CHEMISTRY

WORKSHEET-4

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-4

(C. Organic Chemistry)

Alcohols and Phenols

USE THIS SPACE FOR SCRATCH WORK

Q.1 Which of the following product is obtained by the reaction of Grignard reagent with ketone followed by hydrolysis?

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

Q.2 Which of the following tests helps us to distinguish between methanol and ethanol?

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

Q.3 Which of the following is the weakest acid?

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

Q.4 All of the following statements about phenol and ethanol are correctly matched EXCEPT:

Opt.	Properties	Phenol	Ethanol
A)	Bromination (Br_2/H_2O)	White ppt of 2,4,6-Tribromo phenol	No reaction
B)	H_2/Ni	No reaction	No reaction
C)	Action of organic acid	No reaction	Formation of ester
D)	Iodoform test	No reaction	Yellow ppt of CHI_3

Q.5 In which of the following reaction ethene is formed:

A) $CH_3 - CH_2 - OH + Na \longrightarrow$

B) $CH_3 - CH_2 - OH + SOCl_2 \longrightarrow$

C) $CH_3 - CH_2 - OH + conc.H_2SO_4/180^\circ C \longrightarrow$

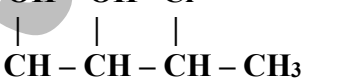
D) $CH_3 - CH_2 - OH + PCl_5 \longrightarrow$

Q.6 Identify X, Y and Z in the following reaction sequence:

$$CH_3 - CH_2 \xrightarrow{HI} (X) \xrightarrow{aq.KOH} (Y) \xrightarrow[NaOH]{I_2} (Z)$$

A) Iodoethane, ethanol, iodoform
B) Ethanol, iodoform, iodoethane
C) Iodoform, iodoethane, ethanol
D) Iodoethane, iodoform, ethanol

Q.7 Which one of the following is the correct name according to IUPAC system for the formula given below?



A) 4-Chloro-2,3-pentadiol C) 3-Chloro-2,3-pentadiol
B) 4-Chloro-3,4-pentadiol D) 3-Chloro-2,4-pentadiol

Q.8 Which of the following drying agent is used to get absolute alcohol from rectified spirit?

A) Conc. H_2SO_4 C) Al_2O_3

B) CaO D) H_3PO_4

Q.9 The phenoxide is more stable than ethoxide ion as:

A) Lone pair on oxygen atom overlaps with the delocalized π-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.10 The type of monohydric alcohols in which –OH group is attached with such carbon atom which is further attached with one carbon atoms and two hydrogen atoms is called:

A) 1° alcohols C) 3° alcohols

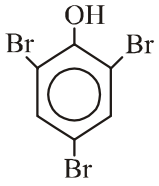
B) 2° alcohols D) Absolute alcohol

Q.11 Which of the following types of alcohols on oxidation with acidified potassium dichromate gives aldehydes?

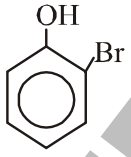
A) 1° alcohols C) 3° alcohols

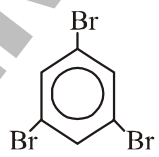
B) 2° alcohols D) Neo alcohol

Q.12 Aqueous phenol decolorizes bromine water to form white ppt. What is the structure of white ppt formed?

A) 

C) 

B) 

D) 

Q.13 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.14 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_2

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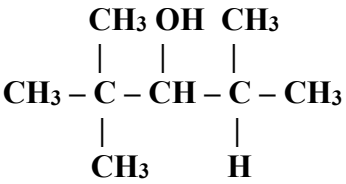
Q.15 Identify X, Y and Z in the following reaction sequence:

$$CH_3CH_2CH_2OH \xrightarrow[170^\circ C]{H_2SO_4} (X) \xrightarrow{HBr} (Y) \xrightarrow{aq.KOH} (Z)$$

A) Propene, isopropyl bromide, isopropyl alcohol
B) Isopropyl alcohol, isopropyl bromide, propene
C) Isopropyl alcohol, propene, isopropyl bromide
D) Isopropyl bromide, propene isopropyl alcohol

Q.16 Which one of the following is the correct name according to IUPAC system for the formula given below?

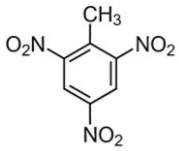


A) 2,2,4-Trimethylpent-3-ol C) 2,2,4-Trimethylpent-2-ol
B) 2,3,4-Trimethylpent-3-ol D) 2,3,5-Trimethylpent-3-ol

Q.17 Which of the following is the strongest acid?

A) Carboxyl acid C) Water
B) Phenol D) Alcohol

Q.18 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.19 Considered the following structure of alcohol:

$$CH_3 - CH = CH - CH_2OH$$

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

A) 2^o alcohols C) 3^o alcohols
B) 1^o alcohols D) Both B and C

Q.21 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

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Q.22 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

Q.23 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.24 Identify X, Y and Z in the following reaction sequence:

$$CH_3CH_2OH \xrightarrow{P/I_2} (X) \xrightarrow{Mg} (Y) \xrightarrow[H_2O/H^+]{HCHO} (Z)$$

A) Ethene, ethylmagnesium iodide, n-propyl alcohol
B) Ethylmagnesium iodide, ethane, n-propyl alcohol
C) n-Propyl alcohol, ethylmagnesium iodide, ethane
D) Ethylmagnesium iodide, n-propyl alcohol, ethene

Q.25 Which of the following reactions involves cleavage of O – H bond in alcohol?

A) $C_2H_5OH + SOCl_2 \xrightarrow{Pyridine} C_2H_5Cl + SO_2 + HCl$

B) $C_2H_5OH + CH_3COOH \xrightarrow{Conc.\ H_2SO_4} CH_3COOC_2H + H_2O$

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.26 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.27 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.28 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.29 Consider the following steps involved in the preparation of ethanol from starch by fermentation process.

I. $2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[Yeast]{Diastase} nC_{12}H_{22}O_{11}$

II. $C_{12}H_{22}O_{11} + H_2O \xrightarrow[Yeast]{Invertase} 2C_6H_{12}O_6$

III. $C_6H_{12}O_6 \xrightarrow[Yeast]{Zymase} 2C_2H_5OH + 2CO_2$

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

A) 1 only
B) II only
C) II and III
D) I, II and III

Q.30 Identify X, Y and Z in the following reaction sequence:

$$CH_3CH_2OH \xrightarrow{PI_3} (X) \xrightarrow{aq.KOH} (Y) \xrightarrow[H+/\Delta]{H_2O} (Z)$$

A) Iodoethane, ethene, ethanol
B) Ethene, iodoethane, ethanol
C) Ethene, ethanol, iodoethane
D) Ethanol, iodoethane, ethane

USE THIS SPACE FOR SCRATCH WORK

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

ANSWERS EXPLAINED

Q.1 (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° alcohols is formed when aldehyde (other than formaldehyde)** treated with Grignard reagent followed by acid **hydrolysis.**

Q.2 (B) **Iodoform test (I_2 + NaOH)** helps us to distinguish **between ethanol** and **methanol.** When **ethanol** is treated with **I_2** in the presence of **NaOH** yellow crystal of **iodoform (CHI_3)** are obtained while methanol **does not** give this test as **shown** in the reaction **($C_2H_5OH+4I_2+6NaOH \rightarrow CHI_3+ HCOONa+5NaI+5H_2O$).**

Q.3 (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 (moldm^3)
Carboxylic acid e.g. (CH_3COOH)	1.7×10^{-5}
Phenol	1.3×10^{-10}
Water	10^{-16}
Ethyne	10^{-20}

Q.4 (B)

Q.5 (C) In the following reaction ethene is formed:

A)

$$CH_3-CH_2-OH + Na \longrightarrow CH_3-CH_2-ONa + H_2$$

B)

$$CH_3-CH_2-OH + SOCl_2 \longrightarrow CH_3-CH_2-Cl + SO_2 + HCl$$

C)

$$CH_3-CH_2-OH + conc.H_2SO_4/180^\circ C \longrightarrow CH_2=CH_2 + H_2O$$

D)

$$CH_3-CH_2-OH + PCl_5 \longrightarrow CH_3-CH_2-Cl + POCl_3 + HCl$$

Q.6 (A) Identify X, Y and Z in the following reaction sequence:

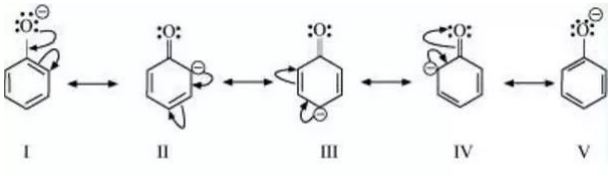
$$CH_3-CH_2 \xrightarrow{HI} \underset{(X)}{CH_3CH_2I} \xrightarrow{aq.KOH} \underset{(Y)}{CH_3CH_2OH} \xrightarrow[NaOH]{I_2} \underset{(Z)}{CHI_3}$$

Q.7 (A) The correct name of the given structure according to IUPAC is 4-Chloro-2,3-pentadiol:

$$^1CH_3-{}^2\underset{|}{CH}-{}^3\underset{|}{CH}-{}^4\underset{|}{CH}-{}^5CH_3$$
(OH, OH, Cl)

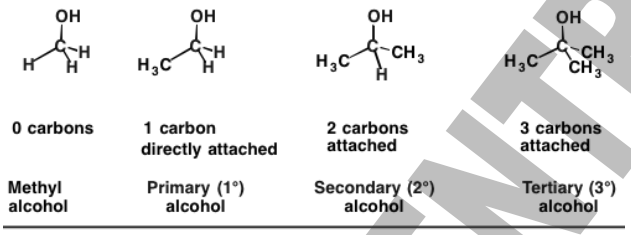
Q.8 (B) Absolute alcohol (almost 100% pure) can be obtained by **redistillation** of rectified sprit in the presence of **CaO** which **absorbs** its **moisture.**

Q.9 (A) (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 π-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:



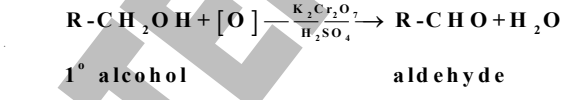
This step of delocalization is not possible with alcohols.

Q.10 (A) Structure of primary secondary and tertiary alcohols are shown below:

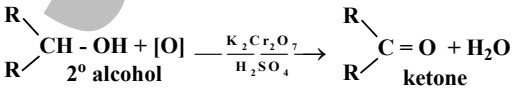


Q.11 (A) Detail of the other reactions are given below

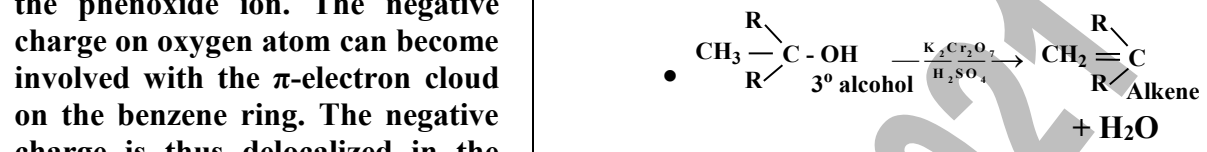
A) On oxidation of a 1° alcohol aldehyde is obtained



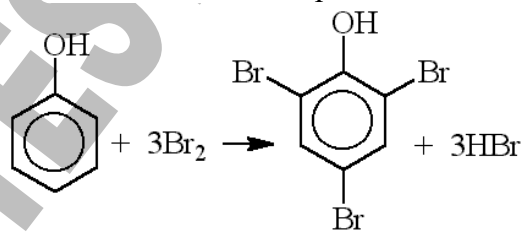
B) On oxidation of a 2° alcohol ketone is obtained



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

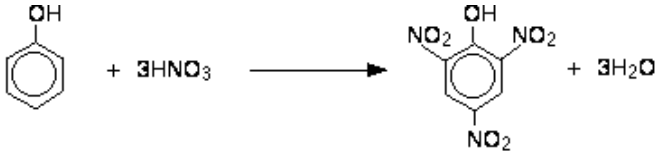


Q.12 (A) (A) If **bromine** water is added to a solution of **phenol** in water, the **bromine** water is decolourised and a white precipitate is formed which smells of antiseptic. Notice the multiple substitution around the ring into all the activated positions.



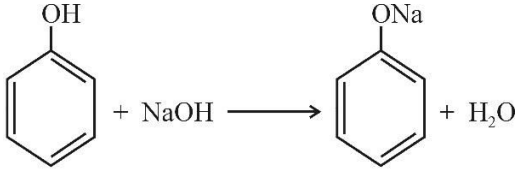
2,4,6-tribromophenol

Q.13 (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:



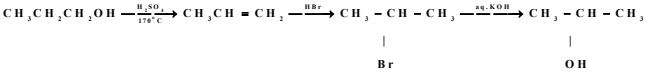
2,4,6-Trinitrophenol

Q.14 (C) Reaction of phenol with alkali (NaOH) results in the formation of salt which show that it is acid base reaction

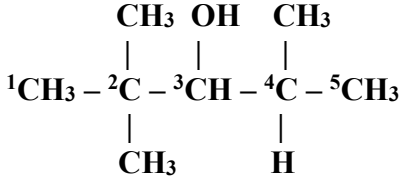


Phenonl **Sodium phenoxide**

Q.15 (A) Identify X, Y and Z in the following reaction sequence:



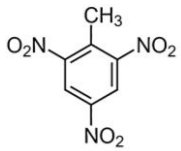
Q.16 (A) The correct name of the given structure according to IUPAC is 2,2,4-Trimethylpent-3-ol



Q.17 (A) Relative acidic strength of alcohol, phenol, water and carboxylic acid is as follows.

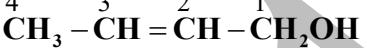
Carboxylic acid > Phenol > Water > Alcohol

Q.18 (A) The correct name according to IUPAC of the given structure is 2,4,6-Tribnitrotoulene (TNT). It is an explosive material.

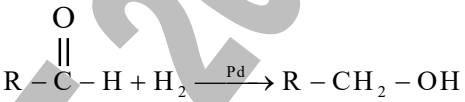


Trinitrotoluene (TNT), or more specifically 2,4,6-trinitrotoluene, is a chemical compound with the formula $C_6H_2(NO_2)_3CH_3$. This yellow solid is sometimes used as a reagent in chemical synthesis, but it is best known as an explosive material with convenient handling properties. The explosive yield of TNT is considered to be the standard measure of bombs and other explosives. In chemistry, TNT is used to generate charge transfer salts.

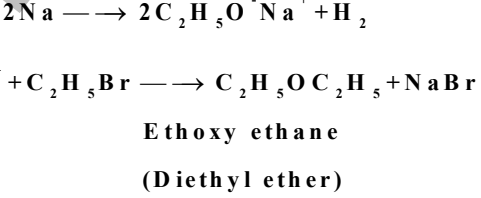
Q.19 (C) The correct name according to IUPAC of the given structure is 2-buten-1-ol.



Q.20 (B) 1° alcohol is prepared by the reduction of aldehyde as shown in the reaction.



Q.21 (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.

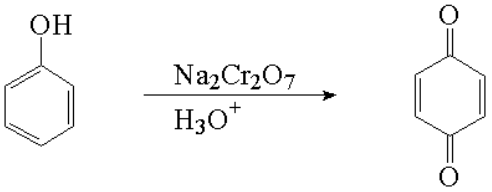


Ethoxy ethane

(Diethyl ether)

Q.22 (C) (1) <u>Reaction with sodium metal:</u> Phenols react with highly electropositive alkali metals such as sodium, potassium etc to yield corresponding phenoxides and hydrogen as shown in the reaction.

(2) <u>Oxidation of phenol:</u> 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:



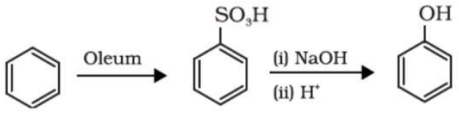
1,4-benzoquinone

Q.23 (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:

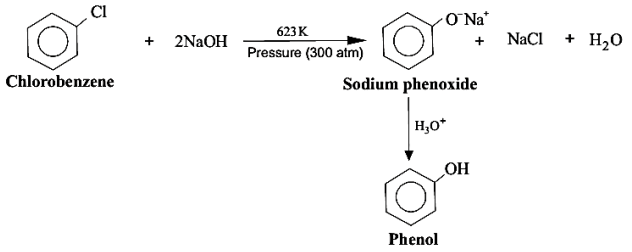
In this process, **benzene sulfonic acid** is reacted with aqueous sodium hydroxide. The resulting salt is mixed with solid sodium hydroxide and fused at a high temperature. The product of this reaction is sodium phenoxide, which is acidified with aqueous **acid** to yield **phenol**.



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

Dow's Process:

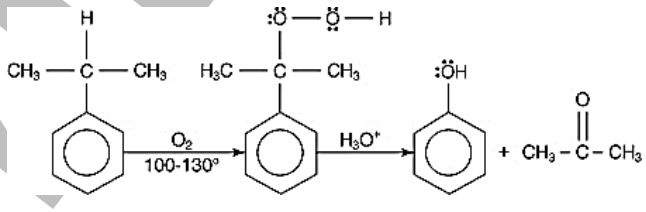
Hydrolysis of chlorobenzene (the **Dow's process**) Benzene is easily converted to chlorobenzene by a variety of methods, one of which is the **Dow's process**. Chlorobenzene is hydrolyzed by a strong base at high temperatures to give a phenoxide salt, which is acidified to phenol.



III. Oxidation of cumene

Oxidation of Cumene:

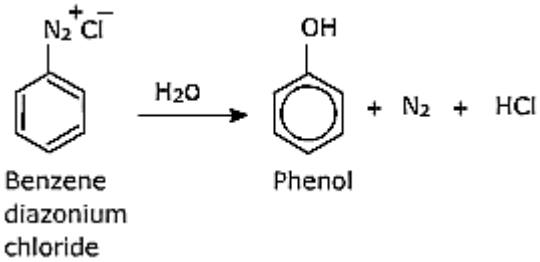
Air **oxidation of cumene**. The air **oxidation of cumene** (isopropyl benzene) leads to the **production** of both **phenol** and acetone, as shown in the following figure. The mechanisms for the formation and degradation of **cumene** hydroperoxide require closer looks, which are provided following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

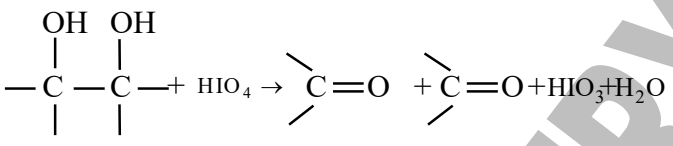


Q.24 (A)

Q.25 (B)

Q.26 (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_4, 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.27 (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 sypry mass.
- Molasses contains 60% fermentable sugars mostly sucrose, glucose and fructose.
- The fermented liquor contains 8 – 10% ethanol

Q.28 (A) A biochemical process in which large molecules are broken down into smaller molecules in the presence of enzymes secreted by microorganism is called fermentation.

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

I. $2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[\text{Yeast}]{\text{Diastase}} nC_{12}H_{22}O_{11}$

Starch — Maltose

II. $C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{Yeast}]{\text{Maltase}} 2C_6H_{12}O_6$

Glucose

III. $C_6H_{12}O_6 \xrightarrow[\text{Yeast}]{\text{Zymase}} 2C_2H_5OH + 2CO_2$

Ethanol

Q.30 (A)

STEP

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