Aldehydes, Ketones and Carboxylic Acids

 Acetic acid is dissolved in water having oxygen as ¹⁸O. How many ¹⁸O atom will be present in the product molecule?

2.
$$\underbrace{\begin{array}{c} OMe \\ OMe \\ COOC_2H_5 \end{array}} \xrightarrow{\begin{array}{c} (i) \text{ H}^+\text{H}_2O \\ (ii) \text{ heat} \end{array}} Z.$$

How many number of sp^2 hybridised carbon atoms are there in the product Z.

 How many membered ring will be formed in the product P of the following reaction.

4. Compound A is obtained by following reaction.

$$CH_3COOC_2H_5 \xrightarrow{(i) C_2H_5ONa} [A]$$

How many following statement(s) is(are) true about A?

- (i) It gives red colour with blue litmus solution.
- (ii) It decomposes NaHCO₃ solution and evolves CO₂ gas.
- (iii) It decolourises bromine water colour.
- (iv) It reacts with 2,4-dinitrophenyl-hydrazine
- (v) Product A will undergo acid catalysed halogenation.
- 5. How many of the following compound is decarboxylated on heating?

(II) $C_2H_5CH(COOH)_2$

- 6. How many of the following compounds can be used as an acylating agent?
 - (I) CH₃COCl
- (II) (CH₃CO)₂O
- (III) CH₂COOH
- (IV) CH2CH2COCI.
- 7. In the scheme given below, how many number of intramolecular aldol condensation products formed from 'Y'?

$$\begin{array}{c}
1. O_3 \\
2. Zn, H_2O
\end{array}$$

$$Y \xrightarrow{1. \text{NaOH (aq)}}$$
2. heat

8. Among the following, how many number of reaction(s) produce(s) benzaldehyde?

I.
$$CO, HCI$$
Anhydrous AlCl₃/CuCl

IV.
$$CO_2Me$$

DIBAL-H

Toluene,-78°C

 H_2O

- **9.** Find the number of reactants among the given options which does not undergo Michael addition?
 - (I) $C_6H_5CH = CHCOCH_3 + C_6H_5COCH_3$
 - (II) $C_6H_5CH = CHCH_2COC_6H_5 + CH_2(COOC_2H_5)_2$

(III)
$$\longrightarrow$$
 + Br \longrightarrow COCH = CH \longrightarrow

- (IV) $CH_2 = CHCOCH_3 + CH_3COCH_3$
- **10.** How many number of aldol reaction(s) occurs in the given transformation?

11. How many number of organic compounds among the following compounds are present in the reaction mixture after the completion of reactions I and II?

Reaction I:
$$H_3C$$
 CH_3
 CH_3

Reaction II:
$$H_3C$$
 CH_3
 CH_3
 CH_3COOH

$$H_3C$$
 CH_2Br
 CBr_3
 CBr_3
 CBr_3
 CBr_3



12. Find the total number of product in the given reaction.

$$\underbrace{\overset{\text{i. KOH, H}_2O}{\underset{\text{ii. H},^+\text{ heat}}{}}}_{O}$$

13. How many steps are there in the mechanism of the following reaction?

$$\begin{array}{c}
O \\
+ CH_3 - C - CI \xrightarrow{\text{AlCl}_3} & O \\
C \\
CH_3
\end{array}$$

- 14. An unknown compound of carbon, hydrogen and oxygen contains 69.77% carbon and 11.63% hydrogen and has a molecular weight of 86. It does not reduce Fehling solution, but forms a bisulphite addition compound and gives a positive iodoform test. How many possible structures can be drawn for the unknown compound?
- **15.** How many total number of ketonic groups are present in compound C and D in the given reaction sequence?

$$\begin{array}{c}
O \\
\hline
C_6H_5CHO \\
\hline
Base
\end{array}
C \xrightarrow{(i) LiAlH_4} D$$



SOLUTIONS

1. (2)
$$CH_3 - C - OH \xrightarrow{H_2O^{18}} CH_3 - C - OH \xrightarrow{1_8O^+H_2}$$

$$\begin{bmatrix} OH & & & & \\ CH_3-C-OH & & & & \\ & \downarrow & & & \\ & 18OH & & & \\ \end{bmatrix} \longrightarrow CH_3-C=O$$

$$\xrightarrow{\text{H}_2\text{O}^{18}} \text{CH}_3 \xrightarrow{\text{I}_8\text{OH}} \text{OH} \xrightarrow{\text{O}^{18}} \text{CH}_3 \xrightarrow{\text{O}^{18}} \text{CH}_3$$

2. (1)
$$\bigcirc$$
 OMe \longrightarrow OH \longrightarrow OH \longrightarrow OH \longrightarrow COOH

Remember that β -keto acids undergo decarboxylation on heating.

3. (5)

$$OH \xrightarrow{NaBH_4} OH$$

$$A \gamma$$
-hydroxy acid

$$\xrightarrow{\text{H}_3\text{O'}}$$

4. (4) (I),(III),(IV),(V)

$$CH_3$$
— C — OC_2H_5 — \longrightarrow

$$\begin{array}{c|c}
O & O^{-} \\
\parallel & \downarrow \\
-CH_{2} - C - OC_{2}H_{5} \longleftrightarrow CH_{2} = C - OC_{2}H_{5} \\
More stable
\end{array}$$

$$\xrightarrow{H^+} CH_2 = C \longrightarrow CC_2H_5.$$
An enol

- (3) Dicarboxylic acids having two—COOH groups on the same carbon atom; and β-keto acids are easily decarboxylated on heating.
- 6. (3) Stronger the basic nature of the leaving group, weaker will be its leavability. In CH₃COOH, OH⁻ is a strong base so it can't be removed easily to form CH₃CO required for acetylation (acylation).

7. (1)
$$\underbrace{\begin{array}{c} 1. O_3 \\ 2. Zn, H_2O \end{array}}_{} \underbrace{\begin{array}{c} O \\ NaOH(aq) \\ O \end{array}}_{}$$

$$\begin{array}{c} OH \\ \hline \\ OH \\ \hline \\ OH_2O \end{array}$$

$$\xrightarrow{-\text{H}_2\text{O}} \text{CHC}$$

$$\frac{\text{COOMe}}{\text{Toluene, -78°C H}_2\text{O}}$$

9. (2) (II) does not have α, β-unsaturated carbonyl group, while (IV) can't form stable carbanion (from acetone). Remember that cyclopentadiene is quite acidic in nature, because its carbanion is stable due to presence



of conjugated system; hence it functions as the nucleophile required in Michael reaction.

10. (3)
$$CH_3 - CHO + HCHO \xrightarrow{OH^-}$$
 1st aldol condensation

$$\begin{array}{c} \alpha \\ \text{CH}_2 \text{--CHO} \\ \mid \\ \text{CH}_2 \text{--OH} \end{array} \xrightarrow[\text{condensation}]{\begin{array}{c} \text{CH}_2 \text{--OH} \\ \alpha \mid \\ \text{CH} \text{--CHO} \\ \mid \\ \text{CH}_2 \text{--OH} \end{array}}$$

$$\frac{\text{OH}^{-}/\text{HCHO}}{\text{3rd aldol} \atop \text{condensation}} + \text{HOCH}_{2} - C - \text{CHO}_{2}$$

$$CH_{2}\text{OH}$$

$$CH_{2}\text{OH}$$

$$\begin{array}{c} \text{CH}_2\text{OH} \\ \text{HOCH}_2 - \begin{array}{c} \text{C} - \text{CH}_2\text{OH} \\ \text{C} - \text{CH}_2\text{OH} \end{array} \\ \begin{array}{c} \text{Cannizzaro} \\ \text{reaction} \end{array}$$

11. (3) Reaction I :
$$CH_3$$
 CH_3 $Er_2(1.0 \text{ mol})$ Na^+OH^-

Reaction II :
$$CH_3$$
 CH_3 CH_3 CH_3 CH_3 CH_3 CH_3 CH_2 CH_2 CH_3

12. (2)

$$CH_3 \xrightarrow{KOH, H_2O} CO$$

13. (3)
$$CH_3COCI + AlCl_3 \xrightarrow{step1} CH_3C^+ = O + AlCl_4^-$$

$$\frac{\text{CH}_{3}\text{C} = 0}{\text{Step 2}}$$

$$\frac{\text{CH}_{3}\text{C}}{\text{Step 2}}$$

$$\frac{\text{AICI}_{4}^{-}}{\text{Step 3}}$$

$$+ \text{HCl} + \text{AICI}_{3}$$
Acetophenone

14. (2) Empirical formula can be calculated as

Element	Percentage	Relative	Simplest
		no. of atoms	ratio
C	69.77	5.81	5
H	11.63	11.63	10
O	18.60	1.16	1

Empirical formula of compound is C₅H₁₀O and empirical formula wt. = 86.

Also molecular wt. = 86.

- :. Molecular formula of compound is C₅H₁₀O.
- (ii) Compound forms bisulphite addition compound and thus has carbonyl gp, i.e. aldehyde or ketone.
- (iii) It does not reduce Fehling solution and thus it is not an aldehyde but a ketone.
- (iv) It gives positive iodoform test and thus it has unit,

(v) Above facts reveal that the compound is CH₃CH₂CH₂COCH₃ or (CH₃)₂CHCOCH₃ pentan-2-one 3-methylbutan-2-one

15. (1)
$$C_6H_5CHO$$

Base

(C)

 C_6H_5CHO
 CHC_6H_5

(C)

 CHC_6H_5

(C)

 CHC_6H_5

(D)

There is only one ketonic group in C and zero ketonic group in D.

