CHEMISTRY

WORKSHEET-5

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-5

(C. Organic Chemistry)

Aldehydes and Ketones

USE THIS SPACE FOR SCRATCH WORK

Q.1 Mark the incorrect statement about aldehydes and ketones:

A) They have higher boiling points than that of alkanes

B) They have lower boiling points than that of alcohols

C) Aldehydes are present in essential oils and ketonic group is present in camphor

D) Aldehydes have H-bonding but ketones do not have

Q.2 All of the following statements are correct about aldehydes and ketones EXCEPT:

A) Aldehydes are easily oxidized while ketones do not

B) Aldehydes show position isomerism while ketones do not

C) Aldehydes can be oxidized easily by Fehling's solution while ketones do not

D) Aldehydes react with alcohols to form acetal while ketones do not

Q.3 Which of the following reactions is not given by ketones?

A) Grignard reagent C) Polymerization

B) 2,4-DNPH D) HCN

Q.4 Which of the following tests is shown by ketones only?

A) Sod. nitroprusside test C) Fehling's solution test

B) Tollen's reagent test D) Benedict's reagent test

Q.5 Which one of the following organic compounds does not give iodoform test?

A) Ethanal C) Methyl ketones

B) Ethanol D) Methanal

Q.6 All of the following reagents reduce aldehydes and ketones to their respective alcohols EXCEPT:

A) H_2/Ni C) N_2H_2/KOH

B) $LiAlH_4$ D) $NaBH_4$

Q.7 Which of the following aldehydes is the most reactive?

A) Methanal C) Butanal

B) Ethanal D) Propanal

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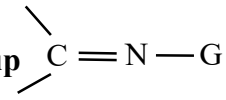
Q.8 Which one of the following does not give iodoform test?

A) Butanone C) 2-Hexnone

B) 2-Pentanone D) 3-Pentanone

Q.9 The reaction of aldehydes and ketones with ammonia derivative G-NH_2 to form compounds containing the

group  **and water is known as _____**

reaction:

A) Nucleophilic addition C) Electrophilic addition

B) Nucleophilic substitution D) Addition-elimination

Q.10 The nucleophilic addition reactions of carbonyl group are catalyzed by bases or acids. An acid catalyzed reaction:

A) Increases nucleophilic character of attacking reagent

B) Increases electrophilic character of carbon of carbonyl group

C) Increases both electrophilic and nucleophilic character

D) Has no effect on the reactivity of carbonyl groups

Q.11 Which one of the following types of reactions is not shown by aldehydes and ketones?

A) Nucleophilic addition reaction

B) Reduction reaction

C) β-Elimination reaction

D) Oxidation reaction

Q.12 Mark the incorrect statement about Aldehydes and Ketones:

A) Aldehydes on reduction with $NaBH_4/H_3O^+$ give 1° alcohol

B) Ketones on reduction with $NaBH_4/H_3O^+$ gives 2° alcohol

C) Aldehydes on reduction with N_2H_4/KOH gives alkane

D) Ketones on reduction with N_2H_4/KOH gives alkene

Q.13 Which of the following is incorrect statement?

A) 1° alcohol on oxidation gives aldehyde

B) 2° alcohol on oxidation gives ketone

C) On dry distillation of calcium methanoate, ethanal is produced

D) On dry distillation of calcium ethanoate, propanone is produced

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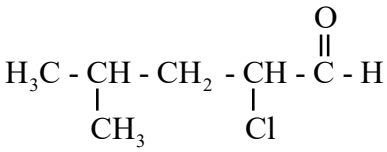
Q.14 Consider the following structure of aldehyde:



The correct name according to IUPAC is:

A) 2-Chloro-4-methylpentanal

B) 2-Methyl-4-chloropentanal

C) 2-Chloro-3-methylbutanol

D) 3-Methyl-2-chloropentanal

Q.15 Aldehydes can occur:

A) Anywhere in the carbon chain

B) In the middle of carbon chain

C) Only at the second carbon atom of the carbon chain

D) Only at the terminal carbon atom of the carbon chain

Q.16 Aldehyde acts as _____ when treated with Fehling's solution.

A) Reducing agent only C) Both A and B

B) Oxidizing agent only D) Neither A nor B

Q.17 Aldehydes and ketones react with ammonia derivatives G-NH_2 to form condensation product containing the group C = N – G and water. The reaction is:

A) Base catalyzed only C) Both A and B

B) Acid catalyzed only D) Neither A nor B

Q.18 Which of the following is not easily oxidized?

A) Aldehyde C) Ketone

B) 1° alcohol D) 2° alcohol

Q.19 Ketones are generally resistant to oxidation. But they can be oxidized by strong oxidizing agent such as ($K_2Cr_2O_7$ + conc. H_2SO_4). On oxidation of 2-pentanone, which of the following products are possible?

A) CH_3CH_2COOH only

B) CH_3-CH_2-COOH and CH_3COOH

C) CH_3COOH only

D) CH_3COOH and HCOOH

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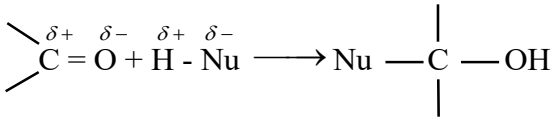
Q.20 Consider the following general reaction of carbonyl group with a reagent:

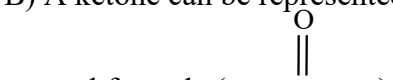


The mechanism of above reaction is:

A) Electrophilic addition reaction
B) Electrophilic substitution reaction
C) Nucleophilic addition reaction
D) Nucleophilic substitution reaction

Q.21 Identify the incorrect statement about aldehydes and ketones:

A) An aldehyde can be represented by general formula ()

B) A ketone can be represented by general formula ()

C) Ketone group is present in maltose, camphor and menthone
D) The homologous series of both aldehydes and ketones have general formula $C_nH_{2n}O$

Q.22 A Bakelite (plastic) is formed by the polymerization of methanal with:

A) Benzene
B) Ammonia
C) Phenol
D) Hydrocarbon

Q.23 Aldehydes and ketones show which of the following type of structural isomerism:

A) Position isomerism
B) Functional group isomerism
C) Metamerism
D) Tatoumerism

Q.24 Which of the following tests is used for the identification of aldehydes only?

Opt.	Tests	Applications
A)	2,4-DNPH	Aldehydes and ketones form a yellow or red precipitate with 2,4-DNPH solution
B)	Addition of HCN	Aldehyde and ketone react with HCN to give cyanohydrins
C)	Benedict's solution test	Aliphatic aldehydes form a brick-red precipitate with Benedict's solution
D)	Reduction with $NaBH_4$	Aldehydes and ketones are reduced to alcohols with $NaBH_4$

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Q.25 Which of the following statements does not match correctly for aldol condensation and cannizzaro reactions?

Opt.	Aldol condensation reaction	Cannizzaro reaction
A)	Aldehydes and ketones which have α-hydrogen undergo this reaction	Aromatic or aliphatic aldehydes which do not have α-hydrogen undergo this reaction
B)	It is carried out in the presence of 50%. NaOH solution at room temperature.	It is carried out in the presence of cold dil. NaOH solution.
C)	It is an addition reaction.	It gives two possible products
D)	A word aldol is given to the product because it contains both aldehyde / ketone and alcohol functional group.	It is known as disproportionation reaction i.e. (self-oxidation-reduction reaction).

Q.26 Which of the following is the formula of semicarbazide?

A) NH_2NH_2 C) $NH_2NHCONH_2$

B) $C_6H_5NHNH_2$ D) NH_2-OH

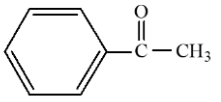
Q.27 Ketones are less reactive than aldehydes. It is because of the following reasons EXCEPT:

A) Both alkyl groups are more electron-donating than that of aldehyde

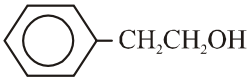
B) Both alkyl groups produce more steric hindrance

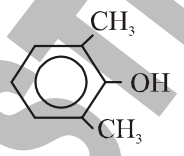
C) Both alkyl group decrease more polarity of carbonyl groups of ketones

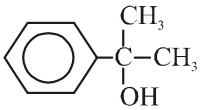
D) Both alkyl groups are electron-withdrawing groups and increase polarity

Q.28 What is the structure of alcohol which on oxidation with acidified $Na_2Cr_2O_7$ gives methyl phenyl ketone ()?

A) 

C) 

B) 

D) 

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Q.29 All of the following statements are correct for the laboratory and industrial preparation of methanal and ethanal EXCEPT:

Opt.	Prep. for	Lab / Ind	Substrate	Reaction
A)	Methanal	Lab method	Methanol	$2CH_3OH + O_2 \xrightarrow[300^\circ C]{Cu} 2HCHO + 2H_2O$
B)	Methanal	Ind method	Methanol	$2CH_3OH + O_2 \xrightarrow[500^\circ C]{Fe_2O_3, MnO_2} 2HCHO + 2H_2O$
C)	Ethanal	Lab method	Ethanol	$CH_3CH_2OH + [O] \xrightarrow[\Delta]{Na_2Cr_2O_7 + dil.H_2SO_4} CH_3CHO + H_2O$
D)	Ethanal	Ind method	Ethene	$2CH_2 = CH_2 + O_2 \xrightarrow[H_2O]{PdCl_2 + CuCl_2} 2CH_3CHO$

Q.30 A base catalyzed reaction in carbonyl compounds increases the:
A) Nucleophilic character of the attacking reagent only
B) Electrophilic character of the carbonyl carbon atom only
C) Electrophilic character of the attacking reagent only
D) Nucleophilic character of the carbonyl carbon atom only

Q.31 Aldol condensation is not successful with compounds:
A) Having no α-hydrogen C) Having α-methyl group
B) Having α-hydrogen D) Difficult to predict

Q.32 Aldehydes are the oxidation product of:
A) p-alcohols C) ter-alcohols
B) s-alcohols D) Carboxylic acids

Q.33 Which one of the following can undergo aldol condensation reaction?
A) Formaldehyde C) Acetaldehyde
B) Benzaldehyde D) Trimethylacetaldehyde

Q.34 Why does hydrogen cyanide add to propanone but not to propene?
A) The addition product formed with propene would not be stable
B) Propanone is more susceptible to nucleophilic attack than propene
C) Propanone is more susceptible to electrophilic attack than propene
D) Propanone is more susceptible to free radical attack than propene

Q.35 Almond essence is used to flavour foods. A student tested a sample of almond essence using 2,4-dinitrophenylhydrazine reagent and obtained coloured crystals. Which had a sharp melting point.
Which class of compound gives this positive result?
A) Alcohols C) Amines
B) Aldehydes D) Carboxylic acids

Q.36 The exhaled breath of diabetics contains propanone.
A medical student wishes to test for diabetes by asking patients to bubble their breath through a reagent.
Which reagent could give a positive result?
A) Alkaline aqueous iodine C) Fehiling's reagent
B) Aqueous bromine D) Tollen's reagent

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Q.37 An organic compound has the following properties:
It gives a positive tri-iodomethane (iodoform) test.
It is readily oxidized to ethanoic acid.
It does not react with Fehling's reagent.
Which compounds would give these results?

A) CH_3CH_2CHO
B) CH_3CH_2OH
C) $CH_3CH_2COCH_3$
D) $CH_3CH_2COCH_2CH_3$

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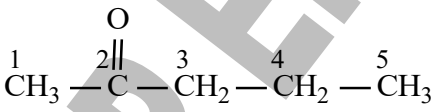
ANSWER KEY (Worksheet-5)							
1	D	11	C	21	C	31	A
2	B	12	D	22	C	32	A
3	C	13	C	23	B	33	C
4	A	14	A	24	C	34	B
5	D	15	D	25	B	35	B
6	C	16	A	26	C	36	A
7	A	17	B	27	D	37	B
8	D	18	C	28	A		
9	D	19	B	29	B		
10	B	20	C	30	A		

ANSWERS EXPLANATION

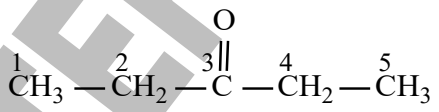
Q.1 (D) In fact, **aldehydes** and **ketones do not** show **hydrogen bonding.** They show dipole-dipole intermolecular forces.

Q.2 (B) It is incorrect statement. In fact, aldehydes **do not** show position isomerism because -CHO group is always present at the terminal carbon atom of the carbon chain. However, ketones show position isomerism. It has been explained by examples:

- **Position isomerism.** The isomers having carbonyl group at different locations in the carbon chain are called position isomers. e.g. pentanone can have carbonyl group at two different locations as shown below:



2-Pentanone



3-Pentanone

Q.3 (C) **Ketones do not** give polymerization whereas **aldehydes** such as **methanal** forms metaformaldehyde and **ethanal** form **paraldehyde polymer.**

Q.4 (A) **Ketones produce a wine red or orange red colour on adding alkaline sodium nitroprusside solution dropwise.**

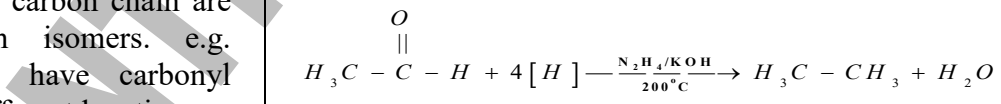
- **While aldehydes do not give this test.**

ADDITIONAL INFORMATIONS

Alkaline sodium nitroprusside (SNP) ($Na_2[Fe(CN)_5NO]$) is used as a medicine to **lower blood pressure.** This may be done if the **blood pressure** is very high and resulting in symptoms, in certain types of heart failure, and during surgery to decrease bleeding. It is used by continuous injection into a vein.

Q.5 (D) Methanal **does not** give iodoform test while all **others A, B and C give iodoform test.**

Q.6 (C) The **Wolf–Kishner's reduction** reaction is a reaction used in organic chemistry to convert **carbonyl functionalities** into **methylene** groups as shown in the reaction. In this reaction **aldehyde** is reduced to **alkane** with **hydrazine** in the presence of **KOH.**



Q.7 (A) **Methanal** is the **most reactive aldehyde** because it has **no alkyl group.** Since **alkyl group is electron** donating thus with the increase of **alkyl groups,** polarity of **carbonyl group** of **carbonyl** compounds decreases and thus reactivity decreases. **Order of the reactivity of aldehyde is as shown:**

Methanal > Ethanal > Propanal > Butanal.

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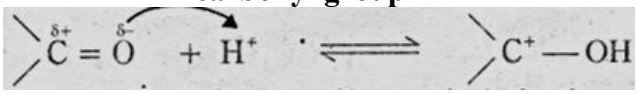
Q.8 (D) 3-Pentanone

$(CH_2 - CH_2 - CO - CH_2 - CH_3)$

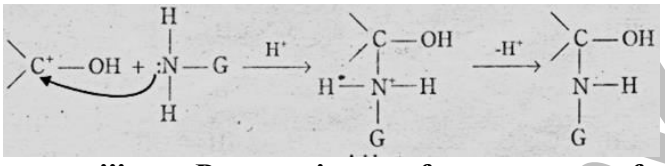
3-Pentanone does not give iodoform test because **methyl ketones** can only give **iodoform test. Other A, B and C** give **iodoform test** they are **treated** as **methyl ketone.**

Q.9 (D) Mechanism of reactions is shown below:

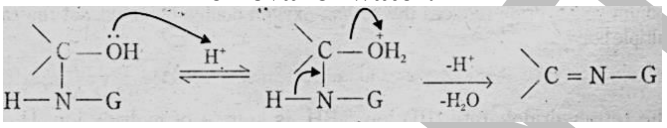
i. Protonation of oxygen of the carbonyl group



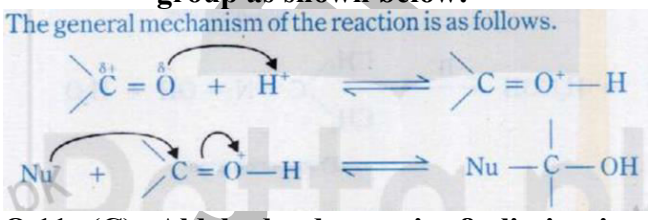
ii. Nucleophilic attack of nitrogen of ammonia derivative on the electrophilic positively charged carbon and deprotonation of the adduct.



iii. Protonation of oxygen of hydroxyl group followed by the removal of water.



Q.10 (B) The nucleophilic addition reactions of carbonyl group are catalyzed by bases or acids. An acid catalyzed reaction increases electrophilic character of carbon of carbonyl group as shown below:

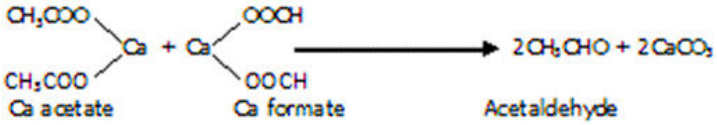


Q.11 (C) Aldehydes do not give β-elimination reaction.

Q.12 (D) Ketone is **less reactive than aldehyde.** So strong **reducing agent** is required for the complete reduction of **ketone** into **alkane** as shown in the reaction

$$H_3C - \overset{O}{\overset{\|}{C}} - CH_3 + 4[H] \xrightarrow{Zn-Hg/HCl} H_3C - CH_2 - CH_3 + H_2O$$

Q.13 (C) It is incorrect statement. In fact, on dry distillation cal.methanoate ethanal cannot be prepared. So in order to prepare ethanal dry distillation of both cal.methanoate and cal.ethanoate is done simultaneously as shown in reaction.



(Calcium ethanoate) (Ethanal)

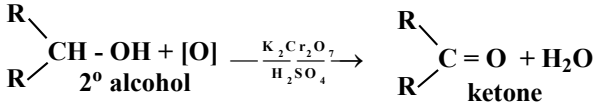
Detail of the other reactions are given below

A) On oxidation of 1° alcohol aldehyde is obtained

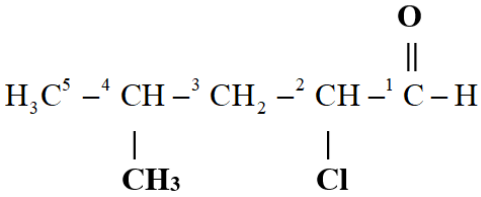
$$R\text{-}CH_2OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} R\text{-}CHO + H_2O$$

1° alcohol **aldehyde**

B) On oxidation of 2° alcohol ketone is obtained



Q.14 (A)

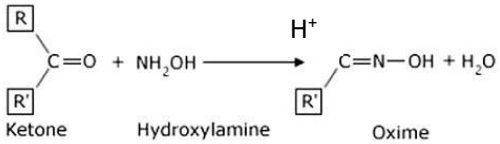


According to IUPAC the correct name of the given structure is 2-Chloro-4-methylpentanal

Q.15 (D) **Carbon is tetravalent.** It can form **four covalent bonds**. Since in aldehyde group carbon atom forms double bond with oxygen and **single bond** with hydrogen. So there is **one vacancy available** for making bond. That is why **aldehydes group** present **at the terminal carbon atom of carbon chain.** It **cannot** be placed **in the middle** of the carbon chain because in such condition carbon atom should **have two vacancies available** which is **not possible in this case.** Similarly **carboxylic acid group (–COOH)** is **always** present **at the terminal carbon** of the **carbon chain.**

Q.16 (A) **Aldehyde** only **acts** as **reducing agent** when **treated** with **mild oxidizing agents** such as **Fehling's solution, Benedict reagent and Tollen's reagent.**

Q.17 (B) **Aldehydes and ketones react** with **ammonia derivative** in acidic medium as shown in the reaction **e.g.**

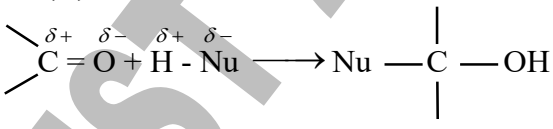


Q.18 (C) **Ketones** are **not easily oxidized** because the **carbonyl group** in ketones is **less polar** in nature. They show oxidative cleavage phenomenon rather than simple oxidation like aldehyde. That is why it **does not** react with mild **oxidizing agents** such as **Fehling's solution, Benedict reagent and Tollen's reagent.** It can only be oxidized in the presence of strong oxidizing agent such as **$K_2Cr_2O_7/H_2SO_4$, $KMnO_4/H_2SO_4$ and conc. HNO_3.**

Q.19 (B) **2-Pentanone** on oxidation in the presence of **strong oxidizing agent** is converted into **propanoic acid** and **ethanoic acid** as shown in the reaction. The oxidation of such ketone is in accordance to **Popoff's rule. This rule states that in the case of ketones, the carbonyl group remains with the smaller alkyl group during oxidation.**

$$CH_3 - CO - (CH_2)_2 - CH_3 + 3[O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3 - CH_2 - COOH + CH_3COOH$$

Q.20 (C)



Q.21 (C) It is incorrect answer. In fact, ketone group is present only in camphor and menthone but not in maltose.

Q.22 (C) A plastic Bakelite is formed by the polymerization of methanal with phenol**.**

Q.23 (B) Aldehydes and ketones show functional group isomerism e.g. Propanal (CH_3-CH_2-CHO) and propanone (CH_3-CO-CH_3) show functional group isomerism.

Q.24 (C) **<u>Benedict's solution test</u>: (An alkaline solution containing a cupric citrate complex ion) aliphatic aldehydes form a brick-red precipitate with Benedict's solution. To an aldehyde solution, add Benedict's solution and boil, a brick-red precipitate of cuprous oxide are formed.**

$$RCHO + 2Cu(OH)_2 + NaOH \longrightarrow RCOONa + Cu_2O + 3H_2O$$

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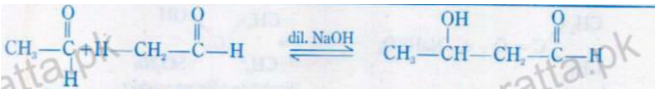
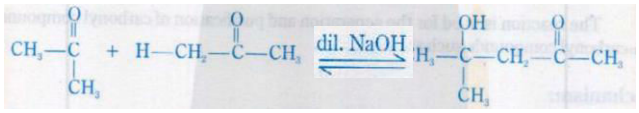
Q.25 (B) Aldol condensation reaction (Reversible reaction)



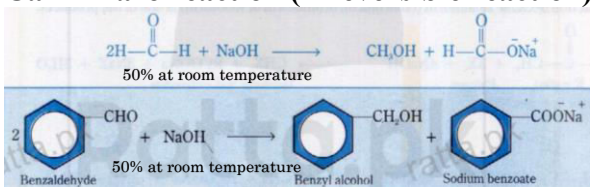
Ethanal Ethanal 3-Hydroxybutanal (aldol)

- **Dilute NaOH or $Ba(OH)_2$ can be used as a base.**



Propanone Propanone 4-Hydroxy-4-methyl-2-pentanone

Cannizzaro reaction (Irreversible reaction)



Q.26 (C)

Opt.	Formula	Name
A)	NH_2NH_2	Hydrazine
B)	$C_6H_5NHNH_2$	Phenylhydrazine
C)	$NH_2NHCONH_2$	Semicarbazide
D)	NH_2-OH	Hydroxylamine

Q.27 (D) It is incorrect statement. The correct statement is as follow:

Both alkyl groups in ketones are electron-donating groups and they decrease polarity in the carbonyl group.

Q.28 (A)

The structure of alcohol ($C_6H_5CHOHCH_3$) on oxidation with acidified $Na_2Cr_2O_7$ gives methyl phenyl ketone.

$$C_6H_5CHOHCH_3 + [O] \xrightarrow{Na_2Cr_2O_7/dil.H_2SO_4} C_6H_5-C(=O)-CH_3$$

Methyl phenyl ketone

- **Nascent oxygen [O] is produced during the reaction by treating $Na_2Cr_2O_7$ with dil. H_2SO_4 as shown in the reaction:**

$$Na_2Cr_2O_7 + 4H_2SO_4(dil.) \longrightarrow Na_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O]$$

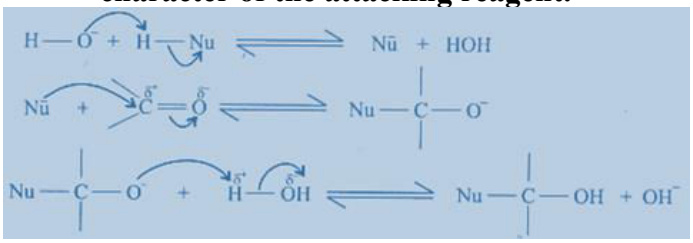
Q.29 (B) It is incorrect statement. The correct statement is as follow;

- **Methanal is manufactured by passing a mixture of methanol vapours and air over iron oxide-molybdenum oxide at 500°C as shown below:**

$$2CH_3OH + O_2 \xrightarrow[500^\circ C]{FeO, Mo_2O_3} 2HCHO + 2H_2O$$

Q.30 (A)

A base catalyzed reaction in carbonyl compounds increases nucleophilic character of the attacking reagent.



Mechanism of base-catalyzed nucleophilic addition reaction

Q.31 (A)

Aldol condensation is not successful with compounds having no α-hydrogen.

Q.32 (A)

Aldehydes are the oxidation product of p-alcohols.

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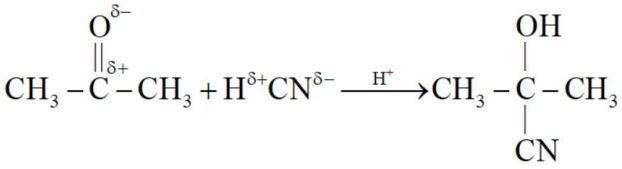
Q.33 (C)

Acetaldehyde can undergo aldol condensation reaction because it has α-hydrogen. While other do not undergo aldol condensation reaction because they do not have aα-hydrogen.

Q.34 (B)

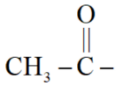
Propanone (a ketone) undergoes nucleophilic addition readily with HCN due to the presence of a partial positive charge on the carbon of the carbonyl. This electron deficient carbon suffers nucleophilic attack by CN^-.



Propene, being electron rich, CN^-. It readily suffers electrophilic attack instead.

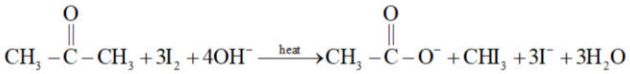
Q.35 (B)

Carbonyl compounds (aldehydes and ketones) give bright c ppt. with 2,4-DNPH.



Q.36 (A)

Propanone contains group. Hence, it gives a positive tri-iodomethane test as shown in the reaction.



Q.37 (B)

CH_3CH_2OH contains CH_3-CH-OH group.

CH_3CH_2OH is a primary alcohol

CH_3CH_2OH is not an aldehyde and hance is not oxidized by Fehiling's solution.

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