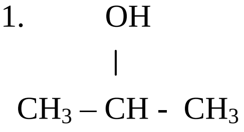
SUMMER-18 EXAMINATION

Model Answer

Subject title: Industrial Chemistry Subject code : 17312

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q No.	Answer	marks
1	**Any 10**	**20**
1-a	**Characteristics of Organic compounds**: (any 2) 1. Generally found in living matter, i.e., animals and plants. 2. Insoluble in water, soluble in organic solvents. 3. Highly inflammable and volatile. 4. Poorer conductors of heat and electricity in aqueous solutions. 5. Usually always contain carbon, especially carbon-hydrogen bonds. 6. Classified into many classes on the basis of functional groups, known as homologous series. Each class is represented by a general formula and the members show similar properties 7. Examples: methane, ethane, acetylene, alcohols, carbon tetrachloride (CCl4), urea	1 mark each
1-b	**IUPAC names:** 1.  $CH_3 - CH(OH) - CH_3$ 2- propanol 2. $H_3C - CH_2 - CH= CH - CH_2 - CH_2 - CH_3$ Heptene (3-Heptene)	1 1

<table>
<tr><td>1-c</td><td>Physical properies of Alkane:(any 2)
1) First four members(C1 to C4) of alkane are gases,next thirteen members (C5 to C17) are colourless liquids and higher alkanes are solids.
2) Liquid alkanes are lighter than water.
3) Alkanes are insoluble in water but freely soluble in organic solvent.
4) Boiling point and specific gravity increases with increase in molecular weight.</td><td>1 mark each</td></tr>
<tr><td>1-d</td><td>Uses of acetylene: (any 2)
1. Ethyne is useful for artificial ripening and preservation of fruits.
2. It is useful in acetylene lamps to generate light.
3. Ethyne is used to prepare various organic compounds.
4. It is also useful to manufacture important organic compounds like acetic acid, acetaldehyde, ethyl alcohol and polymers like PVC…etc.
5. It is useful to produce an oxyacetylene flame.
6. is widely used as a fuel and a chemical building block.
7. Acetylene is used to volatilize carbon in radiocarbon dating.
8. Acetylene is sometimes used for carburization (that is, hardening) of steel when the object is too large to fit into a furnace</td><td>1 mark each</td></tr>
<tr><td>1-e</td><td>Products of the reaction:
1. 1-3dibromopropane
2. Propane</td><td>1
1</td></tr>
<tr><td>1-f</td><td>Differences between alcohols & phenol:
<table>
<tr><th>PHENOL</th><th>ALCOHOL</th></tr>
<tr><td>phenol reacts with $FeCl_3$ whereas normal</td><td>alcohol can not</td></tr>
<tr><td>Phenols are acidic</td><td>Alcohols are not acidic</td></tr>
</table></td><td>1 mark each for any 2</td></tr>
</table>

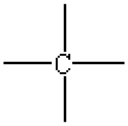
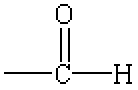
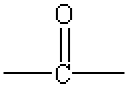
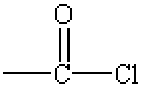
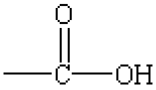
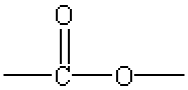
Phenols are acidic and dissolve in a basic solution.	Alcohols are not acidic and will not dissolve in a basic solution
When phenol react with $FeCl_3$ it changes its colour from green to purple.	Alcohols produce no color change.
Phenols produce a brown tarry mass when combined with chromic acid	Not observe in alcohol
phenols dissolve in aqueous NaOH,	Not observe in alcohol
Aromatic	Aliphatic

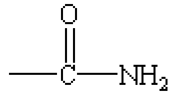
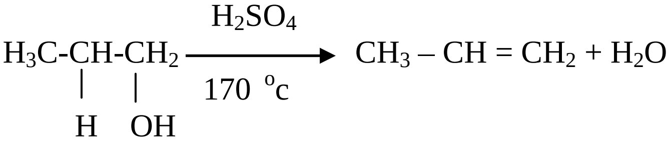
1-g	**Homologues of benzene:** Toluene($C_6H_5CH_3$) Xylene($C_6H_5CH_2CH_3$)	 1 1
1-h	**Uses of phenol : (any two)** 1) The main use of phenol is as a feedstock for phenolic resins, bisphenol A andcaprolactam (an intermediate in the production of nylon-6). 2) It is used in the manufacture of many products including insulation materials, adhesives, lacquers, paint, rubber, ink, dyes, illuminating gases, perfumes, soaps. 3) Also used in embalming and research laboratories. It is a product of the decomposition of organic materials, liquid manure, and the atmospheric degradation of benzene. 4) It is found in some commercial disinfectants,antiseptics, lotions and ointments. 5) Phenol is active against a wide range of microorganisms, and there are some medical and pharmaceutical applications including topical anaesthetic and ear drops, sclerosing agent. 6) It is used in dermatology for chemical face peeling.	1 mark each
1-i	**Nitration:** When benzene is treated with mixture of conc.H_2SO_4 and conc HNO_3 below	2

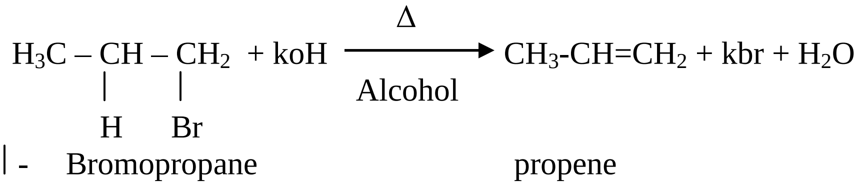
	60^0C benzene gives nitrobenzene while above this temprature the main product is m-Dinitro benzene.  	
1-j	**Action of halogen acids on alcohols:** The hydroxyl group is replaced by the corresponding halogen atoms and an alkyl halide is formed. $ROH + PCl_5 \longrightarrow RCl + POCl_3 + HCl$ Alcohol Alkyl halide $3C_2H_5OH + PCl_3 \longrightarrow 3C_2H_5Cl + H_3PO_3$ Ethyl alcohol Ethyl chloride $3CH_3OH + PI_3 \xrightarrow{P_4 + I_2} 3CH_3I + H_3PO_3$ Methyl alcohol methyl iodide	2
1-k	**Solution:** A solution is a mixture in which substances are intermixed so intimately that they can not be observed as a separate component. Types of solutions : 1) solid in liquid solutions Example : Mercury in zinc , Mercury in Gold, b) $CuSO_4 .5H_2o$	1 1

	2) Liquid in liquid Example : Alcohol in water 3) Gas in liquid Example : water vapours in air, mist.	
1-l	**Indicator**: An indicator is an organic substance used in very small amount to determine the end point in a titration by a visual change of color. Example:-methyl orange, phenolthalein,starch,methyl red **.** **Azeotropes**: are defined as the mixtures of liquids which boil at constant temperature like a pure liquid and possess same composition of components in liquid as well as in vapour phase. Azeotropes are also called constant boiling mixtures because whole of the azeotropes changes into vapour state at constant temperature and their components can not be separated by fractional distillation	1 1
2	**Any 4**	**16**
2-a	**Homologous series-** It is a series of class of organic compounds in which each member differs from its neighbor (immediate higher or lower member)by a constant difference of –CH_2-(methylene) group. Homologous series of alkanes-CH_4,C_2H_6,C_3H_8,C_4H_{10},C_5H_{12} From above example propane(C3H8)differs from ethane (C_2H_6)or butane(C_4H_{10})by a –CH_2- group. Every class of organic compounds has such a homologous series.All members of homologous series have the same general formula.Each homologous series has a particular functional group.	4
2-b	**Classification organic compounds on the basis of functional group**:	4

Functional Group	*Name*	*Example*

 $-\overset{\mid}{\underset{\mid}{C}}-$	Alkane	$CH_3CH_2CH_3$ (propane)
$C=C$	Alkene	$CH_3CH=CH_2$ (propene)
$C\equiv CH$	Alkyne	CH_3C CH (propyne)
F, Cl, Br, or I	Alkyl halide	CH_3Br (methyl bromide)
$-OH$	Alcohol	CH_3CH_2OH (ethanol)
$-O-$	Ether	CH_3OCH_3 (dimethyl ether)
$-NH_2$	Amine	CH_3NH_2 (methyl amine)
 $-\overset{O}{\overset{\|}{C}}-H$	Aldehyde	CH_3CHO (acetaldehyde)
 $-\overset{O}{\overset{\|}{C}}-$	Ketone	CH_3COCH_3 (acetone)
 $-\overset{O}{\overset{\|}{C}}-Cl$	Acyl chloride	CH_3COCl (acetyl chloride)
 $-\overset{O}{\overset{\|}{C}}-OH$	Carboxylic acid	CH_3CO2H (acetic acid)
 $-\overset{O}{\overset{\|}{C}}-O-$	Ester	$CH_3CO_2CH_3$ (methyl acetate)

	 $-\overset{\overset{O}{\parallel}}{C}-NH_2$ · Amide · CH_3NH_2 (acetamide)	
2-c	**Aromatisation in alkanes:** The process of conversion of aliphatic compound into aromatic compound is known as **aromatization**. **Alkanes** having six to 10 carbon atoms are converted into benzene and its homologues at high pressure and temperature in presence of catalyst. Ex.  	4
2-d	**Methods of preparation of alkenes**: (Any 2) 1) **By Dehydration of alcohols** : When alcohols methods is heated in presence of sulphuric acide , water is eliminated and alkene is formed.  $H_3C\text{-}\underset{\overset{\vert}{H}}{CH}\text{-}\underset{\overset{\vert}{OH}}{CH_2} \xrightarrow[170\ ^{o}c]{H_2SO_4} CH_3 - CH = CH_2 + H_2O$ |- Propanol propene 2) **By dehydrogenation of alkyl halide** : When alkyl halide heated with alcoholic solution of Na or k-hydroxide, hydrogen halide is eliminated and alkene is formed.	**2 marks each for any 2**

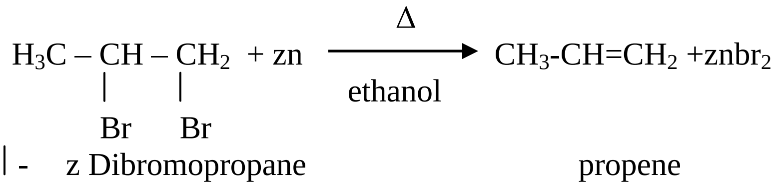


$$H_3C - \underset{\underset{H}{|}}{CH} - \underset{\underset{Br}{|}}{CH_2} + koH \xrightarrow[\text{Alcohol}]{\Delta} CH_3\text{-}CH{=}CH_2 + kbr + H_2O$$

1 - Bromopropane propene

3) **By dehalogenation of vicinal dihalide**. :

A compound having two halogen atoms on adjacent carbon atoms is called a vicinal dehalide. Alkanes are formed when vicinal dehalids are heated with Zn-dust in ethyl alcohol.



$$H_3C - \underset{\underset{Br}{|}}{CH} - \underset{\underset{Br}{|}}{CH_2} + zn \xrightarrow[\text{ethanol}]{\Delta} CH_3\text{-}CH{=}CH_2 + znbr_2$$

1 - z Dibromopropane propene

4) **By cracking of Alkanes**:

Alkanes when heated at 500 – 700 ^{o}c in absence of air, decomposes to yield lower molecular weight alkenes, alkanes and hydrogen.

a) $CH_3 - CH_3 \xrightarrow{600\,^o c} CH_2 = CH_2 + CH_4 + H_2$
Ethane ethylene methane

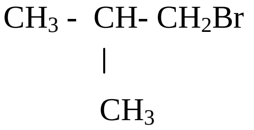
b) $CH_3 - CH_2 - CH_3 \xrightarrow{600\,^o c} CH_3\text{-} CH = CH_2 + CH_2 = CH_2 + CH_4 + H_2$
Propane propane Ethylene methane

2-e

Isomerism in alkyl halides: The isomerism exhibited by alkyl halides is of two types: Chain isomerism and Position isomerism

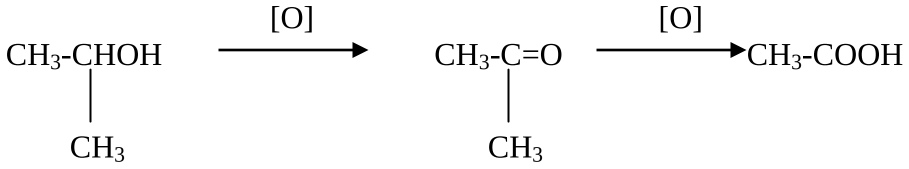
Chain isomerism: Paraffins exhibits chain isomerism. Alkyl halides being derivatives of paraffins show chain isomerism depending upon the nature of the

4

	chain whether it is straight or branched. For example, difference between the following bromo derivatives of butane is due to difference in the nature of the chain. $CH_3 .CH_2 . CH_2 .CH_2Br$ n butyl bromide  $CH_3 - \underset{\displaystyle CH_3}{\underset{\vert}{CH}} - CH_2Br$ Isobutyl bromide **Position isomerism**: Another type of isomerism exhibited by alkyl halide is due to the difference in the position of the halogen atom in the same chain and is termed as position isomerism. Ex. $CH_3 .CH_2 .CH_2I$ n- propyl iodide And $CH_3 .CH I. CH_3$ Isopropyl iodide Both have straight chain formula but differ in the position of the halogen atom.	
2-f	**Differentiate between primary, secondary and tertiary alcohols.** To differentiate between primary, secondary and tertiary alcohols, four methods are used (1) Oxidation method (2) Action of hot reduced cu. (3) victor mayer's method (4) Lucas test. 1) **Oxidation method** :- i) primary alcohols easily oxidized to aldehydes and then to acids, containing same number of carbon atoms , as the original alcohol.	2 marks each for any 2

$$\underset{\text{Ethyl alcohol}}{CH_3\text{-}CH_2OH} \xrightarrow{[O]} \underset{\text{acetaldehyde}}{CH_3\text{-}CHO} \xrightarrow{[O]} \underset{\text{acetic acid}}{CH_3\text{-}COOH}$$

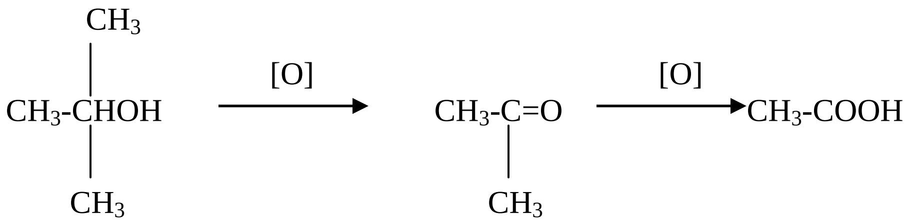
ii) Secondary alcohol, gives ketone, which on prolonged oxidation, by action of oxidizing agent gives acids.



$$CH_3\text{-}\underset{CH_3}{\underset{|}{C}}HOH \xrightarrow{[O]} CH_3\text{-}\underset{CH_3}{\underset{|}{C}}=O \xrightarrow{[O]} CH_3\text{-}COOH$$

Isopropyl alcohol acetone acetic acid

iii)Tertiary alcohol are oxidized by acid oxidizing agents to give mixture of keton and acid

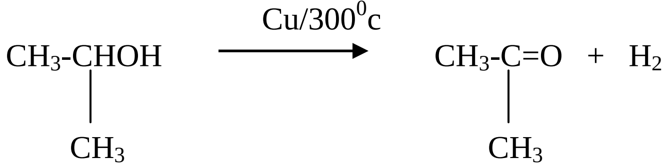


$$CH_3\text{-}\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}HOH \xrightarrow{[O]} CH_3\text{-}\underset{CH_3}{\underset{|}{C}}=O \xrightarrow{[O]} CH_3\text{-}COOH$$

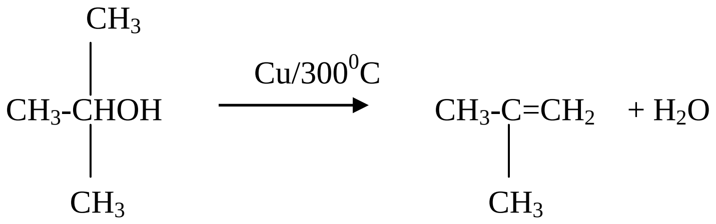
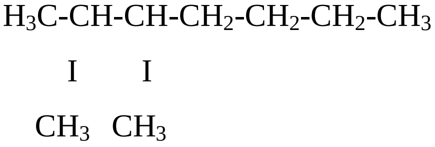
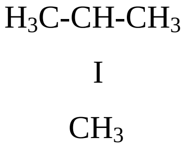
Tertiary butyl alcohol acetone acetic acid

(2) By action of hot reduced Cu : with hot reduced cu at 300^oc , primary alcohol gives aldehydes secondary gives ketone and tertiary alcohols gives olefins.

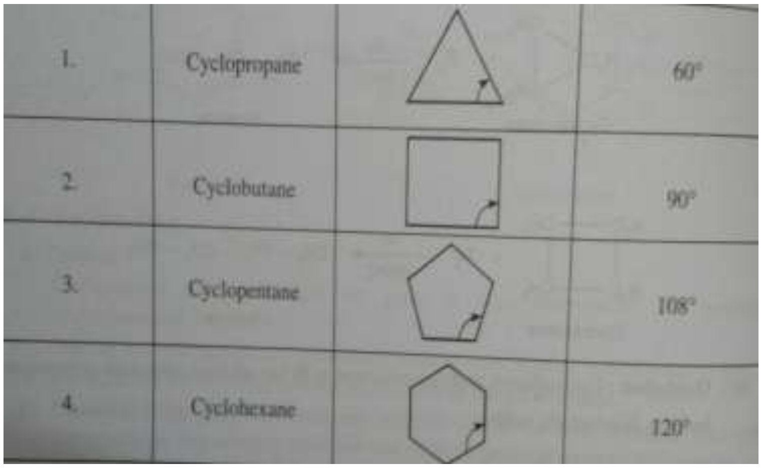
$$\underset{\substack{\text{Ethyl alcohol}\\\text{(primary)}}}{CH_3\text{-}CH_2OH} \xrightarrow{Cu/300^0c} \underset{\text{acetaldehyde}}{CH_3\text{-}CHO + H_2}$$



$$CH_3\text{-}\underset{CH_3}{\underset{|}{C}}HOH \xrightarrow{Cu/300^0c} CH_3\text{-}\underset{CH_3}{\underset{|}{C}}=O + H_2$$

	Isopropyl alcohol acetone (secondary)  $CH_3\text{-}\overset{CH_3}{\underset{CH_3}{C}}HOH \xrightarrow{Cu/300^0C} CH_3\text{-}\underset{CH_3}{C}{=}CH_2 + H_2O$ Tertiary butyl alcohol isobutylene ***Note: Other two methods are also to be considered***	
3	**Any 4**	**16**
3-a	(i) **2,3 dimethyl heptane**  $H_3C\text{-}\underset{CH_3}{CH}\text{-}\underset{CH_3}{CH}\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$ (ii) **2-methyl propane**  $H_3C\text{-}\underset{CH_3}{CH}\text{-}CH_3$	2 2
3-b	**Bayers strain theory-** This theory based on the fact that the normal angle between any pair of bonds of carbon atom is $109^0 28'$.Baeyer postulated that any deviation of bond angles from the normal tetrahedral value impose condition of internal strain on the ring.He also assumed that all cycloalkanes were planar & calculated the angles through which each of the valency bond was deflected from the normal direction in the formation of various rings.It is called angle strain which	4

determine stability of ring.



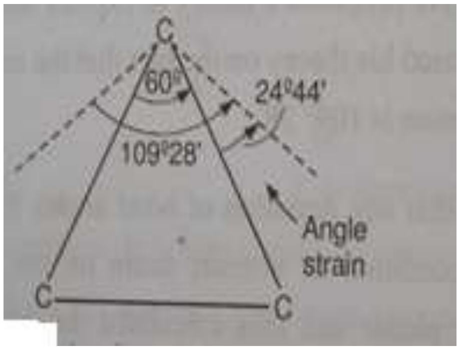
1.	Cyclopropane		60°
2.	Cyclobutane		90°
3.	Cyclopentane		108°
4.	Cyclohexane		120°

In cyclopropane three c atoms occupy the corners of an equilateral triangle.Therefore bond angles of 60^0.Normal angle $109^0 28'$ is compressed to 60^0 & that each of the two bonds involved is pulled in by

$\frac{1}{2}(109^0 28' - 60^0)$

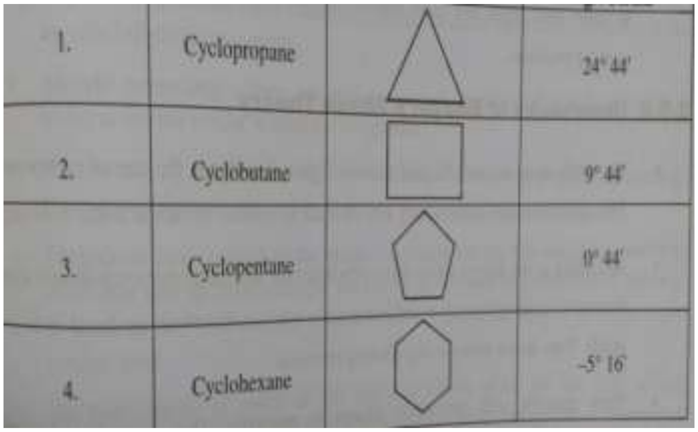
$\frac{1}{2}(49^0 28')$

$= 24^0 44'$



Angle strain in cyclopropane

The value represents angle strain or the deviation through which each bond bends from the normal value.



1.	Cyclopropane	△	24° 44'
2.	Cyclobutane	□	9° 44'
3.	Cyclopentane	⬠	0° 44'
4.	Cyclohexane	⬡	-5° 16'

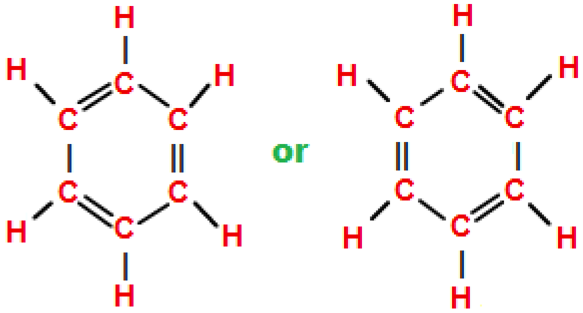
The angle strain for other cycloalkanes can be calculated in the same way.

The angle strain is maximum in case of cyclopropane. According to this theory cyclopropane should be highly strained molecule & unstable also.

3-c

Structure of benzene-

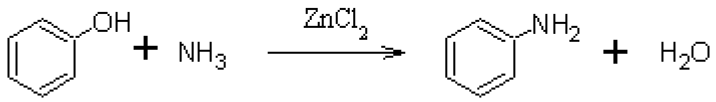
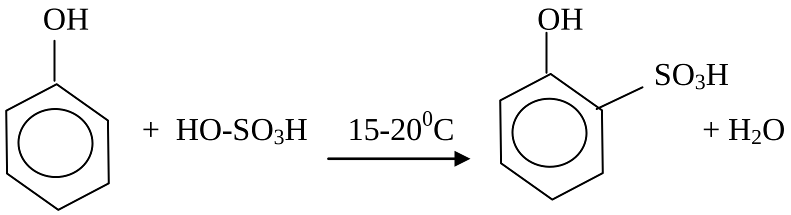
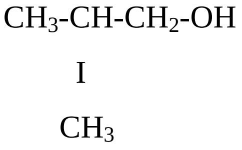
2



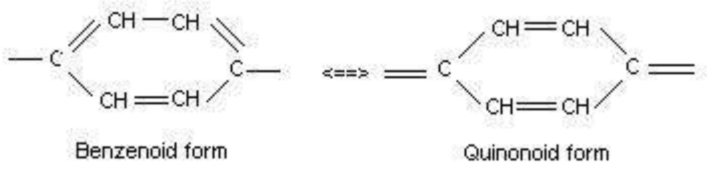
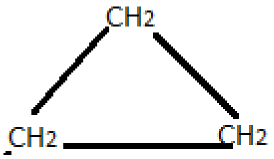
Preparation method of benzene-

1)By heating an aromatic acid or its sodium salt with sodalime (Removal of COOH group)

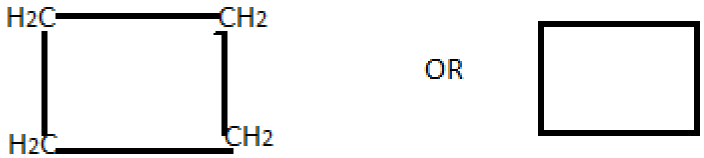
1 mark each for any 2 methods

	$C_6H_5COONa + NaOH \longrightarrow C_6H_6 + Na_2CO_3$ Sodium benzoate benzene 2)By the hydrolysis of sulphonic acid with superheated steam $C_6H_5SO_3H + H_2O \longrightarrow C_6H_6 + H_2SO_4$ Benzene sulphonic acid benzene ***Note: Any other method should be given mark***	
3-d	**Action of ammonia on phenol** When phenol is heated with ammonia in prersence of unhydrus zinc chloride then formation of Aniline takes place  **Action of H_2SO_4 on phenol** – Phenol when treated with conc. H_2SO_4 at room temp. gives o-phenol sulphonic acid.  Phenol sulfuric acid o-phenol sulphonic acid	2 2
3-e	**Chain isomerism**-Alcohol show chain isomerism depending upon nature of chain i.e. straight or branched. $CH_3CH_2CH_2CH_2OH$ n-butyl alcohol $CH_3-\underset{\underset{CH_3}{\vert}}{CH}-CH_2-OH$	2

	The isomerism is due to the difference in the nature of chain.i.e.straight or branched **Position isomerism**-It is due to the difference in the position of hydroxyl group in the same chain . Both have straight chain formula but differ in the position of hydroxyl group. **Functional isomerism**-Monohydric alcohols are isomeric with ethers ,general formula for both of these CnH2n+2O.So ethanol C_2H_5OH is isomeric with dimethyl ether,$CH_3.O.CH_3$ & propanol,C_3H_7OH is isomeric with ethylmethyl ether $C_2H_5.O.CH_3$.This type of isomerism is due to the presence of different functional groups.	1 1
3-f	**Quinonoid theory**: This theory explains the color changes in titrations on the basis of intramolecular changes. This theory believes that- 1. An acid base indicator is either a weak acid or a weak base. 2. An indicator consists of an equilibrium mixture of at least two tautomeric forms one is benzenoid while the other is Quinonoid form. 3. The two forms posses different colors. 4. Out of these forms, one exists in an acid solution & the other form exists in an alkaline solution. 5. The Quinonoid form is generally deeper in colour than beenzenoid form. 6.As the PH of the solution containing an indicator changes one form of the indicator changes to the other & as a result of this the solution shows a change of colour There are two tautomeric forms of methyl orange .The Quinonoid form (red form)exists in an acidic solution & it passes to the Benzenoid form (yellow) as the PH changes to the alkaline side. Phenolphthalein is colorless in an acidic solution where it exists in the	4

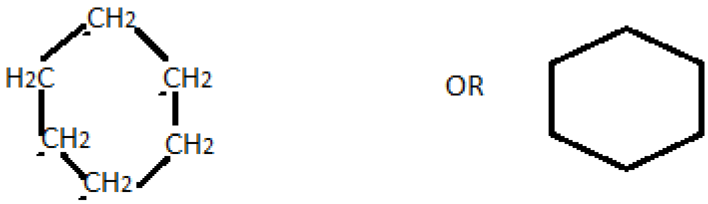
	Benzenoid form .If an alkali is added, it changes to theQuinonoid form & imparts pink color to the solution  	
4	**Any 4**	**16**
4-a	Organic compounds are classified into four categories on the basis of structure. 1. **Aliphatic compounds** : Which consist of open chain of carbon atoms are called aliphatic compounds. Example : (Any 1) a) Propane $CH_3^-CH_2^-CH3$ b) Acetic acid CH_3^-COOH 2. **Alicyclic compounds**: These are cyclic compounds composed of ring of carbon atoms with properties similar to aliphatic compounds. Example : (Any 1) a)  OR  cyclopropane	4

b)



Cyclobutane

c)



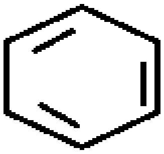
Cyclobexane

3. Aromatic compounds:

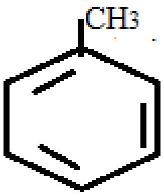
   These are cyclic compounds having six membered ring of carbon atoms with alternate single and double bonds

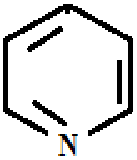
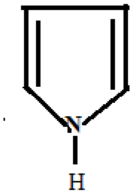
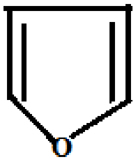
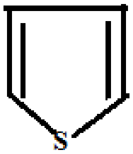
   Example :

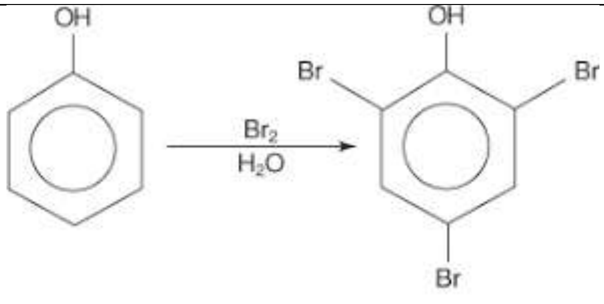
   a) Benzene

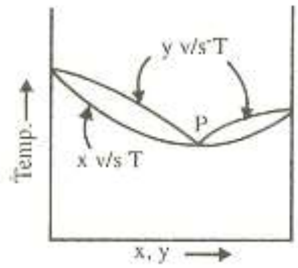
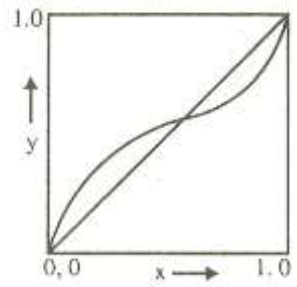


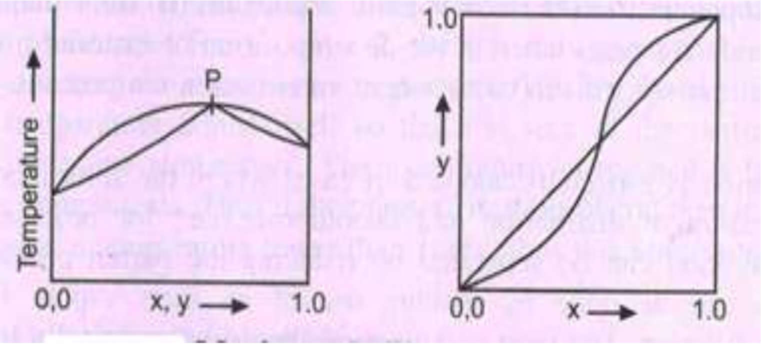
   b) Teluene

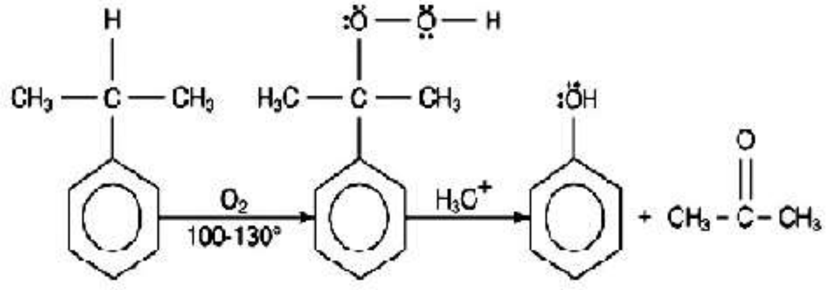


	4. Heterocyclic compounds: These are cyclic compounds in which ring consist of atoms atoms and some other element such as oxygen, nitrogen, sulphur. Example : (Any 1) a) pyridine  b) pyrrole  c) furan  d) Thiopheno 	
4-b	**Saturated compounds** –Hydrocarbons in which all the bonds of carbon atoms are fully utilized & cannot take up more hydrogen atoms are known as saturated compounds.	1
	e.g. alkanes CH_4-methane	1
	Unsaturated hydrocarbons – Hydrocarbons in which all the bonds of carbon atoms are not fully utilized & can take up more hydrogen atoms are known as unsaturated hydrocarbons.The carbon atoms are join to each other by double or triple bond.	1
	e.g. Alkenes & Alkynes(C_2H_4 ,C_2H_2)	1

4-c	 2,4,6-tribromophenol Addition of bromine water to phenol gives 2,4,6-tribromophenol	4
4-d	When an alkene is passed through cold & conc.H_2SO_4 it undergoes addition to form alkyl hydrogen sulphate .This on heating with water gets hydrolysed to form alcohol. C_2H_4 + H_2SO_4 →CH_3 I CH_2HSO_4 CH_3 I CH_2HSO_4 + H_2O ⟶CH_3CH_2OH + H_2SO_4	2 2
4-e	**Raoults** law –The vapour pressure of any solution containing a non volatile solute in a volatile solvent,is proportional to the molefraction of the solvent in the solution. **Classification of solution**: 1. Ideal solution –the like forces must be similar to the unlike forces. There should be no change in volume on mixing the two liquids.No change in enthalpy on mixing.In an ideal solution each component & also the solution should obey Raoults law.	**2** **2**

	Examples of ideal solutions-Hexane + Heptane,Benzene + Toluene 2. Non ideal solution –The solutions which do not obey Raoults law. Like forces are not similar to unlike forces.Change in volume & enthalpy on mixing the two liquid.There are two types of non ideal solutions-solutions which show positive deviation from Raoults law & negative deviation from Raoults law. Examples-positive deviation-Acetone + carbon disulphide Negative deviation –Chloroform + acetone	
4-f	**Minimum boiling azeotropes**-is solution of definite compositions which boils at a definite temp.which is lower than the B.P.of both the components of solution. Minimum boiling azeotropes show positive deviation from Raoults law. Examples of minimum boiling azeotrope /azeotropic mixture-ethanolwater, chloroform-methanol etc.   Boiling point diagram equilibrium diagram **Maximum boiling azeotrope** is a solution of definite composition which boils at a temp. higher than the B.P. of both.the components of the solution	2

	Maximum boiling azeotropes show negative deviation from Raoults law. Examples of maximum boiling azeotrope-HCl-water,water-nitric acid  Boiling point diagram equilibrium diagram	2
5	**Any 4**	**16**
5-a	**IUPAC Rules for naming monofunctional compounds**: 1) Identify the principal functional group. 2) Number the longest chain containing the functional group from the end closer to it. 3) Write the parent name corresponding to the number of carbons in the longest chain. 4) arrange the substituent names with position numbers in alphabetic order 5) Prefix substituent's name with the parent name.	4
5-b	**Phenol from Cumene:** By oxidation of Cumene followed by treatment with acid we can produce phenol.it is generally used for manufacture of phenol.	2

<table>
<tr><td></td><td>

Cumene Cumene hydroperoxide phenol</td><td>2</td></tr>
<tr><td>5-c</td><td>Physical properties of alcohol:
1) Higher members are colorless waxy solids.
2) Lower members are soluble in water & organic solvents.
3) These are lighter than water.
4) Lower members have pleasant smell while higher member are odorless & tasteless.</td><td>1 mark each</td></tr>
<tr><td>5-d</td><td>Distinguish between ideal and non ideal solution:
<table>
<tr><th rowspan="2">Ideal solutions</th><th colspan="2">Non-ideal solutions</th></tr>
<tr><th>Positive deviation from Raoult's law</th><th>Negative deviation from Raoult's law</th></tr>
<tr><td>1.Obey Raoult's law at every range of concentration.</td><td>1. Do not obey Raoult's law.</td><td>1. Do not obey Raoult's law.</td></tr>
<tr><td>2. $\Delta H_{mix} = 0$; neither heat is evolved nor absorbed during</td><td>2. $\Delta H_{mix} > 0$. Endothermic dissolution; heat is</td><td>2. $\Delta H_{mix} < 0$. Exothermic dissolution; heat is evolved.</td></tr>
</table></td><td>1 mark each for any 4</td></tr>
</table>

dissolution.	absorbed.	
3. $\Delta V_{mix} = 0$; total volume of solution is equal to sum of volumes of the components.	3. $\Delta V_{mix} > 0$. Volume is increased after dissolution.	3. $\Delta V_{mix} < 0$. Volume is decreased during dissolution.
4. $P = p_A + p_B = p_A^0 X_A + p_B^0 X_B$ i.e., $p_A = p_A^0 X_A ; p_B = p_B^0 X_B$	4. $p_A > p_A^0 X_A$; $p_B > p_B^0 X_B$ $\therefore$ $p_A + p_B > p_A^0 X_A + p_B^0 X_B$	4. $p_A < p_A^0 X_A$; $p_B < p_B^0 X_B$ $\therefore$ $p_A + p_B < p_A^0 X_A + p_B^0 X_B$
5. $A-A, A-B, B-B$ Interactions should be same, i.e., 'A' and 'B' are identical in shape, size and character.	5. $A-B$ Attractive force should be weaker than $A-A$ and $B-B$ attractive forces. 'A' and 'B' have different shape, size and character.	5. $A-B$ Attractive force should be greater than $A-A$ and $B-B$ attractive forces. 'A' and 'B' have different shape, size and character.
6. Escaping tendency of 'A' and 'B' should be same in pure liquids and in the solution.	6. 'A' and 'B' escape easily showing higher vapour pressure than the expected value.	6. Escaping tendency of both components 'A' and 'B' is lowered showing lower vapour pressure than expected ideally.
7.Examples: benzene + toluene: n-hexane + n-heptane;	7. Examples: Acetone +ethanol	7. Examples: Acetone + aniline;

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>5-e</td><td>

Methods of choosing indicators for acid- alkali titration:

- an appropriate indicator will change colour at the equivalence point of the titration.

  Litmus is not used in titrations because the pH range over which it changes colour is too great.

- Universal indicator which is actually a mixture of several indicators displays a variety of colours over a wide pH range so it can be used to determine an approximate pH of a solution but is not used for titrations. an appropriate indicator will change colour at the equivalence point of the titration.

  Litmus is not used in titrations because the pH range over which it changes colour is too great.

- Determine what species are present at the equivalence point & deduce the pH at the equivalence point

<table>
<tr><th>pH of salts formed from reactions of acids & bases (25^{o}C)</th><th>Strong Base</th><th>Weak Base</th></tr>
<tr><td>Strong Acid</td><td>pH = 7</td><td>pH < 7</td></tr>
<tr><td>Weak Acid</td><td>pH > 7</td><td>pH = 7</td></tr>
</table>

</td><td>4</td></tr>
</table>

- Use the table of indicators to choose an indicator which changes colour over a pH range that includes the equivalence point

Examples:

Strong Acid - Strong Base titration

$HCl(aq) + NaOH(aq) \text{----->} NaCl(aq) + H_2O(l)$

At equivalence the only species present will be $NaCl(aq)$ & $H_2O(l)$

The solution of a salt of a strong acid and a strong base will have a pH=7

$NaCl(aq)$ will have a pH=7

A suitable indicator would be bromothymol blue (pH range 6.2 - 7.6) or phenol red (pH range 6.8 - 8.4)

Strong Acid - Weak Base titration

$HCl(aq) + NH_3(aq) \text{----->} NH_4Cl(aq)$

NH_4Cl is the salt of a strong acid & a weak base, so a solution of NH_4Cl will have a $pH < 7$ (NH_4^+ is a weak acid)

A suitable indicator would be methyl orange (pH range 3.1 - 4.4) or methyl red

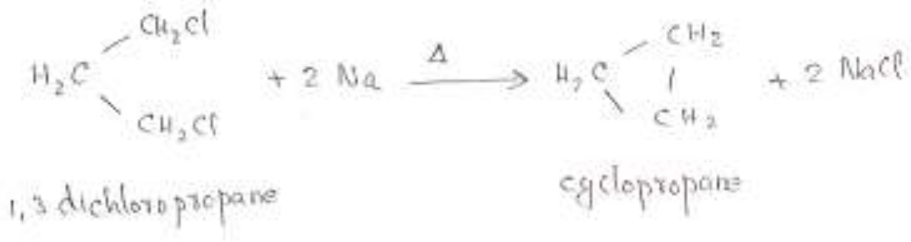
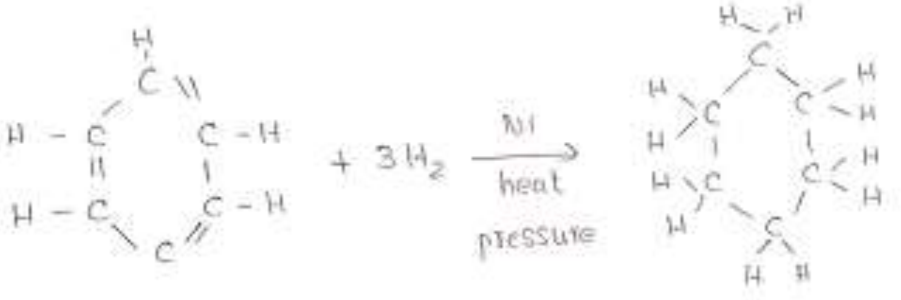
(pH range 4.4 - 6.0)

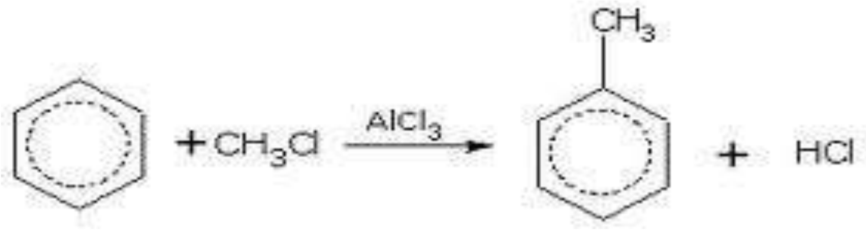
Weak Acid - Strong Base titration

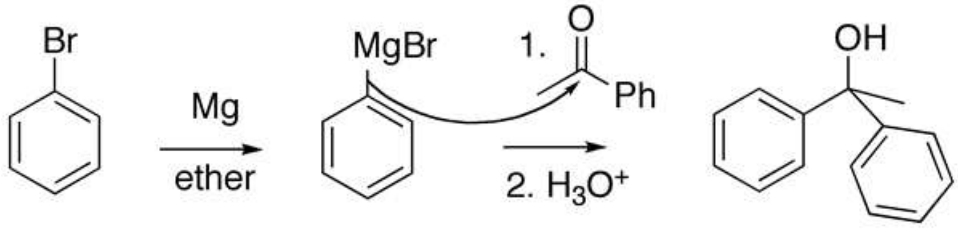
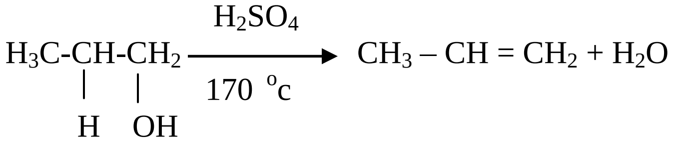
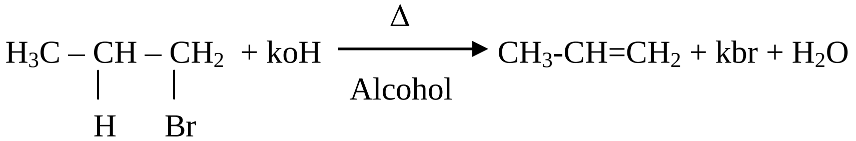
$CH_3COOH(aq) + NaOH(aq) \text{----->} CH_3COONa(aq) + H_2O(l)$

CH_3COONa is the salt of a weak acid & a strong base, so a solution of CH_3COONa will have a $pH > 7$ (CH_3COO^- is a weak base)

A suitable indicator would be phenolphthalein (pH range 8.3 - 10.0) or

	thymol blue (pH 8.0 - 9.6)	
5-f	**Methods for preparation of cycloalkanes** (any one) i) **From Di-halides :** Terminal di-halide are treated with sodium or zinc to form cycloalkanes.  ii) **From aromatic hydrocarbons** :  Benzene cyclohexane **physical properties of cycloalkanes**: 1. Cyclopropane and cyclobutane are gases at room tempareture.the remaining cycloalkanes are liquids. 2. melting and boiling points of cycloalakane increases with increase of	2 2

	molecular weight. 3. Cycloalkanes are insoluble in water but dissolves in ethanol and water.	
6	**Any four**	**16**
6-a	**Polymerisation :** It is the process of combination of two or more monomeric units to form a high molecular weight compound with or without the elimination of H_2O , HCl etc. under specific conditions of temperature pressure and catalyst. Example : a) $nCH_2{=}CH_2 \xrightarrow{\text{polymerisation}} [-CH_2-CH_2-]_n$ ethylene polyethylene	2 2
6-b	**Friedel-crafts reaction**: Benzene reacts at room temperature with a chloro alkane (for example, chloromethane or chloro ethane) in the presence of aluminium chloride as a catalyst. It is known as **Friedel-Crafts retion of benzene**  Benzene Toluene **Grignard's reaction:**	2

		2
6-c	**Methods of preparation of alkenes**: **By Dehydration of alcohols** : When alcohols methods is heated in presence of sulphuric acide , water is eliminated and alkene is formed.  $H_3C\text{-}\underset{H}{CH}\text{-}\underset{OH}{CH_2} \xrightarrow[170\ ^{o}c]{H_2SO_4} CH_3 - CH = CH_2 + H_2O$ |- Propanol propene **By dehydrogenation of alkyl halide** : When alkyl halide heated with alcoholic solution of Na or k-hydroxide, hydrogen halide is eliminated and alkene is formed.  $H_3C - \underset{H}{CH} - \underset{Br}{CH_2} + koH \xrightarrow[Alcohol]{\Delta} CH_3\text{-}CH\text{=}CH_2 + kbr + H_2O$ |- Bromopropane propene	2 2
6-d	**Ostwald theory** :Ostwald's theory considers indicator to be a weak acid or base whose unionised forms differently coloured. In presence of acid or base, ie pH change, there is ionization of indicator and hence the colour change appears. For example phenolphthalein	4

	phenolphthalein is a weak acid (PhH) PhH<_-_-_-_-_-_->Ph- + H+ ....(1) (colourless (Pink in base) in acid) H+ + OH- <-_-_-_-_-_-_> H_2O In presence of an acid (H+) equilibrium (1) is displaced towards the left hand side (a case of LeChatelier's principle); when strong base like NaOH is added, this equilibrium is displaced towards right hand side and there is colour change from colourless to pink when pH changes. This indicator is not suitable for titrating weak base since weak base can't furnish enough OH- that can react with H+ of the phenolphthalein and can impart pink colour only after excess of weak base is added.	
6-e	**Azeotropic Mixture** Azeotropes are defined as the mixtures of liquids which boil at constant temperature like a pure liquid and possess same composition of components in liquid as well as in vapour phase. Their dew point and bubble point are identical. Azeotropes are also called constant boiling mixtures because whole of the azeotropes changes into vapour state at constant temperature and their components can not be separated by fractional distillation. Azeotrope can not be separated by distillation because the dew point and bubble point are identical.	4

6-f	**Ethylamine from ethyl iodide:** When alkyl halides are heated with ethanoic solution of ammonia under pressure in a sealed tube a mixture of amines are obtained. $C_2H_5I + H\ NH_2 \longrightarrow C_2H_5NH_2 + HI$	4