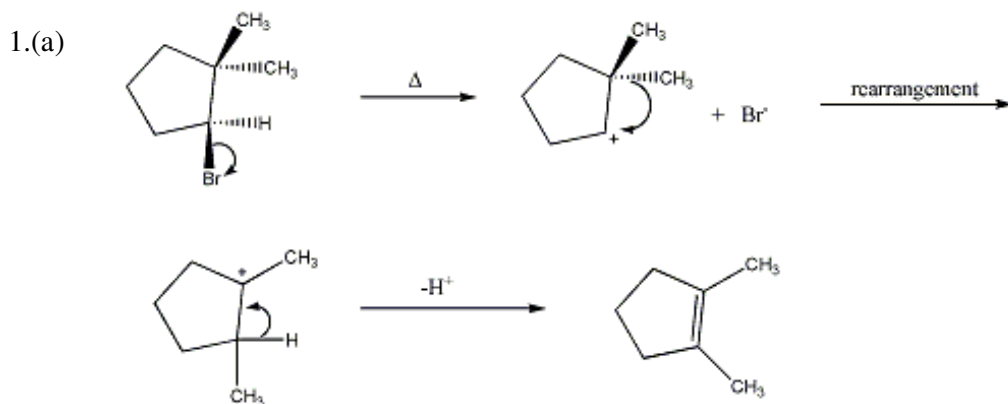
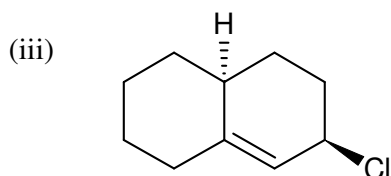
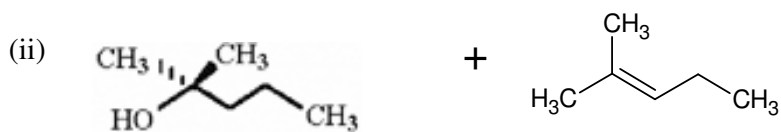
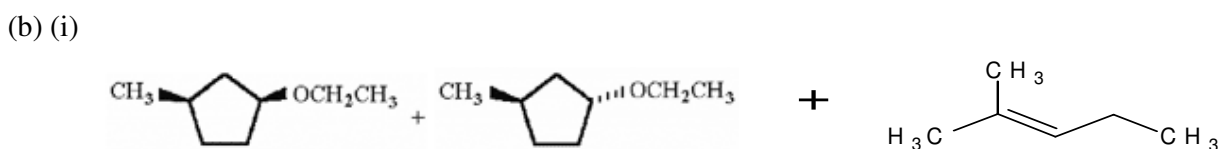


SECTION B:



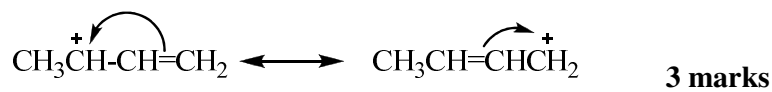
Name of mechanism: E1 elimination.

7 marks



8 marks

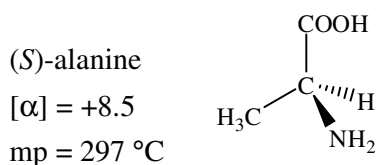
(c) The intermediate carbocation resulting from 3-bromobut-1-ene is resonance stabilized .



(d) $(\text{CH}_3)_3\text{COH} < (\text{CH}_3)_3\text{CO}^- < \text{CH}_3\text{CH}_2\text{O}^- < \text{CH}_3\text{CH}_2\text{S}^-$

2 marks

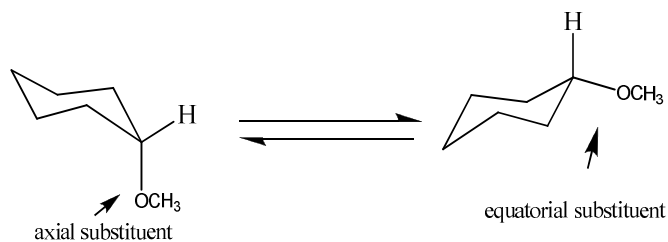
2(a)



- (i). The melting point is **same** as the *S* isomer.
- (ii). The melting point of a racemic mixture is often **different** from the melting point of the enantiomers.
- (iii). The specific rotation of (*R*)-alanine is equal to **-8.5**, same as (*S*) but opposite sign.
- (iv). The optical rotation of a racemic mixture is equal to **Zero**. A racemic mixture is optically inactive.
- (v). (1) Solution of pure (*S*)-alanine \Rightarrow **optically active**
(2) Equal mixture of (*R*) and (*S*)-alanine \Rightarrow **optically inactive**
(3) 75% (*S*) and 25% (*R*)-alanine \Rightarrow **optically active**.

8 marks

(b)



- (i). $K_{eq} = 2.7$
- (ii). The K_{eq} is > 1 and therefore the product (the conformation of the right) is favored at equilibrium.
- (iii). The ΔG° for this process must be negative since the product is favored.

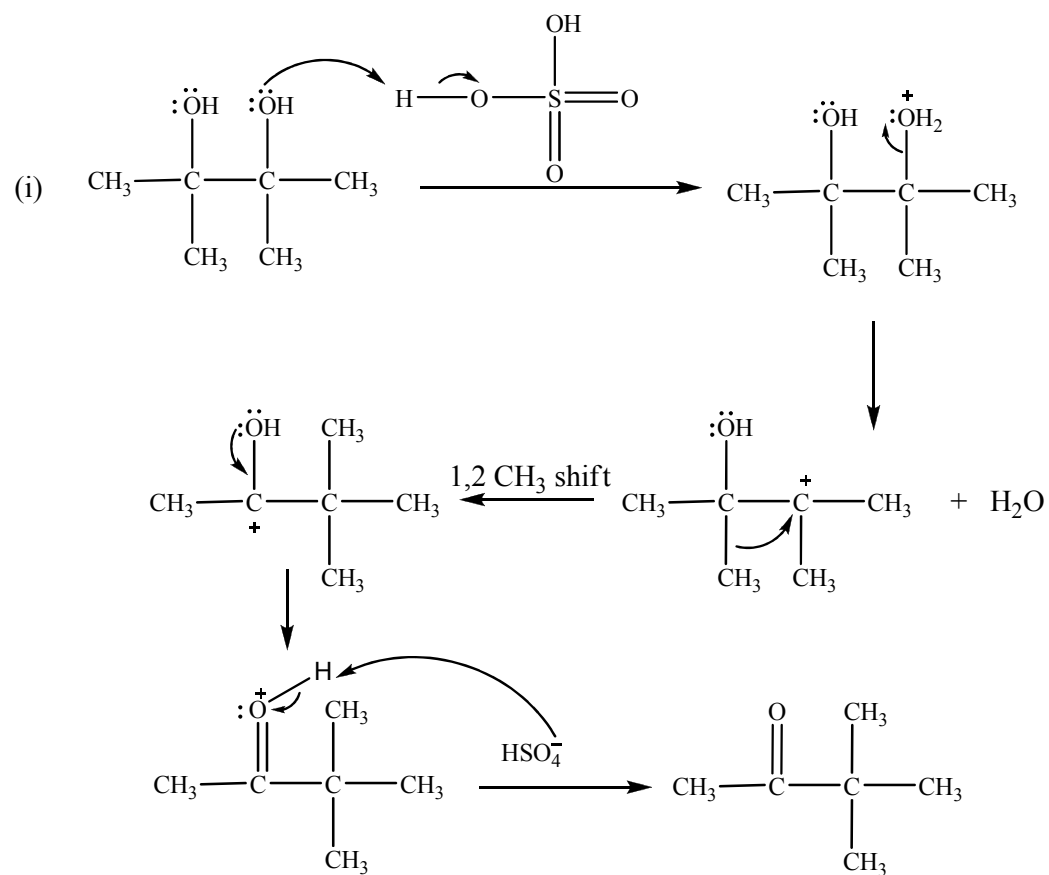
4 marks

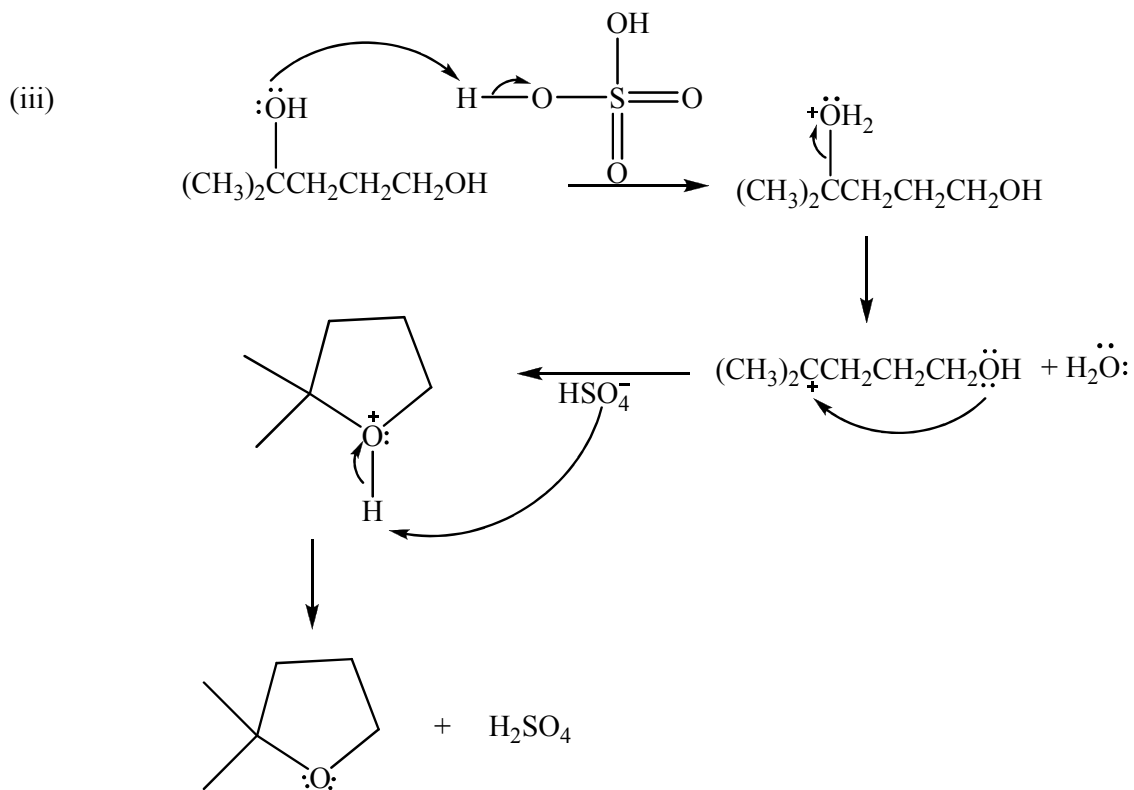
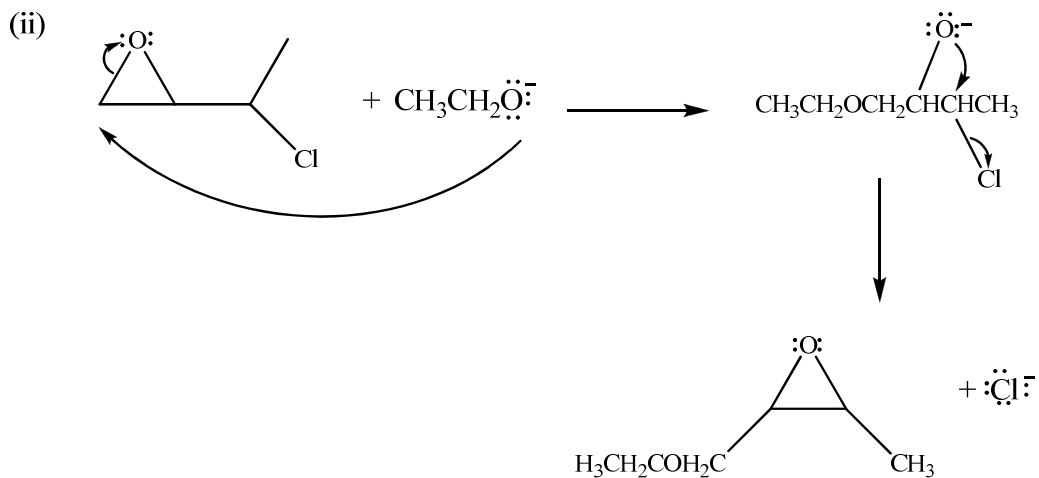
(c) $\text{CH}_3\text{CH}_2\text{OCH}_2\text{Cl}$ affords a resonance-stabilized carbocation, making an $\text{S}_{\text{N}}1$ reaction possible even though the alkyl halide is 1° .

- 3 (a) 1-pentanol (1° alcohol)
 2-pentanol (2° alcohol)
 3-pentanol (2° alcohol)
 2-methyl-1-butanol (1° alcohol)
 2-methyl-2-butanol (3° alcohol)
 3-methyl-2-butanol (2° alcohol)
 3-methyl-1-butanol (1° alcohol)
 2,2-dimethyl-1-propanol (1° alcohol)
 Also all cyclic alcohols having 5 carbon atoms.

5 marks

(b)

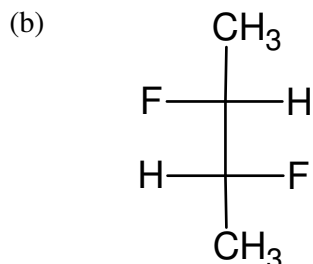




4 (a) (i) 6-ethyl-2,6,7-trimethyl-5-propylnonane

(ii) 1-bromo-4-ethyl-2-methyl-3-isopropylhexane

4 marks



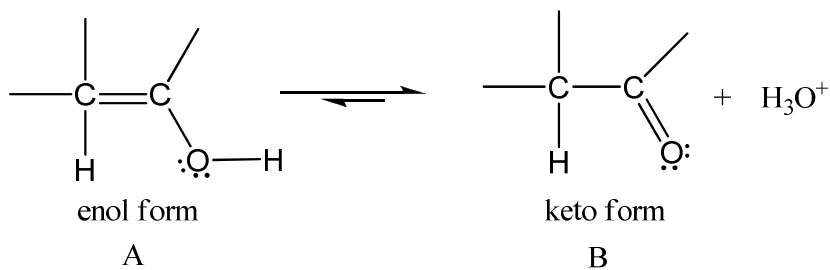
4 marks

(c)

- (i). **False.** The reaction is endothermic
- (ii). **True.** This assumes that ΔG° is approximately equal to ΔH° .
- (iii). **False.** $K_{eq} < 1$
- (iv). **True.**
- (v). **False.** The starting material is favored at equilibrium.

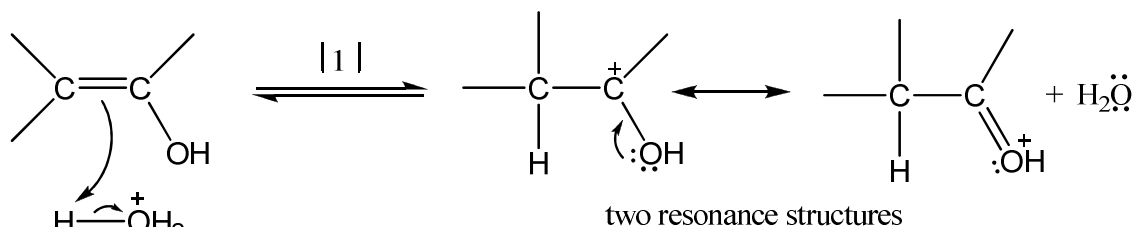
6 marks

(d) (i) Keto-enol tautomers



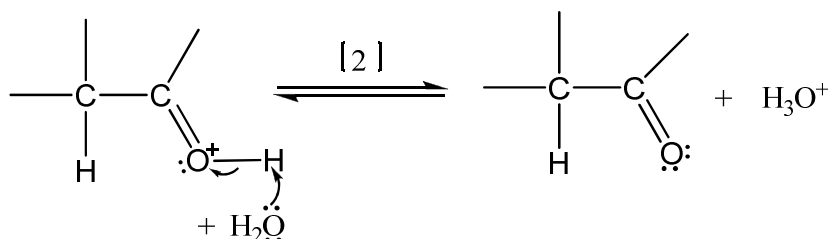
A and B are tautomers. Tautomers are constitutional isomers that differ in the location of a double bond and a hydrogen atom. An enol tautomer has an O-H bonded to a C=C. Whereas a keto tautomer has a C=O and an additional C-H bond. Equilibrium favors the keto form largely because a C=O is much stronger than a C=C. The process of converting one tautomer to the other is catalysed by both acid and base. An example would be the following steps showing the conversion of an enol form to the keto form using an acid.

Step [1] Protonation of the enol double bond



Protonation of the enol C=C with acid (H_3O^+) adds H^+ to form a **resonance stabilized carbocation**.

Step [2] Deprotonation of the OH group



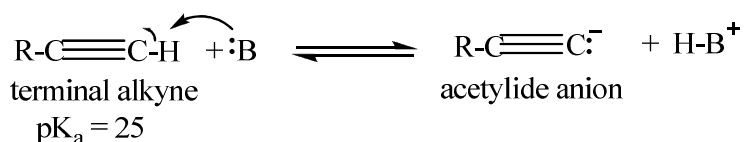
Loss of a proton forms the carbonyl group. Because the acid used in step [1] is reformed in step [2] tautomerization is **acid catalysed**.

(ii) Williamson ether synthesis

A Williamson ether synthesis is the synthesis of an ether via the $\text{S}_{\text{N}}2$ mechanism. The substrate is usually a primary alkyl halide (since it is less sterically hindered) and the reagent is a strong base i.e. the alkoxide anion. An example reaction is the synthesis of methyl ethyl ether. Either bromomethane or bromoethane can be used to react with $\text{CH}_3\text{CH}_2\text{O}^-$ or CH_3O^- respectively. The preferred reaction would be bromomethane with the ethoxide ion as this is less sterically hindered. Bromoethane has a methyl group attached to the reaction centre whereas bromomethane does not have any bulky groups attached to it.

(iii) Acidity of terminal alkynes

The C-H bond in the terminal alkyne is sp hybridized and all sp hybridized C-H bonds are more acidic than the sp^2 and sp^3 C-H bonds because of the higher s character. Therefore terminal alkynes are readily deprotonated with a strong base in a Bronsted-Lowry acid-base reaction. The resulting anion is called an acetylide anion.



Since an acid-base equilibrium favors the weaker acid or base, only bases having conjugate acids with pK_{a} values higher than 25 are strong enough to form a significant concentration of acetylide anion.