Nanyang Junior College
Chemistry (9729)

Tutorial 14
Hydroxy Compounds

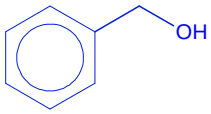
H2

Prepared by Mrs Judy Tan **JC2/2025**

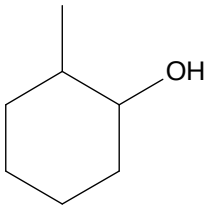
Section A: Self-Check Questions

Part 1: Alcohols

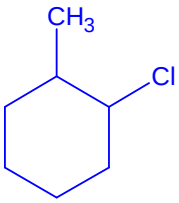
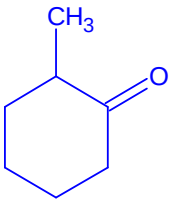
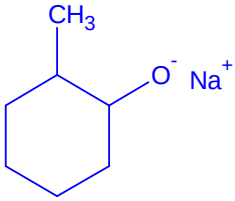
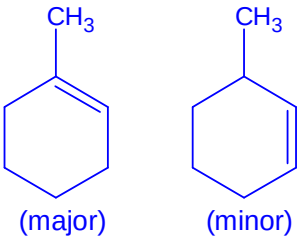
1 For the following compounds given by their IUPAC name, draw their skeletal formula.

(i) Propan-1,3-diol	**(ii)** Phenylmethanol
	

2 Below is a cyclohexane derivative.

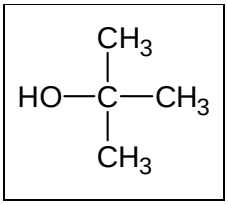


State the type of reaction and draw the structural formula of the organic product(s) formed by the action of the reagents stated below:

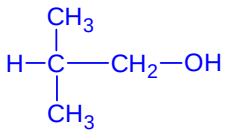
(a) HCl (g)  Type of reaction: nucleophilic substitution	**(b)** Acidified dichromate(VI) ions  Type of reaction: oxidation
(c) Na metal  Type of reaction: reduction	**(d)** Concentrated H_2SO_4 at 170°C  (major) (minor) Type of reaction: elimination

3 There are four structural isomers of C_4H_9OH.

The structure of one isomer, 2-methylpropan-2-ol, a tertiary alcohol is shown below.



(i) Draw the structures and give the names of the other **three** isomers of C_4H_9OH. Classify each as either primary, secondary or tertiary.

isomer	$CH_3CH_2CH_2CH_2OH$	$CH_3CH(OH)CH_2CH_3$	
name	butan-1-ol	butan-2-ol	2-methylpropan-1-ol
classification	primary	secondary	primary

(ii) One of the isomers gives a positive test with alkaline aqueous iodine. Identify the isomer and write a balanced equation for the reaction.

The isomer is $CH_3CH(OH)CH_2CH_3$, (butan-2-ol).

$CH_3CH(OH)\ CH_2CH_3\ + 4I_2\ + 6NaOH \rightarrow\ CHI_3\ + CH_2CH_3CO_2^-Na^+\ + 5NaI\ + 5H_2O$

(iii) 2-methylpropan-2-ol could be distinguished from the other two isomers by a simple chemical test. State the test and give the observations.

test: To each sample, add potassium dichromate(VI), H_2SO_4 (aq) and heat

Observations:

2-methylpropan-2-ol (Tertiary alcohol): Orange potassium dichromate(VI) remains

Butan-1-ol & butan-2-ol: Orange potassium dichromate(VI) turns green

Continue on the next pg

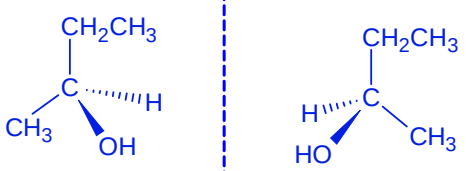
(iv) One of the isomers of $C_4H_{10}O$ exhibit the following:

- It exists as a pair of isomers.
- 3 alkenes are formed when it is heated with Al_2O_3.

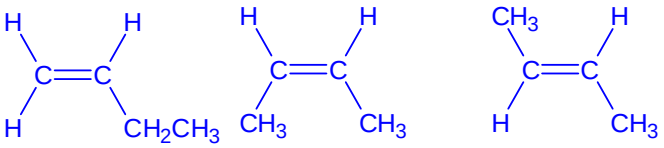
Identify the alcohol, including your reasoning.

The alcohol is $CH_3CH(OH)CH_2CH_3$. (butan-2-ol)

- It exists as a pair of enantiomers as it contains a chiral carbon.

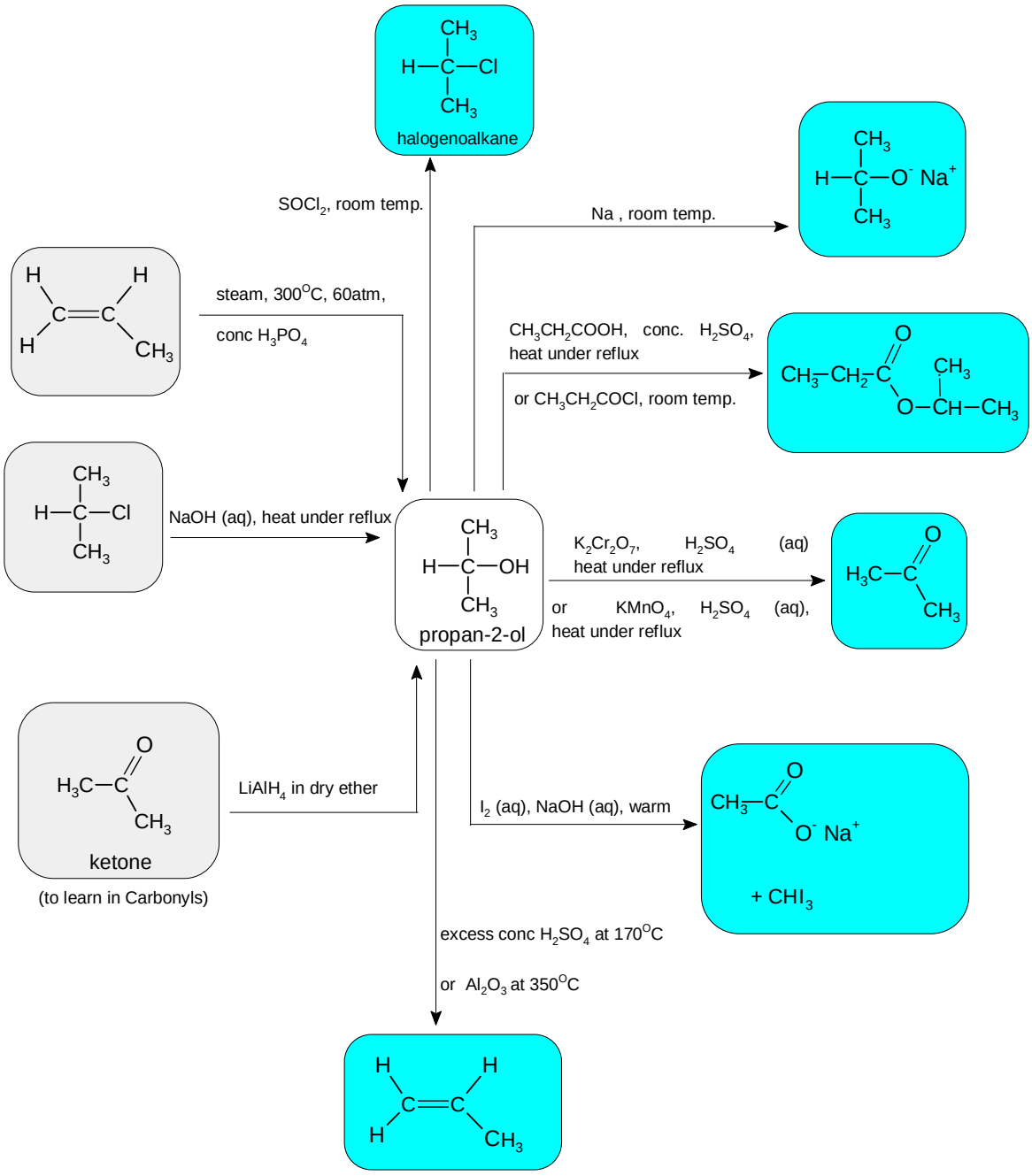


- It undergoes elimination with Al_2O_3 to form the 3 alkenes:



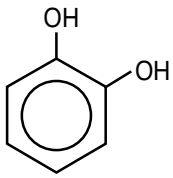
But-1-ene cis but-2-ene trans but-2-ene

4 Complete the following summary of reactions for a secondary alcohol, propan-2-ol.
(Compare this summary with the one for a primary alcohol – pg 20 of notes, how are reactions of a primary and secondary alcohol different?)

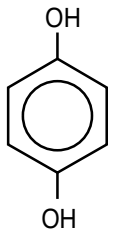


Part 2: Phenols

5



catechol



hydroquinone

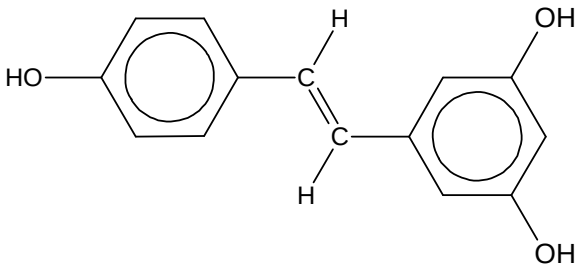
Catechol has a lower melting point (104 ^{o}C) than hydroquinone (169 ^{o}C). Explain this observation. [3]

Both catechol and hydroquinone have simple molecular structure. [1]

Both catechol and hydroquinone form intermolecular hydrogen bonds between molecules, but catechol is also able to form intramolecular hydrogen bonds. Formation of intramolecular hydrogen bonds in catechol reduces the extent of intermolecular hydrogen bonding. [1]

This leads to weaker intermolecular forces in catechol and therefore less energy is required to overcome these forces. [1]

6 *Reversatrol* is an insect repellent which is emitted by damaged plants. Which reagent, in its reaction with *Reversatrol*, shows both electrophilic addition and electrophilic substitution?



A bromine

B ethanoyl chloride

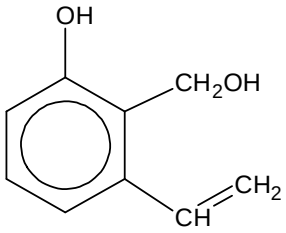
C hydrogen bromide

D steam

Ans: A

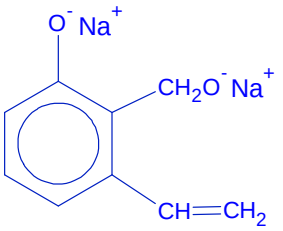
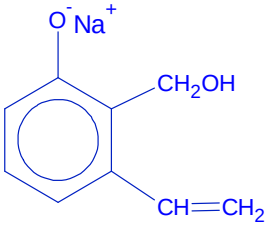
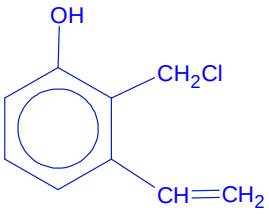
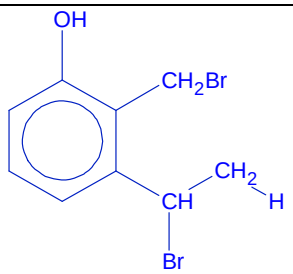
Bromine undergoes electrophilic addition with the alkene and electrophilic substitution on the benzene.
(B) Ethanoyl chloride undergoes condensation reaction with the phenol.
(C) Hydrogen bromide undergoes electrophilic addition with the alkene.
(D) Steam undergoes electrophilic addition with the alkene.

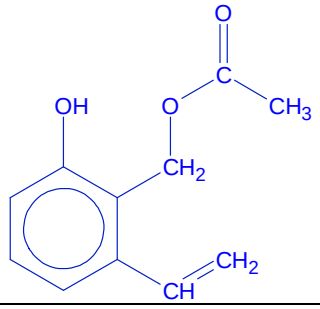
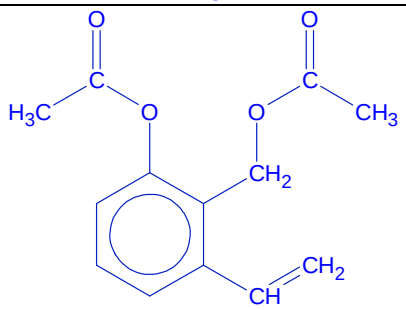
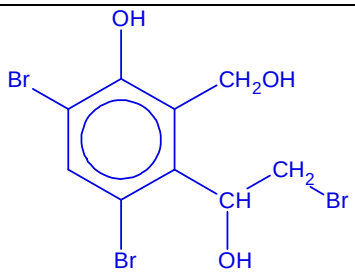
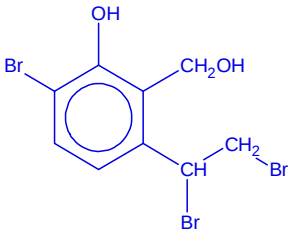
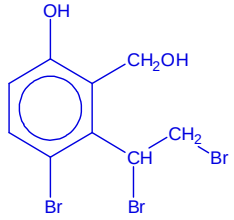
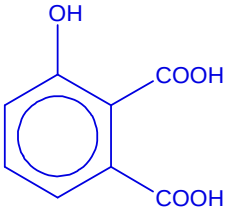
7 Suggest the condition for the following reagents to react with the compound below, and the organic product(s) obtained. State "no reaction" if they do not react at all.
[Hint: Refer to Pg 21 summary by reagent to help recall the different reactions of functional groups]



It is a good practice to identify the functional gp present in the compound:

Phenol, primary alcohol, alkene and arene

	Reagent	Condition	Organic product
(a)	sodium metal	room temp	
(b)	sodium hydroxide	room temp	
(c)	sodium carbonate	room temp	no reaction
(d)	phosphorous(V) chloride	room temp	
(e)	hydrogen bromide	heat	

	Reagent	Condition	Organic product
(f)	ethanoic acid	conc. H_2SO_4, heat under reflux	
(g)	anhydrous ethanoyl chloride	room temp	
(h)	aqueous bromine	room temp	 Assume excess bromine is provided and phenol undergoes multi-substitution
(i)	bromine in CCl_4	room temp	 or 
(j)	potassium manganate(VII)	H_2SO_4(aq), heat under reflux	
(k)	potassium dichromate (VI)	H_2SO_4(aq), heat with immediate distillation