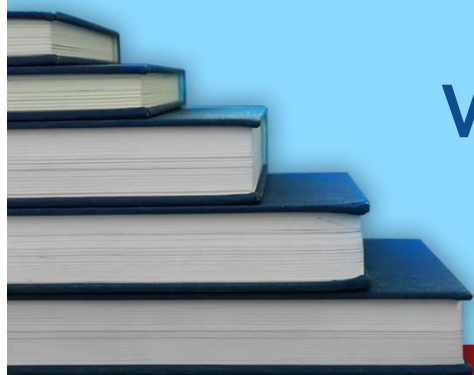


# CHEMISTRY



## WORKSHEET-3



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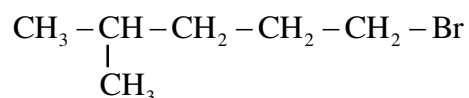
**Worksheet-3****(C. Organic Chemistry)****Alkyl Halides, Alcohols and Phenols**

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SCRATCH WORK

**Q.1** The type of alkyl halides in which halogen is attached with such C-atom which is further attached with two C-atoms are called?

- A) 1° alkyl halides                      C) 3° alkyl halides  
B) 2° alkyl halides                      D) 4° alkyl halides

**Q.2** Consider the following structure formula of alkyl halide:



The correct name according to IUPAC is:

- A) 1-Bromo-4-methylpentane  
B) 2-Methyl-5-bromopentane  
C) 2-Methyl-1-bromopentane  
D) 2-Methyl-2-bromopentane

**Q.3** Which of the following is the best method to prepare alkyl halides?

- A) Reaction of alcohol with HCl in the presence of catalyst  $\text{ZnCl}_2$   
B) Reaction of alcohol with  $\text{PCl}_5$   
C) Reaction of alcohol with  $\text{PCl}_3$   
D) Reaction of alcohol with  $\text{SOCl}_2$  in the presence of pyridine solvent

**Q.4** Which of the following alkyl halides cannot be prepared by the direct halogenation of alkanes?

- A)  $\text{R} - \text{Cl}$                                   C)  $\text{R} - \text{I}$   
B)  $\text{R} - \text{Br}$                                   D)  $\text{R} - \text{F}$

**Q.5** Which of the following is good leaving group?

- A)  $\text{NH}_2^-$                                       C)  $\text{OR}^-$   
B)  $\text{HSO}_4^-$                                     D)  $\text{OH}^-$

**Q.6** Which of the following statements is not correct for  $S_N2$  mechanism reaction?

- A) It is bimolecular, 2<sup>nd</sup> order reaction
- B) Order of ease of  $S_N2$  mechanism in alkyl halide is 1° alkyl halide > 2° alkyl halide > 3° alkyl halide
- C) It takes place in the presence of polar solvent
- D) It involves 100% inversion in the products

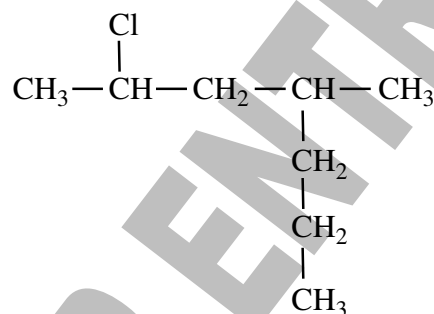
**Q.7** Mark the incorrect statement about alkyl halide:

- A) Boiling points of haloalkanes are greater than that of alkanes
- B) Order of decreasing boiling points in alkyl halides is  $R-I > R-Br > R-Cl > R-F$
- C) Alkyl halides are soluble in water
- D) Primary alkyl halides can be prepared by reaction of  $PCl_5$  or  $SOCl_2$  with alcohols but not aryl halide

**Q.8** Which of the following halide ion ( $X^-$ ) is good nucleophile and good leaving group?

- A)  $I^-$
- B)  $Cl^-$
- C)  $F^-$
- D)  $Br^-$

**Q.9** Which one of the following is the correct name according to IUPAC system for the formula given below?



- A) 4-Methyl-6-chloroheptane
- B) 2-Chloro-4-methylheptane
- C) 2-Chloro-4-n propylhexane
- D) 2-Chloro-4-n propylpentane

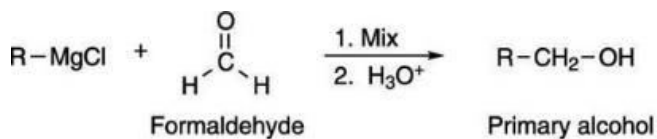
**Q.10**  $CCl_4$  has all of the following characteristic features EXCEPT:

- A) It is colourless liquid
- B) It is used as industrial solvent
- C) It is insoluble in water and soluble in alcohol for fat, oil etc
- D) It is inflammable

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**Q.11** Considered the following reaction of Grignard reagent with methanal (a carbonyl compound) followed by hydrolysis:



The mechanism of reaction before hydrolysis is:

- A) Electrophilic addition reaction  
 B)  $\beta$ -elimination  
 C) Nucleophilic addition reaction  
 D) Nucleophilic substitution reaction
- Q.12** Which of the following product is obtained by the reaction of Grignard reagent with ketone followed by hydrolysis?

- A) 1° alcohol  
 B) 2° alcohol  
 C) 3° alcohol  
 D) Both B and C

**Q.13** Which of the following type of alcohols is the most reactive when bond is to be broken between carbon and oxygen atoms?

- A) R - OH  
 B)  $\begin{array}{c} \text{R} \\ | \\ \text{R}-\text{C}-\text{OH} \\ | \\ \text{R} \end{array}$   
 C) R - CH<sub>2</sub> - OH  
 D)  $\begin{array}{c} \text{R} \\ | \\ \text{R}-\text{C}, \text{CH}-\text{OH} \end{array}$

**Q.14** Alkyl halides are considered to be very reactive compounds towards nucleophiles because:

- A) They have an electrophilic carbon  
 B) They have an electrophilic carbon and a good leaving group  
 C) They have an electrophilic carbon and bad leaving group  
 D) They have a nucleophilic carbon and a good leaving group

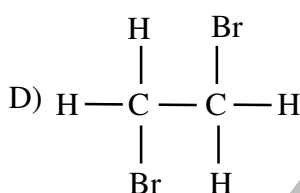
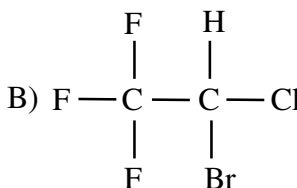
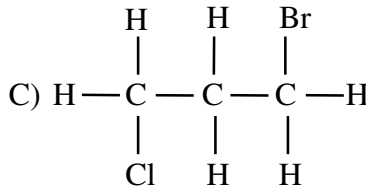
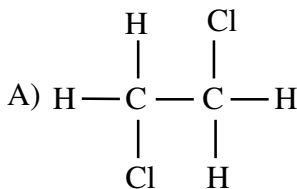
**Q.15** Which of the following tests helps us to distinguish between methanol and ethanol?

SCRATCH WORK

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SCRATCH WORK

- A) Lucas test  
 B) Iodoform test  
 C) Tollen's test  
 D) Baeyer's test

**Q.16 Which one of the followings is Halothane?**



**Q.17 Which of the following is the weakest acid?**

- A) Carboxylic acid  
 B) Ethanol  
 C) Phenol  
 D) Ethyne

**Q.18 All of the following statements about phenol and ethanol are correctly matched EXCEPT:**

Options	Properties	Phenol	Ethanol
A)	Bromination (Br <sub>2</sub> /H <sub>2</sub> O)	White ppt of 2,4,6-Tribromo phenol	No reaction
B)	H <sub>2</sub> /Ni	No reaction	No reaction
C)	Action of organic acid	No reaction	Formation of ester
D)	Iodoform test	No reaction	Yellow ppt of CHI <sub>3</sub>

**Q.19 Which of the following raw material is/are used to prepare ethyl alcohol?**

- A) Starch only  
 B) Molasses only  
 C) Both A and B  
 D) Neither A nor B

**Q.20 Which of the following drying agent is used to get absolute alcohol from rectified spirit?**

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- A) Conc.  $\text{H}_2\text{SO}_4$                       C)  $\text{Al}_2\text{O}_3$   
B)  $\text{CaO}$                                       D)  $\text{H}_3\text{PO}_4$

**Q.21 Identify the incorrect statement about the use of chloroform:**

- A) It is used as an anesthetic substance  
B) It is used as a solvent for fats waxes and resins  
C) It is used in manufacturing freons  
D) It is used as preservative for anatomical specimen

**Q.22 All of the following are characteristic features of Teflon plastic EXCEPT:**

- A) It is valuable plastic which resists the action of acid and alkali  
B) It is used as coating the electrical wiring  
C) It is used as a non-stick coating for cooking pans  
D) It reacts with oxidants

**Q.23 The phenoxide is more stable than ethoxide ion as:**

- A) Lone pair on oxygen atom overlaps with the delocalized  $\pi$ -bonding system in benzene  
B) Oxygen atom is directly bonded with benzene ring in phenoxide ion  
C) The negative charge is localized on oxygen atom of phenoxide ion  
D) The negative charge is delocalized on oxygen atom of ethoxide ion

**Q.24 Which of the following is the most dangerous factor which damages ozone?**

- A) Aerosol spray  
B) Use of chlorofluorocarbons  
C) Effect of  $\text{SO}_2$  and  $\text{NO}_2$  pollutant  
D) Global warming by  $\text{CO}_2$

**Q.25 Grignard reagent is reactive due to:**

- A) The presence of halogen atom  
B) The polarity of C – Mg bond  
C) The presence of Mg atom  
D) The polarity of C – X bond

**Q.26 In which of the following reactions alcohol is produced?**

- A) Reaction of alkyl halide with aqueous KOH  
B) Reaction of alkyl halide with alcoholic KOH  
C) Reaction of alkyl halide with KCN followed by acidic

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SCRATCH WORK**

hydrolysis

D) Reactions of alkyl halide with sodium alkoxide

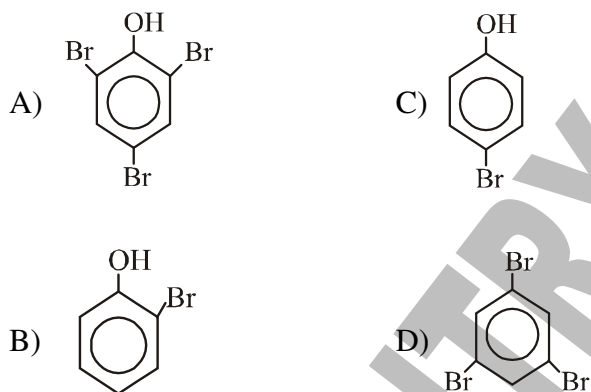
**Q.27** The type of monohydric alcohols in which –OH group is attached with such carbon atom which is further attached with three carbon atoms and no hydrogen atom is called:

- A) 1° alcohols                      C) 3° alcohols  
B) 2° alcohols                      D) Absolute alcohol

**Q.28** Which of the following types of alcohols on oxidation with acidified potassium dichromate gives aldehydes?

- A) 1° alcohols                      C) 3° alcohols  
B) 2° alcohols                      D) Neo alcohol

**Q.29** Aqueous phenol decolorizes bromine water to form white ppt. What is the structure of white ppt formed?



**Q.30** When phenol is treated with concentrated nitric acid at high temperature, which of the following product is obtained?

- A) o-nitrophenol                      C) m-nitrophenol  
B) p-nitrophenol                      D) 2,4,6-trinitrophenol

**Q.31** Which of the following reactions shows that phenol acts as an acid?

- A) Reaction with conc. nitric acid  
B) Reaction with bromine  
C) Reaction with NaOH  
D) Reaction with H<sub>2</sub>

**Q.32** Which of the following is the strongest acid?

- A) Carboxyl acid                      C) Water

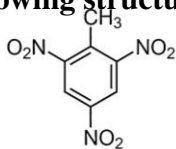
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B) Phenol

D) Alcohol

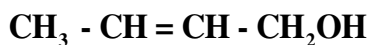
Q.33 Considered the following structure:



The correct name according to IUPAC of the above structure is:

- A) 2,4,6-Trinitrotoulene      C) 2,3,4-Trinitrotoulene  
B) 1,3,5-Trinitrotoulene      D) 1,2,3-Trinitrotoulene

Q.34 Considered the following structure of alcohol:



The correct name according to IUPAC of the above structure is:

- A) 1-Butene-2-ol      C) 2-Butene-1-ol  
B) 2-Butene-4-ol      D) 1-Butene-4-ol

Q.35 Which of the following type of alcohols is prepared by the reduction of aldehydes?

- A) 2° alcohols      C) 3° alcohols  
B) 1° alcohols      D) Both B and C

Q.36 Which of the following methods is used to prepare ethers?

- A) Williamson's synthesis  
B) Kolbe's electrolytic method  
C) Strecker synthesis  
D) Wolf Kishner's reduction reaction

Q.37 Which of the following reactions is / are possible with phenol?

- A) Reaction with sodium metal only  
B) Oxidation of phenol only  
C) Both A and B  
D) Neither A nor B

**USE THIS SPACE FOR  
SCRATCH WORK**



**Q.38** Different methods are given to prepare phenol:

- I. By the reaction of sodium salt of benzene sulphonic acid with NaOH at 320°C followed by reaction with HCl
- II. By the reaction of Chlorobenzene with 10% NaOH at 360°C and 150 atmospheric pressure
- III. Oxidation of cumene
- IV. Hydrolysis of diazonium salt

Which of the above methods is known as Dow's process?

- A) II only  
B) I only  
C) II and III  
D) I and II

**Q.39** Which of the following reactions involves cleavage of O – H bond in alcohol?

- A)  $C_2H_5OH + SOCl_2 \xrightarrow{\text{Pyridine}} C_2H_5Cl + SO_2 + HCl$
- B)  $C_2H_5OH + CH_3COOH \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H + H_2O$
- C)  $C_2H_5OH + HCl \xrightarrow{ZnCl_2} C_2H_5Cl + H_2O$
- D)  $C_2H_5OH + HNH_2 \xrightarrow{ThO_2} C_2H_5NH_2 + H_2O$

**Q.40** Oxidative cleavage of 1,2-diol with periodic acid results in the formation of:

- A) Two molecules of carbonyls  
B) Two molecules of carboxylic acids  
C) Two molecules of alcohols  
D) Two molecules of ethers

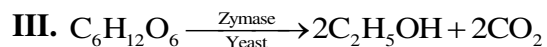
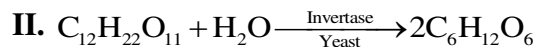
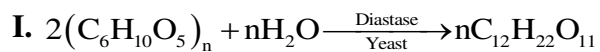
**Q.41** Which of the following enzymes is involved in the conversion of sugar (molasses) into glucose and fructose?

- A) Diastase  
B) Invertase  
C) Maltose  
D) Zymase

**Q.42** A biochemical process in which large molecules are broken down into smaller molecules in the presence of enzymes secreted by microorganism is called?

- A) Fermentation  
B) Cracking  
C) Polymerization  
D) Reforming

**Q.43** Consider the following steps involved in the preparation of ethanol from starch by fermentation process.



Which of the above statement is incorrect in the preparation of ethanol from starch by fermentation process?

A) 1 only

C) II and III

B) II only

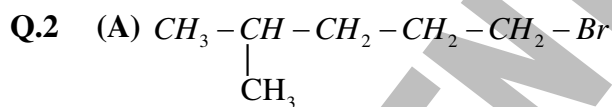
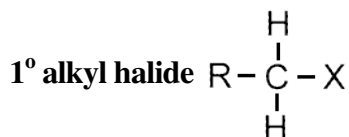
D) I, II and III

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## ANSWER KEY (Worksheet-03)

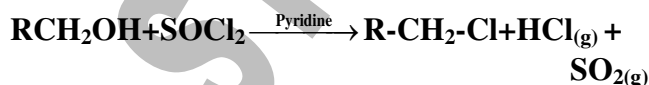
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2	A	13	B	24	B	35	B
3	D	14	B	25	B	36	A
4	C	15	B	26	A	37	C
5	B	16	B	27	C	38	A
6	C	17	D	28	A	39	B
7	C	18	B	29	A	40	A
8	A	19	C	30	D	41	B
9	B	20	B	31	C	42	A
10	D	21	C	32	A	43	B
11	C	22	D	33	A		

## ANSWERS EXPLAINED



According to IUPAC the correct name of the given structure is **1-Bromo-4-methylpentane**.

Q.3 (D) This is the best method to prepare **alkyl halides** because the side products in this reaction are in the gaseous state



Q.4 (C) Order of reactivity of halogens with alkane is as follow  $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$ . This order shows that  $\text{I}_2$  is least reactive and it does not react with

alkane to form alkyl halide. It is clear that  $\text{R-I}$  cannot be prepared from alkane.

Q.5 (B)

Good Leaving Group	Poor Leaving Group
$\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ and $\text{HSO}_4^-$	$\text{OH}^-$ , $\text{OR}^-$ and $\text{NH}_2^-$
Less polar	More polar
Low bond energy	Greater bond energy
Give fast reaction	Give slow reaction

Q.6 (C)  $\text{S}_{\text{N}}2$  mechanism reaction takes place in the presence of **non-polar solvent** such as n-hexane not in the presence of polar solvent (e.g.  $\text{H}_2\text{O}$ ).

Q.7 (C) Alkyl halides are soluble in **non-polar solvent**.

Q.8 (A) Leaving group ability can be explained on the basis of strength of the **C-X bond**. The **C-I bond** is the **weakest bond** hence iodide is the **best leaving group**.

- Increasing order of the leaving groups:  
 $\text{F}^- < \text{Cl}^- < \text{Br}^- < \text{I}^- \dots\dots\text{i}$

The greater the electronegativity, the more stable the halide ion (since electrons are tightly held).

- Increasing order of the nucleophiles  
 $\text{F}^- < \text{Cl}^- < \text{Br}^- < \text{I}^- \dots\dots\text{ii}$
- Since iodine is the least electronegative, it is the **least stable halide hence the strongest nucleophile**.
- Another important factor would be **Hard-Soft concept**. Alkyl halides are soft electrophiles so the substitution is favored by soft nucleophiles. The **softness of the nucleophiles increases down the group** i.e.  $\text{F}^- < \text{Cl}^- < \text{Br}^- < \text{I}^-$
- Other (B, C and D) are weak nucleophile and poor leaving group

- The relative rate at which a nucleophile (Nu:) reacts to displace (substitute for) a leaving group is called 'nucleophilicity'. Consider the following nucleophilic substitution reactions:
- $\text{CH}_3\text{OH} + \text{HI} \rightarrow \text{CH}_3\text{I} + \text{HOH}$
- $\text{CH}_3\text{OH} + \text{HCl} \rightarrow \text{CH}_3\text{Cl} + \text{HOH}$
- The first reaction is much faster than the second because  $\text{I}^-$  is a much better Nu: than  $\text{Cl}^-$ . The leaving group (HOH) was the same in both cases. The nucleophilicity (relative reactivity) of various Nu: is listed in the following table ...

Reactivity	Nu:	Relative Reactivity
very weak	$\text{HSO}_4^-$ , $\text{H}_2\text{PO}_4^-$ , $\text{RCOOH}$	< 0.01
weak	ROH	1
	HOH, $\text{NO}_3^-$	100
fair	$\text{F}^-$	500
	$\text{Cl}^-$ , $\text{RCOO}^-$	$20 \times 10^3$
	$\text{NH}_3$ , $\text{CH}_3\text{SCH}_3$	$\sim 300 \times 10^3$
good	$\text{N}_3^-$ , $\text{Br}^-$	$\sim 600 \times 10^3$
	$\text{OH}^-$ , $\text{CH}_3\text{O}^-$	$2 \times 10^6$
very good	$\text{CN}^-$ , $\text{HS}^-$ , $\text{RS}^-$ , $(\text{CH}_3)_3\text{P}^-$ , $\text{I}^-$ , $\text{H}^-$	$> 100 \times 10^6$

- Note that Nu: are electron donors as are Lewis bases and reducing agents. Nu: are either uncharged (with non-bonded electrons) or they are anions, but they are never cations. Nu: are basic, neutral, or sometimes weakly acidic, but not strongly acidic. Strong acids ( $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ) and Lewis acids ( $\text{AlCl}_3$ ,  $\text{SnCl}_2$ ) are electrophiles ( $\text{E}^{+}$ s), i.e., electron acceptors as are oxidizing agents.
- Within any given row of the periodic table, nucleophilicity decreases from left to right as polarizability decreases

(because electronegativity of the central atom is increasing).

$\text{CH}_3^-$	>	$\text{NH}_2^-$	>	$\text{OH}^-$	>	$\text{F}^-$
	>	$\text{NH}_3$	>	$\text{OH}_2$	>	HF
		$\text{PH}_2^-$	>	$\text{SH}^-$	>	$\text{Cl}^-$
		$\text{PH}_3$	>	$\text{SH}_2$	>	HCl

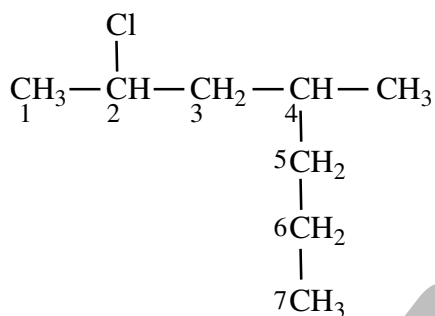
- For nucleophiles with the same attacking atom, the anion is more nucleophilic than the neutral compound.
- $\text{Cl}^- > \text{HCl}$      $\text{OH}^- > \text{HOH}$      $\text{RO}^- > \text{ROH}$   
 $\text{NH}_2^- > \text{NH}_3$      $\text{CH}_3\text{CO}_2^- > \text{CH}_3\text{CO}_2\text{H}$   
 $\text{CN}^- > \text{HCN}$
- Nucleophilicity increases down any column of the periodic table; as the polarizability of atoms increases ...

$\text{NH}_2^-$	$\text{OH}^-$	$\text{F}^-$
$\text{H}_2\text{P}^-$	$\text{HS}^-$	$\text{Cl}^-$
$\text{H}_2\text{As}^-$	$\text{HSe}^-$	$\text{Br}^-$
$\text{H}_2\text{Sb}^-$	$\text{HTe}^-$	$\text{I}^-$

- Note the similarities and differences of nucleophiles and bases.
- Nu:-s and bases are both electron donors
- Basicity deals with equilibrium position (Keq). At equilibrium, a stronger base holds a greater proportion of  $\text{H}^+$ . Nucleophilicity deals with kinetics. A stronger Nu:- attacks faster than a weaker one.
- Basicity deals with interaction with  $\text{H}^+$  while nucleophilicity is broader and also deals with interaction with other atoms, especially, but not only C atom.
- Polarizability of Nucleophiles:
- A polarizable nucleophile, e.g.,  $\text{I}^-$ , is large and soft ('teddy bear-like') because its valence (donor) electrons are far from the nucleus (in the 5th period). The electron cloud is readily distorted during bond making and breaking which reduces the energy maximum in the transition state and thus speeds up reactions.

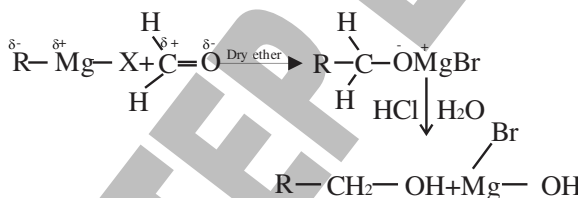
- A non-polarizable nucleophile, e.g., F<sup>-</sup> is small and hard ("golf ball-like"). Its outer valence electrons are close to the nucleus (in the 2nd period) and tightly held. F<sup>-</sup> forms strong bonds but its electron cloud is not easily distorted during bond formation and breaking so its transition state is at high energy (slow reaction) state.
- It is generally true that good nucleophiles are also good leaving groups for the same reasons.

**Q.9 (B)** The correct name according to IUPAC of the given structure is **2-Chloro-4-methylheptane**.



**Q.10 (D)** CCl<sub>4</sub> is **non-polar** and is **non-flammable**.

**Q.11 (C)** Mechanism of reaction in the formation of intermediate product **before** hydrolysis is **nucleophilic addition** reaction as shown below. Others A, B, and D are not related.



**Q.12 (C)**

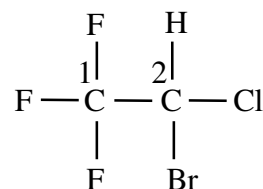
- A **3° alcohol** is formed when **ketone** is treated with **Grignard reagent** followed by acid hydrolysis.
- A **1° alcohol** is formed when **formaldehyde (methanal)** is treated with **Grignard reagent** followed by acid hydrolysis
- A **2° alcohol** is formed when **aldehyde (other than formaldehyde)** treated with Grignard reagent followed by acid hydrolysis.

**Q.13 (B)** A **3° alcohol** is more reactive because **3° carbocation** is more stable than others.

**Q.14 (B)** In alkyl halides the **α-carbon** is electrophilic in character. When nucleophile attacks the **α-carbon**, then halogen atom acts as a leaving group.

**Q.15 (B)** Iodoform test (I<sub>2</sub> + NaOH) helps us to distinguish between ethanol and methanol. When ethanol is treated with I<sub>2</sub> in the presence of NaOH yellow crystal of iodoform (CHI<sub>3</sub>) are obtained while methanol **does not** give this test as shown in the reaction (C<sub>2</sub>H<sub>5</sub>OH + 4I<sub>2</sub> + 6NaOH → CHI<sub>3</sub> + HCOONa + 5NaI + 5H<sub>2</sub>O).

**Q.16 (B)** The structure of haloethane is given below:



**2-Bromo-2-Chloro-1,1,1-trifluoroethane**

**Q.17 (D)** From the  $K_a$  value as shown in the table, it is clear that ethyne is a weaker acid because its  $K_a$  value is smaller.

Name of compound	$K_a$ (mol dm <sup>-3</sup> )
Carboxylic acid e.g. (CH <sub>3</sub> COOH)	$1.7 \times 10^{-5}$
Phenol	$1.3 \times 10^{-10}$
Water	$10^{-16}$
Ethyne	$10^{-20}$

**Q.18 (B)** In fact by hydrogenation of phenol, cyclohexanol is formed but ethanol does not react with hydrogen in the presence of Ni.

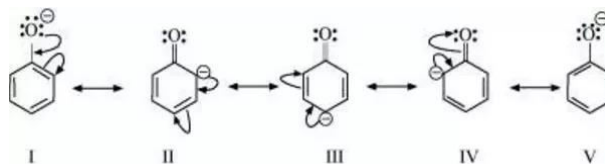
**Q.19 (C)** Ethyl alcohol is obtained by fermentation from both starch and molasses.

**Q.20 (B)** Absolute alcohol (almost 100% pure) can be obtained by redistillation of rectified spirit in the presence of CaO which absorbs its moisture.

**Q.21 (C)** A, B and D are the uses of chloroform except C.

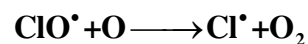
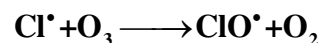
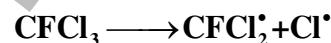
**Q.22 (D)** Teflon plastic not only reacts with acid and alkali but also it reacts with oxidant.

**Q.23 (A)** Phenol is much more acidic than alcohol but less acidic than carboxylic acid. The reason why phenol is acidic lies in the nature of the phenoxide ion. The negative charge on oxygen atom can become involved with the  $\pi$ -electron cloud on the benzene ring. The negative charge is thus delocalized in the ring and the phenoxide ion becomes relatively stable. Delocalization of negative charge in the ring of phenoxide is shown below:



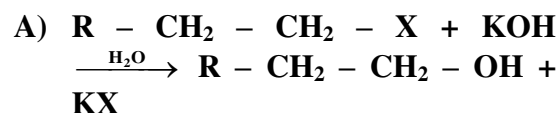
This step of delocalization is not possible with alcohols.

**Q.24 (B)** Use of chlorofluorocarbons is the most dangerous for ozone layer. Chlorofluorocarbons used as refrigerants in air conditioning and in aerosol sprays are inert in the troposphere but slowly diffuse into stratosphere, where they are subjected to ultraviolet radiation generating  $Cl^\bullet$  free radicals. Chlorofluorocarbons (CFCs) play an effective role in removing  $O_3$  in the stratosphere due to following reactions.



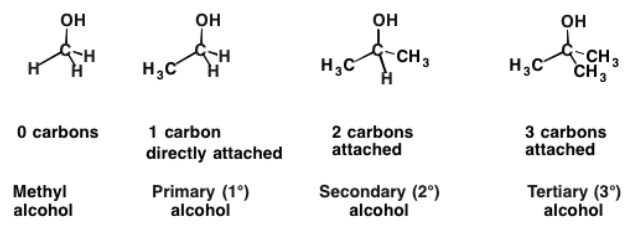
**Q.25 (B)** The greater reactivity of Grignard's reagent is due to the polarity of  $\alpha$ -carbon and Mg bond (the electronegativity of C = 2.5, Mg = 1.2 and the difference is 1.3 so C - Mg bond is polar). The  $\alpha$ -carbon develops the partial negative charge and acts as nucleophilic centre  $R^{\delta-} - Mg^{\delta+} - X$ .

**Q.26 (A)** As a reaction of alkyl halide with aqueous KOH, alcohol is formed as shown in the reactions:



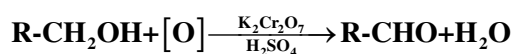
**Q.27 (C)** Structure of primary secondary and tertiary alcohols are shown below:





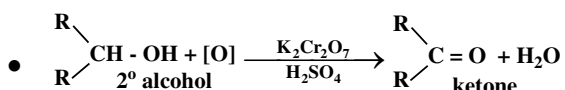
**Q.28 (A) Detail of the other reactions are given below**

A) On oxidation of a 1° alcohol aldehyde is obtained

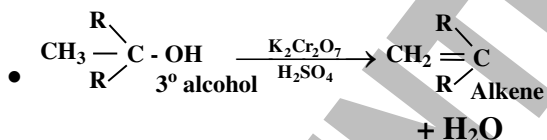


1° alcohol aldehyde

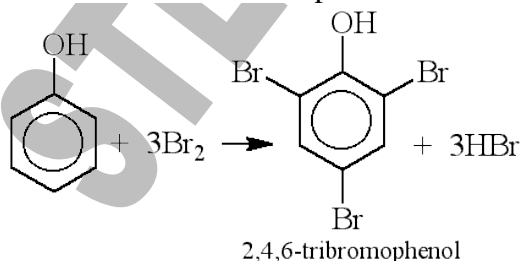
B) On oxidation of a 2° alcohol ketone is obtained



C) A 3° alcohols are resistant to oxidation. In the presence of acid dichromate they undergo elimination reactions to give alkenes

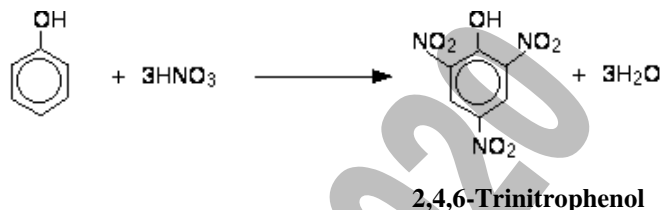


**Q.29 (A)** If **bromine** water is added to a solution of **phenol** in water, the **bromine** water is decolourised and a white precipitate is formed which smells of antiseptic. Notice the multiple substitution around the ring into all the activated positions.

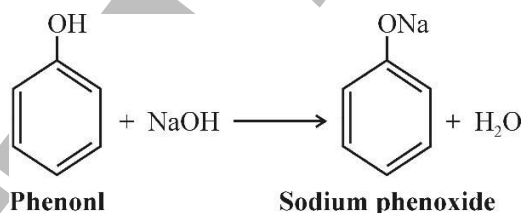


**Q.30 (D)** When phenol is treated with concentrated nitric acid at high

temperature in the presence of conc. sulphuric acid, 2,4,6-trinitrophenol is obtained as shown in the reaction:



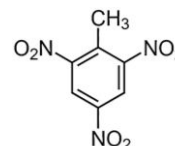
**Q.31 (C)** Reaction of phenol with alkali (NaOH) results in the formation of salt which show that it is acid base reaction



**Q.32 (A)** Relative acidic strength of alcohol, phenol, water and carboxylic acid is as follows.

Carboxylic acid > Phenol > Water > Alcohol

**Q.33 (A)** The correct name according to IUPAC of the given structure is 2,4,6-Tribnitrotoulene (TNT). It is an explosive material.

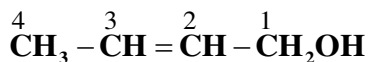


**Trinitrotoluene (TNT)**, or more specifically **2,4,6-trinitrotoluene**, is a chemical compound with the formula  $\text{C}_6\text{H}_2(\text{NO}_2)_3\text{CH}_3$ . This yellow solid is sometimes used as a reagent in chemical synthesis, but it is best known as an explosive material with convenient handling properties. The explosive yield of TNT is considered to be the standard measure of bombs and other explosives. In chemistry,

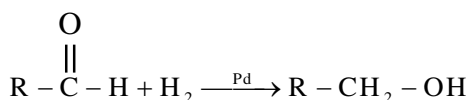


TNT is used to generate charge transfer salts.

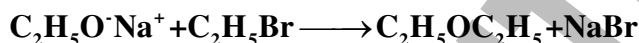
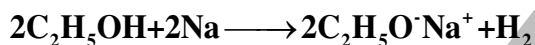
Q.34 (C) The correct name according to IUPAC of the given structure is 2-buten-1-ol.



Q.35 (B) 1° alcohol is prepared by the reduction of aldehyde as shown in the reaction.

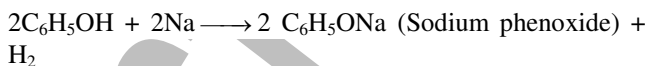


Q.36 (A) An alcohol is treated with metallic sodium to form alkoxides. This alkoxide ion is a strong nucleophile and readily reacts with alkyl halide to produce an ether. e.g.



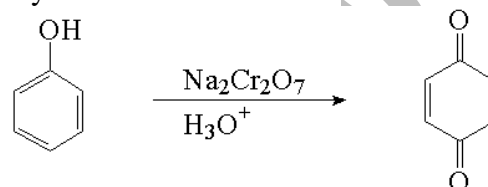
Ethoxy ethane  
(Diethyl ether)

Q.37 (C) (1) Reaction with sodium metal: Phenols react with highly electropositive alkali metals such as sodium, potassium etc to yield corresponding phenoxides and hydrogen as shown in the reaction.



(2) Oxidation of phenol: Phenols are rather easily oxidized despite the absence of a hydrogen atom on the hydroxyl bearing carbon. Among the colored products from the oxidation of phenol by chromic

acid is the dicarbonyl compound para-benzoquinone (also known as 1,4-benzoquinone or simply quinone); an ortho isomer is also known. Oxidation of phenol is shown by the reaction as follow:



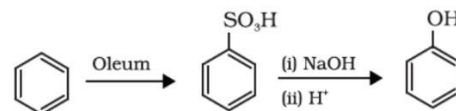
1,4-benzoquinone

Q.38 (A) Detail of all the reactions are given below:

I. By the reaction of sodium salt of benzene sulphonic acid with NaOH at 320°C followed by reaction with HCl.

From sodium salt of Benzene sulphonic acid:

In this process, benzene sulfonic acid is reacted with aqueous sodium hydroxide. The resulting salt is mixed with solid sodium hydroxide and fused at a high temperature. The product of this reaction is sodium phenoxide, which is acidified with aqueous acid to yield phenol.

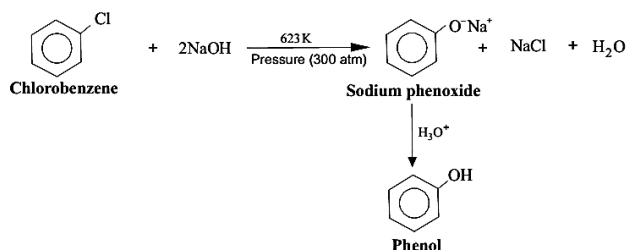


II. By the reaction of Chlorobenzene with 10% NaOH at 360°C and 150 atmospheric pressure.

Dow's Process:

Hydrolysis of chlorobenzene (the Dow's process) Benzene is easily converted to chlorobenzene by a variety of methods, one of which is the Dow's process. Chlorobenzene is hydrolyzed by a strong base at high

temperatures to give a phenoxide salt, which is acidified to phenol.

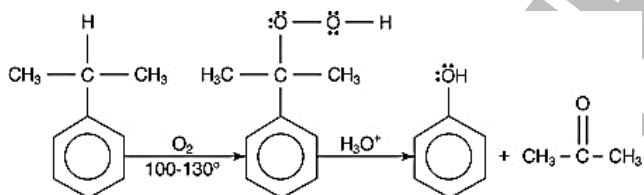


### III. Oxidation of cumene

#### Oxidation of Cumene:

**Air oxidation of cumene.** The air oxidation of cumene (isopropyl benzene) leads to the production of both phenol and acetone, as shown in the following figure. The mechanisms for the formation and degradation

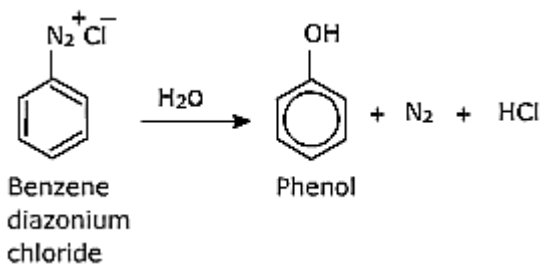
of cumene hydroperoxide require closer looks, which are provided following the figure.



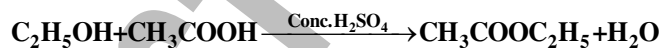
### IV. Hydrolysis of diazonium salt

#### Hydrolysis of Diazonium salt:

Phenol is dissolved in sodium hydroxide solution to give a solution of sodium phenoxide. The solution is cooled in ice, and cold benzenediazonium chloride solution is added. There is a reaction between the diazonium ion and the phenoxide ion and a yellow-orange solution or precipitate is formed.

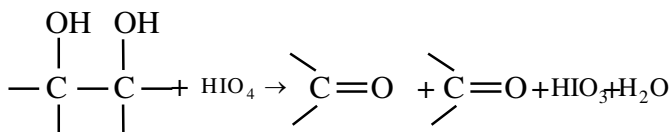


**Q.39 (B) Reaction of alcohol with carboxylic acid in the presence of conc. H<sub>2</sub>SO<sub>4</sub> (dehydrating agent) ester is formed. This reaction involves O – H bond cleavage in alcohol as shown in the reaction.**



**Q.40 (A) Oxidative cleavage of 1,2-diol with periodic acid results in the formation of two molecules of carbonyls as shown in the reaction.**

- 1,2- or vicinal diols are cleaved by periodic acid, HIO<sub>4</sub>, into two carbonyl compounds.
- The reaction is selective for 1,2-diols.
- The reaction occurs via the formation of a cyclic periodate ester.
- This can be used as a functional group test for 1,2-diols.
- The products are determined by the substituents on the diol.



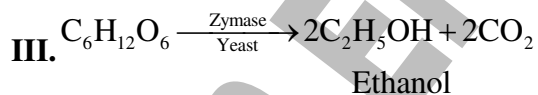
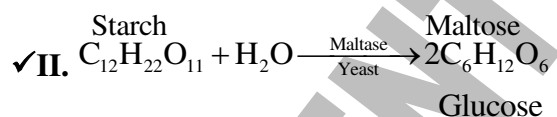
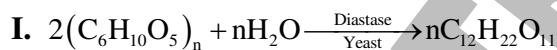
**Q.41 (B) Invertase enzymes is used in the conversion of sugar (molasses) into glucose and fructose as shown in the reaction**

- Molasses is the mother liquor left after crystallization of cane sugar from concentrated juice.
- It is dark coloured thick syrupy mass.
- Molasses contains 60% fermentable sugars mostly sucrose, glucose and fructose.
- The fermented liquor contains 8 – 10% ethanol



**Q.42 (A)** A biochemical process in which large molecules are broken down into smaller molecules in the presence of enzymes secreted by microorganism is called?

**Q.43 (B)** It is incorrect statement. The correct statement is as follow:



# STOP

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