly attached to the carbon with the -OH bond	2 carbons directly attached to the carbon with the -OH bond	3 carbons directly attached to the carbon with the -OH bond
		

58

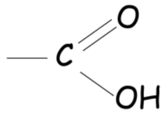
Alcohols with 2 hydroxyl groups are called diols	Alcohols with 3 hydroxyl groups are called triols
 ethane-1,2-diol	 propane-1,2,3-triol (glycerol)

59 Hydroxyl groups make alcohol molecules polar and gives rise to hydrogen bonding. Hydrogen bonding in alcohols can explain the physical properties of alcohols

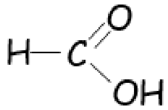
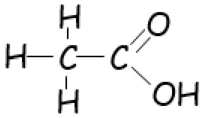
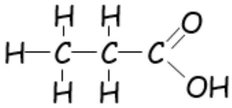
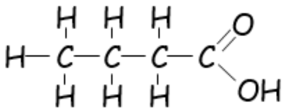
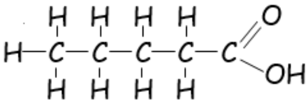
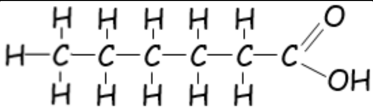
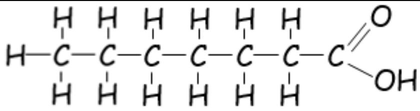
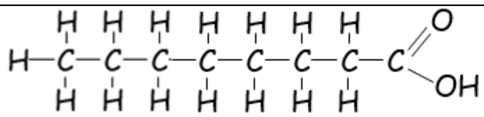
- Raised melting and boiling points due to hydrogen bonding bringing molecules closer together
- Higher viscosity (thickness) of alcohols as hydrogen bonding brings molecules closer together
- Alcohols are polar molecules due to hydrogen bonding so alcohols are soluble/miscible in water

Higher Chemistry Self-Evaluation
Unit 2.3 Carboxylic Acids

Page | Traffic Light: Red | Amber | Green

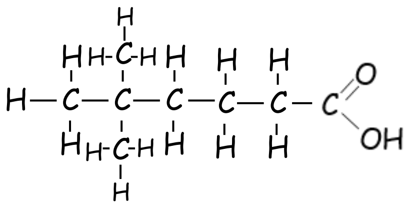
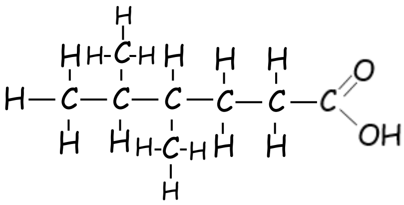
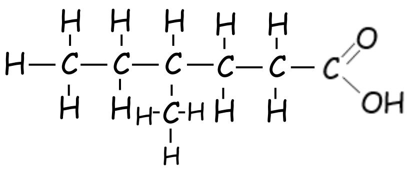
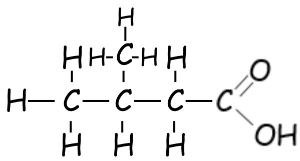
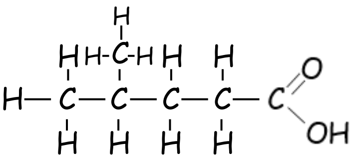
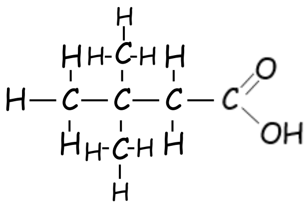
60 A carboxylic acid is a molecule containing the carboxyl functional group  ☹ 😐 ☺

61a 62a Straight-chain carboxylic acids can be drawn and named:

 methanoic acid $HCOOH$	 ethanoic acid CH_3COOH	 propanoic acid C_2H_5COOH	 butanoic acid C_3H_7COOH
 pentanoic acid C_4H_9COOH		 hexanoic acid $C_5H_{11}COOH$	
 heptanoic acid $C_6H_{13}COOH$		 octanoic acid C_7H_{15} $COOH$	

☹ 😐 ☺

61b 62b Branched-chain carboxylic acids can be drawn and named:

 5,5-dimethylhexanoic acid	 4,5-dimethylhexanoic acid
 4-methylhexanoic acid	 3-methylbutanoic acid
 4-methylpentanoic acid	 3,3-dimethylbutanoic acid

☹ 😐 ☺

63 Carboxylic acids react with bases:

metal oxide	+	carboxylic acid	→	salt	+	water
metal hydroxide	+	carboxylic acid	→	salt	+	water
metal carbonate	+	carboxylic acid	→	salt	+	water + carbon dioxide

☹ 😐 ☺

64 The naming of salts follows the following rules:

- first name of the salt comes from the first name of the base
- second name of the salt comes from the acid used

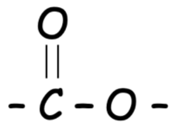
sodium oxide	+	methanoic acid	→	sodium methanoate	+ water
potassium hydroxide	+	ethanoic acid	→	potassium ethanoate	+ water
calcium carbonate	+	propanoic acid	→	calcium propanoate	+ water + carbon dioxide

☹ 😐 ☺

Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.4 Esters, Fats & Oils	Page	Traffic Light		
			Red	Amber	Green

65 (84)

An ester can be identified from the ester link found in esters



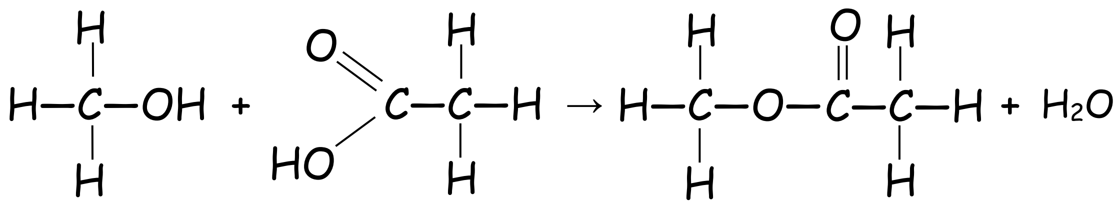
☹ 😐 ☺

---

66 67 (85) (86)

An ester is named as shown below:

ALCOHOL + CARBOXYLIC ACID → ESTER + WATER



methanol + ethanoic acid → methyl ethanoate + water

CH_3OH + CH_3COOH → CH_3OCOCH_3 + H_2O

☹ 😐 ☺

---

68 (93)

Esters have a characteristic sweet/fruity smell and are particularly useful compounds used in:

Flavourings	Esters are responsible for the smell and flavour of many fruits and flowers. They are used as artificial flavourings.
Fragrances	They are used in perfumes as fragrance which includes apple, bananas, etc
Non-polar industrial solvents	Ethyl ethanoate can be used to extract caffeine from coffee and tea. Esters are used as solvents for dyes, drugs, antibiotics, glues, inks paints and varnishes.

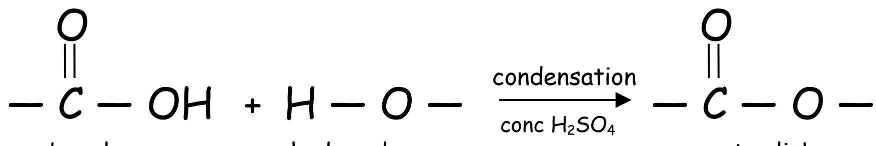
☹ 😐 ☺

---

69 70 71 (88) (89)

Esters are formed by the condensation reaction between an alcohol and a carboxylic acid.

- Esters are formed by a condensation reaction. Condensation reactions are where two molecules join together with the removal of a small molecule (usually water).
- water is removed as the ester link is formed between the carboxyl (-COOH) group found in carboxylic acids and the hydroxyl group (-OH) found in alcohols



☹ 😐 ☺

---

72 73

Esters can undergo hydrolysis to form an alcohol and a carboxylic acid

- an alkali (e.g. sodium hydroxide solution) is a catalyst for this reaction
- a water molecule is added across the break point during the hydrolysis of an ester into a carboxylic acid and an alcohol

☹ 😐 ☺

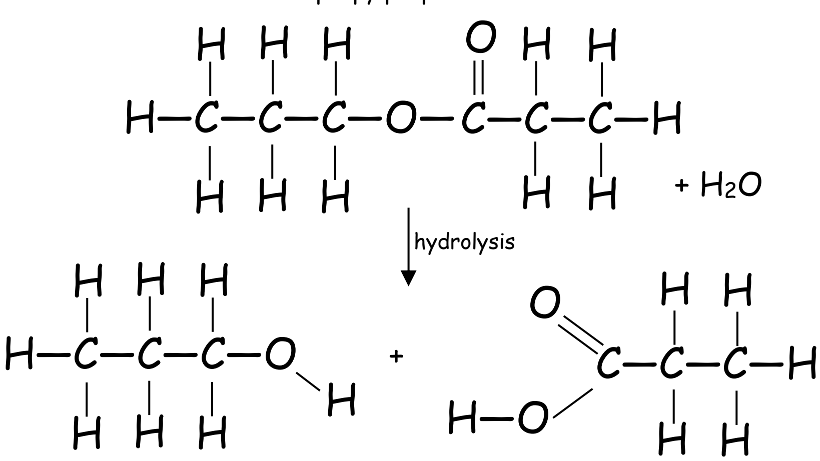
---

74 75 (87) (90)

The products of the breakdown of an ester are shown below:

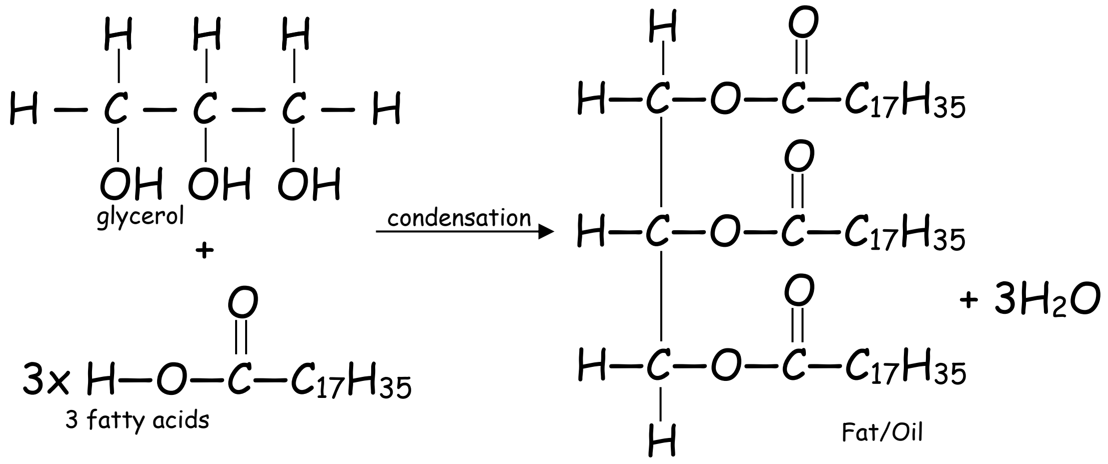
- the parent carboxylic acid and the parent alcohol are obtained by hydrolysis of the ester
- hydrolysis splits a molecule into smaller molecules with water added at the break

propylpropanoate



propan-1-ol propanoic acid

☹ 😐 ☺

76
(117)
(120)
	Edible fats and edible oils are esters formed from the condensation reaction between carboxylic acids and glycerol (propane-1,2,3-triol)
	• carboxylic acids are also known as fatty acids, usually with 16 or 18 carbons
	• each of the fatty acids in an edible fat/oil need not have the same formula
	    o fatty acids chains can be saturated with no C=C double bonds (general formula $-C_nH_{2n+1}$)
	    o fatty acids chains can be unsaturated with one or more C=C double bonds
	
			☹	😐	☺

77 **78** (112) (113)	Edible oils have a lower melting point than edible fats. The lower melting points of oils compared to those of fats is related to the higher unsaturation of oil molecules (i.e. more C=C bonds in oils than fats) • double bonds in fatty acid chains prevent oil molecules from packing closely together • greater number of C=C double present, the weaker the van der Waals forces of attraction between the molecules lowering the melting point • The greater the degree of unsaturation the lower the melting point		☹	😐	☺
79 **80**	Unsaturated compounds decolourise bromine solution quickly. • bromine molecules add across the C=C double bonds by an addition reaction • the greater the number of C=C double bonds in a substance the more bromine solution that will be decolourised.		☹	😐	☺
81 (111) (115)	Fats and oils are an essential part of a healthy diet • supplies the body with a source of energy and is a more concentrated source of energy than carbohydrates • essential for the transport and storage of fat-soluble vitamins in body		☹	😐	☺

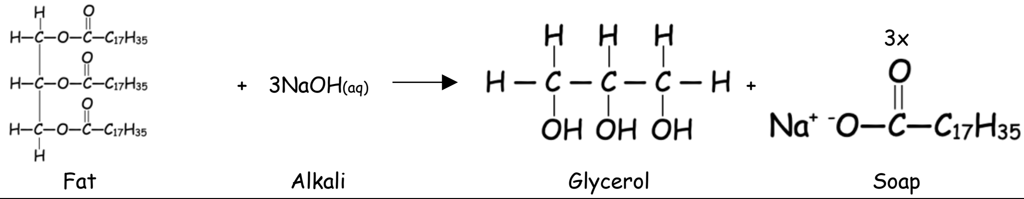
Dalziel High School

Higher Chemistry Self-Evaluation
Unit 2e Soaps, Detergents & Emulsions

		Page	Traffic Light: Red	Amber	Green

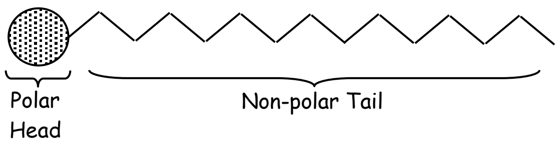
82 Soaps are produced by the alkaline hydrolysis of edible fats and edible oils.

- Hydrolysis produces 3 fatty acid molecules and one glycerol molecule
- Fatty Acids produced are neutralised by alkali forming water-soluble ionic salts called soaps.



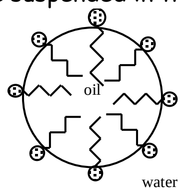
83 Soaps are used to remove non-polar substances such as oil and grease. Oils and grease do not mix with water.

A soap molecule has the structure:



- hydrophobic non-polar hydrocarbon tail (e.g. $-C_{17}H_{35}$)
- tail is readily soluble in non-polar compounds (hydrophobic)
- hydrophilic ionic head ($-COO^-$) is water soluble
- hydrophilic head will not enter hydrophobic oil droplet

Oil droplets are suspended in the water by soap:



- hydrophobic tails dissolve in the droplets of oil/grease
- negatively-charged polar head is hydrophilic so head faces out into surrounding water
- agitation causes ball-like structures to form
- non-polar substance such as oil/grease are held inside the ball and suspended in the water
- repulsion prevents the oil droplets re-joining and helps disperse the oil.

☹ ☺ ☺

84 85 Hard water is the term used to describe water containing high levels of dissolved metal ions.

- when soap is used in hard water, an insoluble precipitate forms which is known as scum
- soapless detergents do not form scum with hard water
  - soapless detergents also remove oil/grease by the same mechanism shown above
  - soapless detergents also have non-polar hydrophobic tails and ionic hydrophilic heads

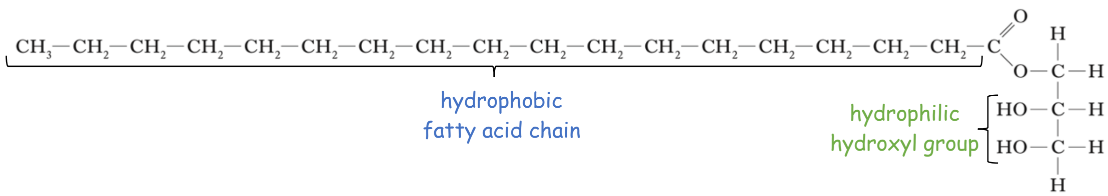
86 87 An emulsifier is used to prevent non-polar liquids and polar liquids from separating into two layers

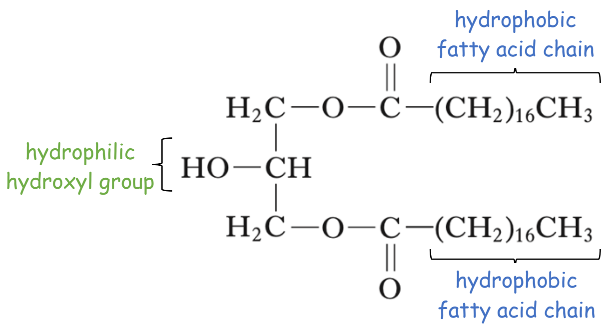
- an emulsion is a mixture of two or more immiscible liquids which contains small droplets of one liquid dispersed in another liquid

☹ ☺ ☺

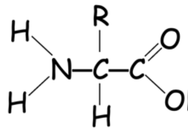
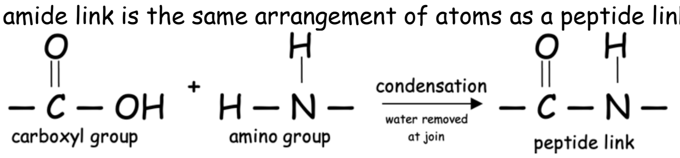
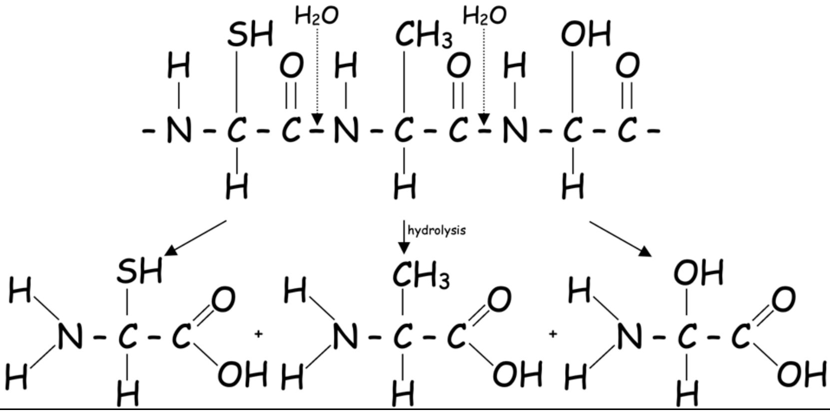
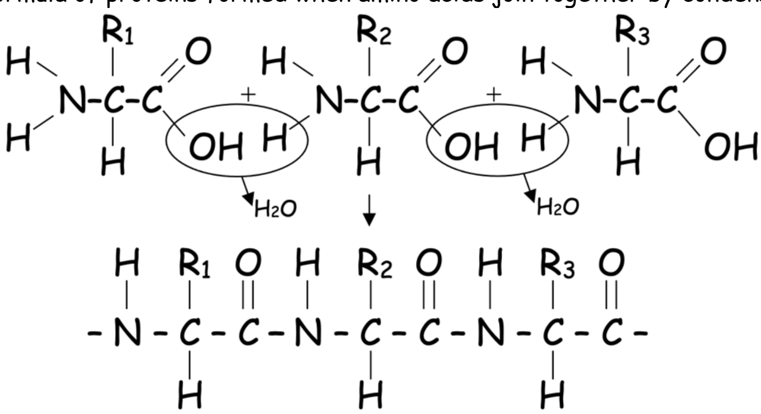
88 Emulsifiers for use in food can be made by reacting edible oils with glycerol.

- molecules formed in this reaction have one or two fatty acids linked to each glycerol backbone
- hydroxyl -OH group(s) in the emulsifier formed are hydrophilic while the fatty acid(s) attached from glycerol backbone are hydrophobic.
- Hydrophobic fatty acid chains dissolve in oil while the hydrophilic hydroxyl -OH groups dissolve in water.
- Together a stable emulsion is formed.





☹ ☺ ☺

	Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.6 Proteins	Page	Traffic Light Red	 Amber	 Green
89		Proteins are the major structural materials found in animal tissues. • proteins are also involved in the maintenance and regulation of life processes • enzymes are proteins which act as biological catalysts		☹	😐	☺
90		Amino acids are small molecules which are the building blocks which join together to form proteins. Amino acids contain the following: • a carboxyl group (-COOH) • an amino group ($-NH_2$)  		☹	😐	☺
91 **92** (97) (98)		Proteins are made from many amino acids joining together by a condensation reaction. • amino group of one amino acid and the carboxyl group of another amino acid join together • elimination of water molecule as they join together • the peptide link is formed by the condensation reaction of an amine group with a carboxyl group between 2 different amino acids ○ the amide link is the same arrangement of atoms as a peptide link found in proteins.  		☹	😐	☺
93 **94**		Proteins needed in the body are formed by linking together differing sequences of amino acids. • certain amino acids required for protein synthesis are called essential amino acids as our bodies cannot make them and must be eaten in our diet.		☹	😐	☺
95 **96** (101) (102)		During digestion, enzyme catalysed hydrolysis of proteins amino acids  		☹	😐	☺
97 (95) (96) (99)		The structural formula of proteins formed when amino acids join together by condensation reaction:  		☹	😐	☺

98		Within proteins, long-chain protein molecules form spirals, sheets and other complex shapes.
		• chains are held in these forms by intermolecular bonding between the side chains of the constituent amino acids.
		• When these proteins are heated, the intermolecular bonds are broken which allows the proteins to change shape
		  ○ different types of intermolecular bonds, including hydrogen bonds, are broken and the shape of the protein structure is irreversibly changed
		  ○ When the protein changes shape it **denatures** and can cause proteins in food to change texture as they are cooked.
				☹	😐	☺

Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.7 Oxidation of Food	Page	Traffic Light: Red	Amber	Green

99 (57) (58)

When applied to carbon compounds:
- oxidation results in an increase in the oxygen to hydrogen ratio
- reduction results in a decrease in the oxygen to hydrogen ratio

100 102 106a (54) (55)

Products of the oxidation of alcohols is dependent on the type of alcohol being oxidised:

PRIMARY ALCOHOL → oxidation ❶ → ALDEHYDE → oxidation ❸ → CARBOXYLIC ACID

SECONDARY ALCOHOL → oxidation ❷ → KETONE → ✖ no oxidation

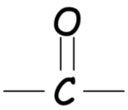
TERTIARY ALCOHOL → ✖ no oxidation

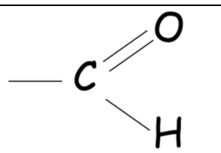
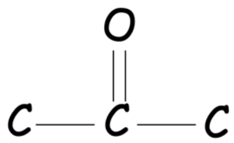
101 106b (53) (56)

Oxidation is carried out by oxidising agents:

hot copper (II) oxide	acidified dichromate solution	Benedict's/Fehling's solution	Tollen's Reagent
black → brown	orange → green	blue → brick red	colourless → silver mirror
$Cu^{2+} + 2e^- \rightarrow Cu$	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	$Cu^{2+} + e^- \rightarrow Cu^+$	$Ag^+ + e^- \rightarrow Ag$
oxidation types: ❶❷❸	oxidation types: ❶❷❸	oxidation type: ❸	oxidation type: ❸

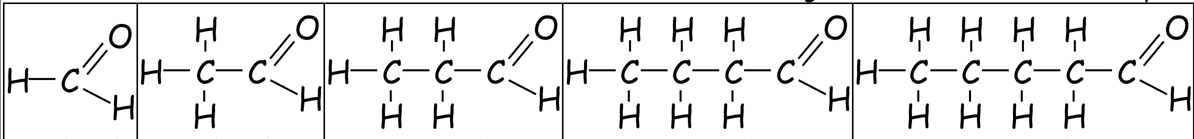
103 (40)

Aldehyde and ketone molecules contain the carbonyl functional group 

Type of Carbonyl Compound	Aldehyde	Ketone
Name ending	-al	-one
Structure Of Functional Group		

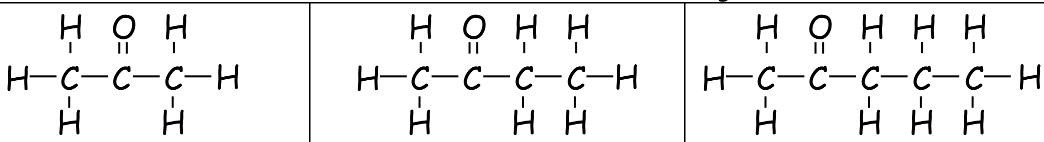
104 105 (44) (46) (47)

Names, structural formulae and molecular formulae can be used for straight and branched-chains aldehydes



methanal	ethanal	propanal	butanal	pentanal

Names, structural formulae and molecular formulae can be used for straight and branched-chain ketones:



propanone	butanone	pentan-2-one

107

Many flavour and aroma molecules are aldehyde
- in whisky, oxygen diffuses into the cask and forms aldehydes contributing to the flavour in whisky

108

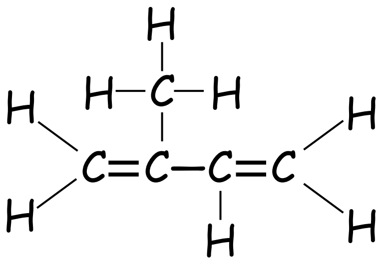
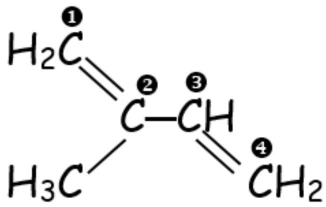
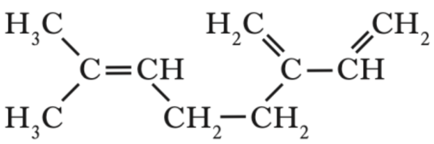
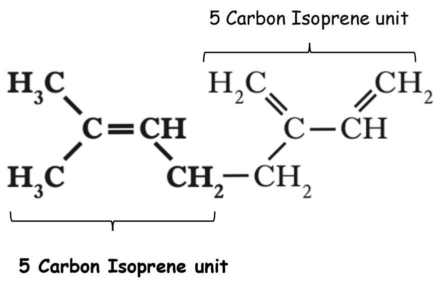
Oxygen from the air causes the oxidation of food giving edible oil foods a rancid flavour

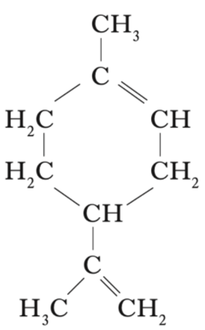
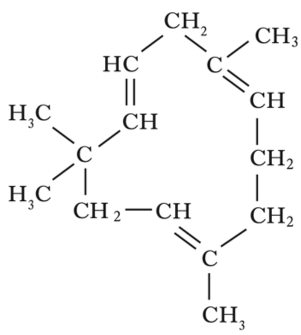
109

Antioxidants are molecules which prevent unwanted oxidation reactions from occurring
- antioxidants are substances that are easily oxidised
- antioxidants molecules are oxidised instead of the compounds they are being used to protect
- antioxidants can be identified as the substance being oxidised in a redox reaction

	Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.8 Fragrances	Page	Traffic Light: Red	Amber	Green

110		Essential oils are concentrated extracts of volatile, non-water soluble aroma compounds from plants
		• essential oils are mixtures of many different compounds
		• essential oils do not as a group have any specific chemical properties or functional groups in common
		• they are defined by the fact that they convey characteristic fragrances
		• essential oils are usually extracted by distillation or solvent extraction techniques.
		• essential oils are widely used in
		  ○ perfumes
		  ○ cosmetic products
		  ○ flavourings in foods
		  ○ cleaning products
		  ○ aromatherapy
				☹	😐	☺

111		Terpenes are key components of most essential oils. • Terpenes are unsaturated compounds formed from joining together isoprene units • Isoprene is 2-methylbuta-1,3-diene C_5H_8  		☹	😐	☺
112		Terpenes are important in terms of the flavour and aroma of food • terpenes are components in a wide variety of fruit and floral flavours and aromas • terpenes can be oxidised in plants producing some of the compounds responsible for the aroma of spices.		☹	😐	☺
113a		The structure of a terpene can be analysed to identify the isoprene units within the molecule.  Myrcene $C_{10}H_{16}$ 		☹	😐	☺

113b		The number of isoprene units which join together to make a terpene can be worked out from the number of carbons in the terpene
		• The number of carbons in the terpene will be multiple of five.
		  ○ Terpene molecules with 10 carbons formed when *two* C_5H_8 units joined together
		  ○ Terpene molecules with 15 carbons formed when *three* C_5H_8 units joined together
		e.g.
		
		Limonene: $C_{10}H_{16}$
		2x C_5H_8 units joined together
		
		Humulene: $C_{15}H_{24}$
		3x C_5H_8 units joined together				

	Dalziel High School	Higher Chemistry Self-Evaluation Unit 2.9 Skin Care	Page	Red	Amber	Green
114	Ultraviolet (UV) radiation is a high-energy form of EM radiation and is present in sunlight. • Exposure to UV light provides sufficient energy for bonds to be broken within molecules • UV light causes sunburn and accelerates ageing of skin • Sun-block applied to your skin prevents UV light reaching the skin			☹	😐	☺
115	Free radicals are atoms or molecules which have an unpaired electron. • UV light breaks bonds to form free radicals • free radicals are highly reactive due to this unpaired electron			☹	😐	☺
116 117 118	The steps involved in a free radical reaction are • **Initiation** ○ UV light generates radicals $Br_2 \xrightarrow[\text{UV light/slow}]{\text{Homolytic fission}} Br^\bullet + Br^\bullet$ • **Propagation** ○ A propagation reaction involves the loss of a radical, but also the formation of another radical. The reaction now has to keep going, or propagate itself $Br^\bullet + CH_4 \longrightarrow CH_3^\bullet + HBr$ $CH_3^\bullet + Br_2 \longrightarrow CH_3Br + Br^\bullet$ • **Termination** ○ Termination involves radicals coming together to form covalent bonds. $CH_3^\bullet + Br^\bullet \longrightarrow CH_3Br$ $CH_3^\bullet + CH_3^\bullet \longrightarrow CH_3CH_3$ $Br^\bullet + Br^\bullet \longrightarrow Br_2$			☹	😐	☺
119	Free-radical scavengers are molecules that react with free radicals to form stable molecules • prevents free radical chain reactions from occurring. • natural free radical scavengers include: Melatonin, Vitamin E and beta-carotene • free radical scavengers are added to cosmetics, food and plastics.			☹	😐	☺