Name: __ANSWERS_____ Date: _____

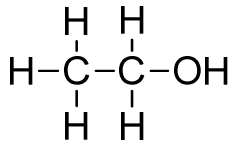
BCI SCIENCE

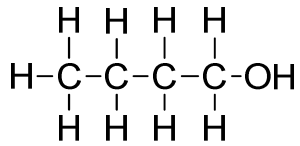
SCH 4U

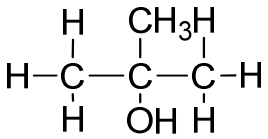
Reactions of Alcohols & Haloalkanes

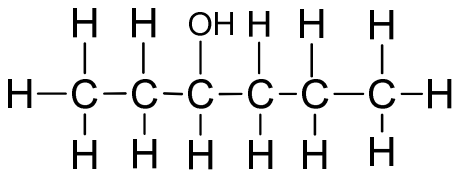
** You may need to use the internet for some answers **

1. (a) Name the following alcohols:

	
Ethanol	**1°**

	
1-butanol	**1°**

	
2-methyl-2-propanol	**3°**

	
3-hexanol	**2°**

(b) Write in each box next the name whether the alcohol is primary (1°), secondary (2°) or tertiary (3°).

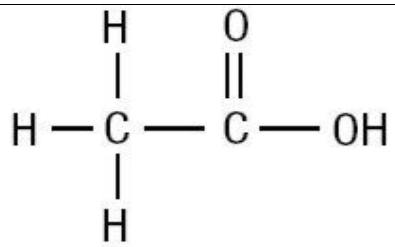
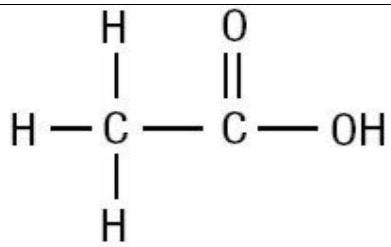
2. (a) Alcohols up to four carbons long are soluble in water. Explain why they are soluble but alcohols of longer length are not.

Up to 4 C, the polarity of the C-O and O-H bonds overcome the non-polar nature of the alkyl chain. Past 4 C, the non-polar chain trumps the polar bonds making the molecule more non-polar in nature. Like dissolves like.

(b) The boiling points of alcohols are much higher than their corresponding alkanes. For example the boiling point of ethane is -89 °C compared to that of ethanol 78 °C. Explain why there is a large difference between the two.

Alcohols have polar C-O and O-H bonds meaning they can experience dipole-dipole and H-bonding intermolecular forces. These are stronger forces to overcome than just dispersion forces in alkanes. Stronger forces require more energy = ↑ boiling point.

3. (a) Alcohols can undergo oxidation reactions with both acidified dichromate and acidified permanganate. Complete the following table showing **ethanol** reacting with both:

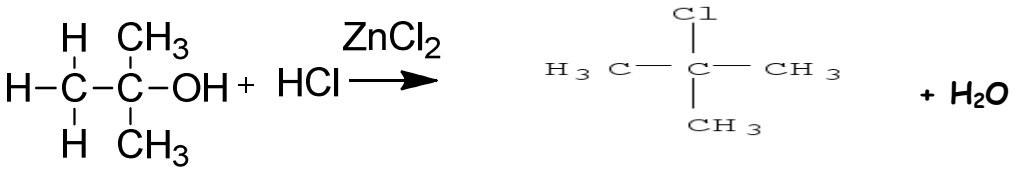
	$Cr_2O_7^{2-}/H^+$	MnO_4^-/H^+
Initial colour	**bright red/orange**	**purple**
Final colour after oxidation	**green**	**colourless**
Structural formula of organic product produced as ethanol has reacted		
Name of organic product	**ethanoic acid**	**ethanoic acid**
Formula of species after oxidation	**CH_3COOH**	**CH_3COOH**

(b) Complete the following sentences by adding the correct words:

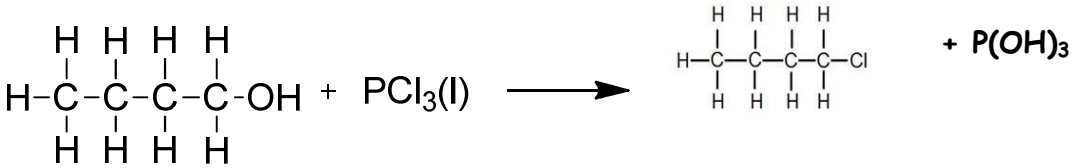
Primary and **secondary** alcohols can undergo oxidation with acidified dichromate and acidified **permanganate** solutions. However, **tertiary** alcohols cannot be oxidised by either of these reagents. The product of an oxidation of a primary alcohol is an **aldehyde** .

4. Alcohols can undergo substitution reactions with a variety of reagents. Complete the following reactions, showing **all products formed**:

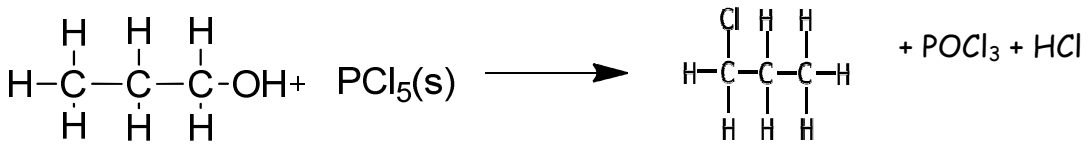
(a)



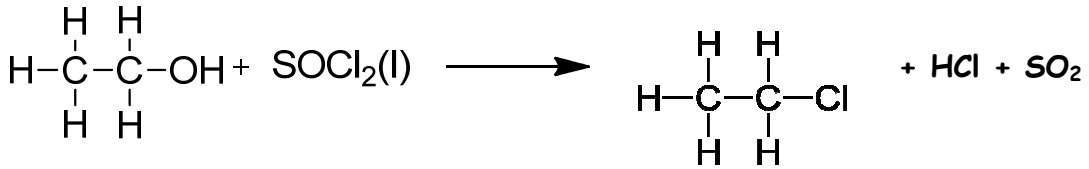
(b)



(c)



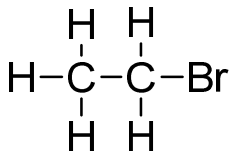
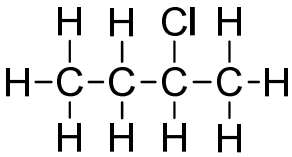
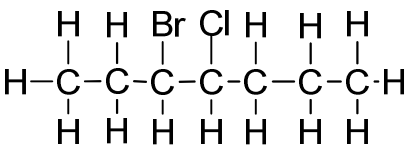
(d)



5. State Zaitsev's rule for elimintation and explain it further using butan-2-ol and conc H_2SO_4.

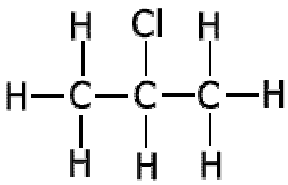
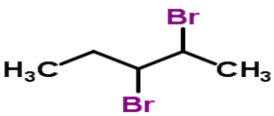
During an elimination reaction, the more stable alkene is the major product. For example, there will be more trans-2-butene formed from the elimination of butan-2-ol than cis-2-butene as trans is a more stable structure.

6. (a) Name the following haloalkanes:

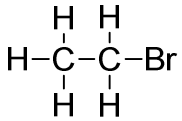
					
Bromoethane	**1°**	**2-chlorobutane**	**2°**	**3-bromo-4-chloroheptane**	**2°**

(b) Classify the above as 1°, 2° or 3° and write that number in the box next to the name.

(c) Draw structural formulae for the following:

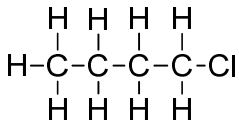
2-chloropropane	2,3-dibromopentane	2-bromo-4-chlorohexane
		**$CH_3CH(Br)CH_2CH(Cl)CH_2CH_3$**

7. (a) Haloalkanes can undergo substitution reactions with ammonia. Draw and name the **organic products** of the following reactions:



$+ \quad 2NH_{3(alc)} \longrightarrow$ **$CH_3CH_2\text{-}NH_2 + HBr$**

Name: **aminoethane +hydrobromic acid**



$+ \quad 2NH_{3(alc)} \longrightarrow$ **$CH_3CH_2CH_2CH_2\text{-}NH_2 + HCl$**

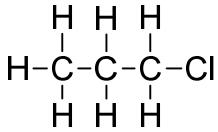
Name: **1-aminobutane + hydrochloric acid**

(b) Haloalkanes can also undergo elimination reactions.

(i) State the meaning of an elimination reaction.

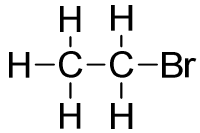
An elimination reaction involves the removal of a functional group to form a multiple bond.

(ii) Complete the following reactions by drawing and naming the organic products.



$+ \quad KOH_{(alc)} \longrightarrow$ **$CH_3CH{=}CH_2 + KCl + H_2O$**

Name: **1-propene + potassium chloride + water**



$+ \quad NaOH_{(alc)} \longrightarrow$ **$CH_2{=}CH_2 + NaBr + H_2O$**

Name: **ethane + sodium bromide + water**

(iii) Explain why the KOH or NaOH must be in alcoholic conditions.

The KOH or NaOH must be in alcoholic conditions in order to favour elimination and make water and the ionic salt. If it is not in alcoholic conditions then the reaction will likely undergo substitution and therefore not form a multiple bond.