SUMMER-14 EXAMINATION

Model Answer

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	Total marks
1-a	Functional group – It is a group of atoms bonded together in a unique fashion which is present in the molecule & it is responsible for its characteristics chemical properties. e.g. –OH,-COOH are the functional groups of alcohol & acid respectively.	01 01	02
1-b	Series of class of organic compounds in which each member differs from its neighbor (immediate higher or lower member) by a constant difference of –CH2-methylene group C_6H_6,C_6H_5-CH_3, $C_6H_5C_2H_5$	01 01	02
1-c	Alkanes are known as paraffins.These are the simplest compounds made of carbon & hydrogen only.Alkanes are having low Reactivity from the Latin phrase Parum affinis means little affinity	02	02
1-d	Alkyl magnesium halide i.e. Grignard reagent are obtained by treating alkyl halides with magnesium in anhydrous ether. These on treatments with water give alkanes. RX+Mg---→ RMgX	01 01	02
1-e	1.Domestic fuel in the form of natural gas e.g. methane 2.Refrigerants,solvents 3.Rubber compounding, packing 4. Alkanes are used in lubricants, plasticizers.	½ for each one	02
1-f	Aromaticity – The property of extra stability & inertness shown by unsaturated cyclic organic compounds.	01 01	02

	Ex-benzene,phenol,tolune		
1-g	1.As an antiseptic 2. Manufacturing of drugs like aspirin	02	02
1-h	By the action of alkyl halides on benzene in the presence of anhydrous aluminum chloride catalyst $C_6H_6+CH_3Cl$------>$C_6H_5CH_3+HCl$	01 01	02
1-i	Phenols are classified as 1.Monohydric 2.Dihydric 3.Trihydric According to as they contain one, two or three hydroxyl group	02	02
1-j	Monohydric alcohols are further classified as primary, secondary& tertiary alcohols according as the carbon atom to which the hydroxyl group is attached, isprimary, secondary& tertiary carbon atom. Primary alcohol contain the primary alcoholic group,-CH_2OH,e.g. methanol CH_3OH Secondary alcohol-$(CH_3)_2CHOH$ isopropyl alcohol Tertiary alcohol-$(CH_3)_3COH$ tert-butyl alcohol	02	02
1-k	It states that the relative lowering in vapor pressure of a dilute solution is equal to mole fraction of the solute present in the solution.	02	02
1-l	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. EX-methyl orange, phenolthalein	01 01M	02
2-a i)	Ethyl methyl ketone	01	04

	O ll CH_3-C-CH_2CH_3		
ii)	4,5 dimethyl -1-heptanol CH_3 CH_3 l l CH_3-CH_2-CH-CH-CH_2-CH_2-CH_2-OH	01	
iii)	2-ethyl-5-methyl hexanoic acid CH_3 C_2H_5 l l CH_3-CH-CH_2-CH_2-CH-COOH	01	
iv)	3-ethyl-4-nitrohexane NO_2 C_2H_5 l l CH_3-CH_2-CH-CH-CH_2-CH_3	01	
2-b	1. Select the longest continuous chain of carbon atoms, it is known as main or parent chain & other chains attached to it are known as side chains. The no. of carbon atoms present in main chain determines the parent name of hydrocarbon. C l C-C-C-C-C-C-C 2. Number the c atoms of parent chain from the end which gives smallest possible no the carbon carrying the branches.	04	04

C
l
C-C-C-C-C-C-C
1 2 3 4 5 6 7

3. Prifix the name of substituent to the name of parent hydrocarbon & indicate its position on parent chain.

CH_3
l
CH_3-CH_2-CH-CH_2-CH_2-CH_2-CH_3
3-methyl heptane

4. When more than one substituent's are present on the main chain their names are given as per alphabetical order, inserting hyphen (-) in between the names of substituents.

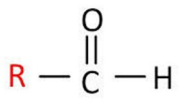
CH_3 C_2H_5
l l
H_3C-CH-CH-CH_2-CH_2-CH_2-CH_3
3-ethyl-2-methyl heptane

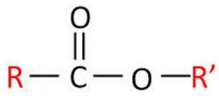
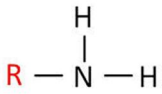
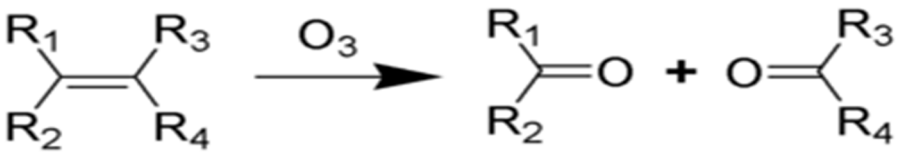
5. When the same substituent is present two or more times in the molecule then it is indicated by di, tri, tetra etc to the substituent name.

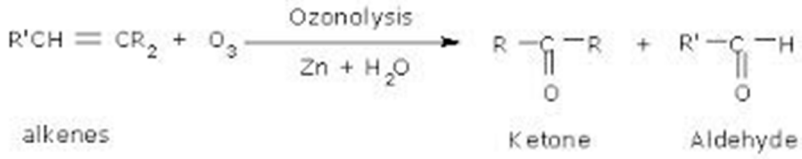
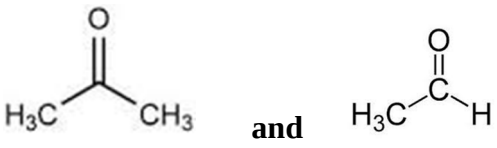
CH_3 CH_3
l l
H_3C-CH-CH-CH_2-CH_2-CH_2-CH_3
2,3-dimethyl heptane

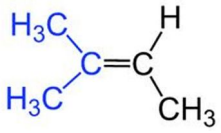
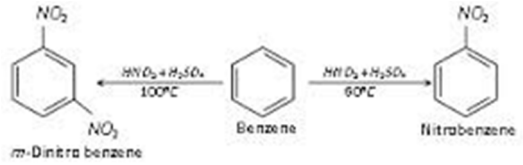
6. The position of double bond or triple bond is indicated by prefixing the no. of carbon preceding such bonds.

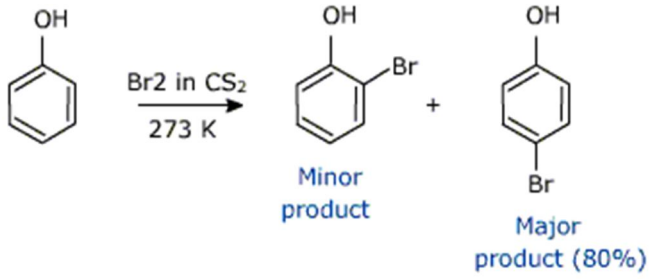
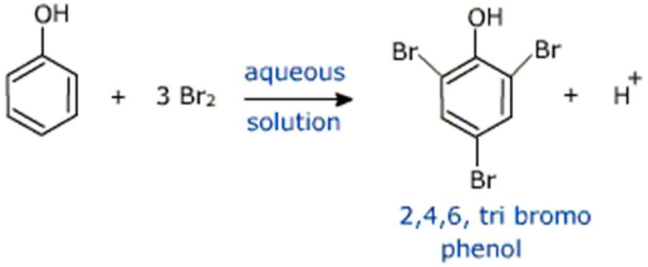
	$H_3C-CH_2-CH=CH-CH_2-CH_2-CH_3$ 3-heptene		
2-c	**Methods of preparation of alkenes:** **1.By cracking of alkanes**. Alkanes when heated at 500-700^{0}c,in absence of air decompose to give alkenes ,alkanes & hydrogen. 600^0c $CH_3-CH_3 \xrightarrow{} CH_2=CH_2+H_2$ 2.**By dehydration of alcohols**. When alcohol is heated in presence of sulphuric acid a molecule of water is eliminated &alkenes is formed. $\xrightarrow[H_2SO_4]{\Delta}$ $C_2H_5OH \longrightarrow CH_2=CH_2+H_2O$	02 02	04
2-d	**Modification of Baeyer's strain theory** (Sache-Mohr theory of strain less rings) Sache & Mohr proposed theory about stability of cycloalkanes that such rings can becomes free from strain if all the ring carbon are not forced into one plane, as was assumed by Baeyer. If the ring assumed a folded or puckered condition the normal tetrahedral angle 109^028 are retained & so the strain within the ring is relieved.eg. cyclohexane can exist in two non-planer puckered conformations both of which are completely free from strain.	04	04
2-e	**Preparation of benzene** **From phenol** Phenol when heated with zinc dust gives benzene. $C_6H_5OH+Zn \rightarrow C_6H_6+ ZnO$	02	04

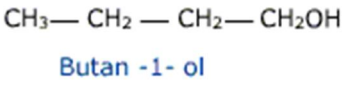
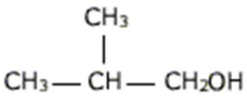
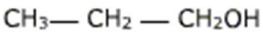
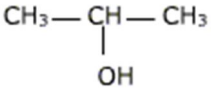
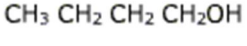
	From acetylene Red hot Cu tube C_2H_2----------→ C_6H_6	02	
2-f	**Action on Ethanol** 1**. Acetic acid** Ethanol reacts with acetic acid to form ester. The process is called esterification.It is reversible &generally carried out in presence of a dehydrating agent like conc. H2SO4 $CH_3COOH + C_2H_5OH \leftrightarrow CH_3COOC_2H_5 + H_2O$ 2.**Sodium metal** When ethanol reacts with sodium metal sodium ethaxoide is formed . $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$ Sodium ethoxide 3.**Hydrochloric acid** Ethanol reacts with HCl to form ethyl chloride i.e. alkyl halide. $C_2H_5OH + HCl \leftrightarrow C_2H_5Cl + H_2O$ 4.**PCl_5** When ethanol reacted with PCl5 alkyl halide is formed. $C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl + POCl_3 + HCl$	01 01 01 01	04
3-a i)	**Aldehyde** 	1	4

ii)	**Ester**	1	
iii)		1	
	Amines		
iv)		1	
	Ether		
			
3-b	**Ozonolysis of alkenes** It is a reaction in which the double bond is completely broken and the alkene molecule converted into two smaller molecules.  Ozonolysis (cleavage "by ozone) is carried out in two stages:	1	4

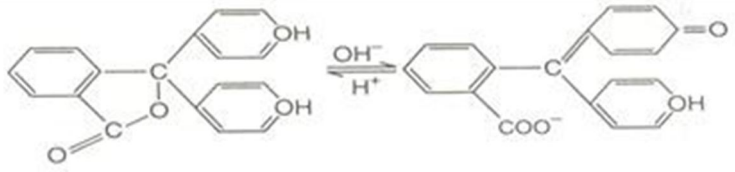
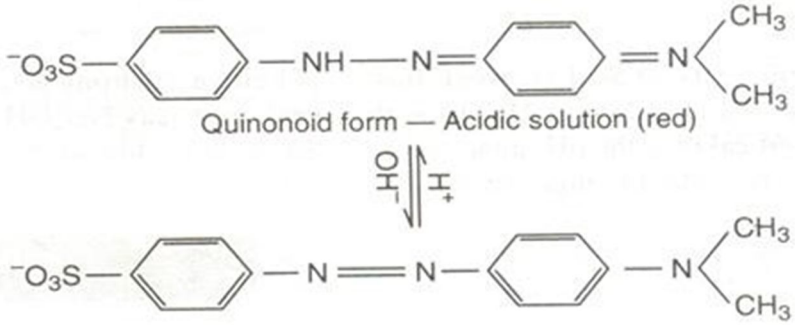
	i)First, addition of ozone to the double bond to form an ozonide ; ii)Second, hydrolysis of the ozonide to yield the cleavage products. Ozone gas is passed into a solution of the alkene in some inert solvent like carbon tetrachloride; evaporation of the solvent leaves the ozonide as a viscous oil. This unstable, explosive compound is not purified, but is treated directly with water, generally in the presence of a reducing agent. If oxidsing reagent is used, aldehyde or ketone if oxidisable can further oxidise into carboxylic acid which is not the case with reducing agents. The function of the reducing agent, which is frequently zinc dust, is to prevent formation of hydrogen peroxide, which would otherwise react with the aldehydes and ketones. (Aldehydes, RCHO, are often converted into acids, RCOOH, for ease of isolation.)  **Ozonalysis** is the best method for locating the position of double bond in unknown alkenes. In the cleavage products a doubly-bonded oxygen is found attached to each of the originally doubly-bonded carbons.  **Acetone** **and** **Acetaldehyde**	2 1	

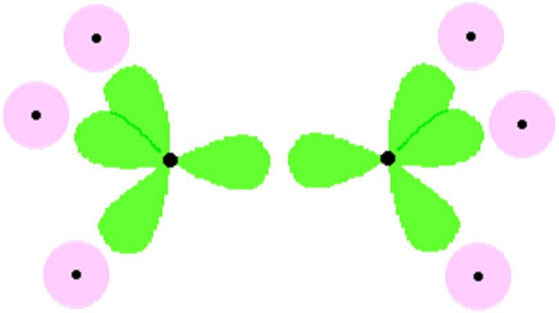
	Joining the oxygenated carbon by double bond we get the original alkenes  **2-Methyl-2-butene**		
3-c	**Nitration:** When benzene is treated with mixture of conc.H_2SO_4 and conc HNO_3 below 60^0C benzene gives nitrobenzene while above this temprature the main product is m-Dinitro benzene.  **Sulphonation:** When Benzene is treated with hot conc. Sulphuric acid then formation of Benzene Sulphonic acid takes place 	2 2	4
3-d	**Reaction with Bromine** On treating phenol with bromine, different reaction products are formed. When	2	4

	the reaction is carried out in a solvent of low polarity such as $CHCl_3$ or CS_2 and at low temperature, mono bromo phenols are formed.  **Reaction with Bromine water** When the reaction is carried out in aqueous medium (apolar solvent) i.e., bromine water 2,4,6 tribromophenol is formed.  	2	
3-e	**Isomerism** occurs when two or more organic compounds have the same molecular formulae, but different structures. These differences tend to give the molecules different chemical and physical properties. There are three types of structural isomerism that you need to be aware of: chain isomerism, positional isomerism and functional isomerism. **Isomerism of alcohols**	1	4

	Alcohols exhibit following types of isomerism: **1. Chain isomerism** Alcohols with four or more carbon atoms exhibit this type of isomerism in which the carbon skeleton is different.  Butan -1- ol  2 - Methylbutan -1-ol **2. Position isomerism** Alcohols with three or more carbon atoms can exhibit position isomerism. In this type of isomerism the position of the functional group i.e., the -OH group varies. In other words the carbon atoms to which the -OH group is attached is different.  Propan -1- ol  Propan -2- ol **3. Functional isomerism** Alcohols with two or more carbon atoms can exhibit functional isomerism with ethers. Thus ethers and alcohols have the same molecular formula but have different functional groups, hence they are called functional isomers.  Butan -1- ol	1 1 1	

	$CH_3— CH_2— O— CH_2CH_3$ Ethoxyethane		
3-f	**Quinonoid theory:** According to this theory: (a) The **acid-base indicators** exist in two tautomeric forms having different structures. Two forms are in equilibrium. One form is termed benzenoid form and the other quinonoid form.  (b) The two forms have different colors. The color change in due to the interconversation of one tautomeric form into other. (c) One form mainly exists in acidic medium and the other in alkaline medium. Thus, during **titration** the medium changes from acidic to alkaline or vice-versa. The change in pH converts one tautomeric form into other and thus, the colour change occurs. **Phenolphthalein** has benziod form in acidic medium and thus, it is colourless while it has quinonoid form in alkaline medium which has pink colour.	1 1 1	4

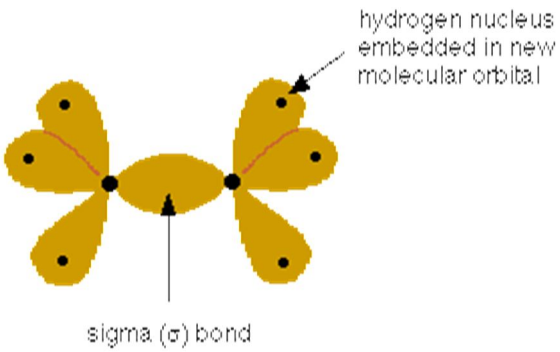
	 **Methyl orange** has quinonoid form in acidic solution and benzenoid form in alkaline solution. The color of benzenoid form is yellow while that of quinoniod form is red.  	1	
4-a i) ii) iii) iv)	Butanoic Acid 3-choro propene 1-Choro-2,2-dimethyl-propane Ethyl methyl ketone	1 mark each	4
4-b	Each carbon atom in the ethane promotes an electron and then forms sp^3 hybrids exactly as we've described in methane. So just before bonding, the atoms look like this:	1	4



1

The hydrogens bond with the two carbons to produce molecular orbitals just as they did with methane. The two carbon atoms bond by merging their remaining sp^3 hybrid orbitals end-to-end to make a new molecular orbital. The bond formed by this end-to-end overlap is called a ***sigma bond.*** The bonds between the carbons and hydrogens are also sigma bonds.

1

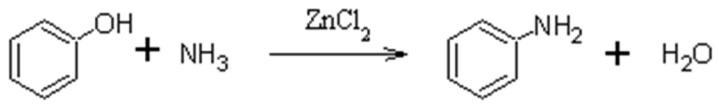
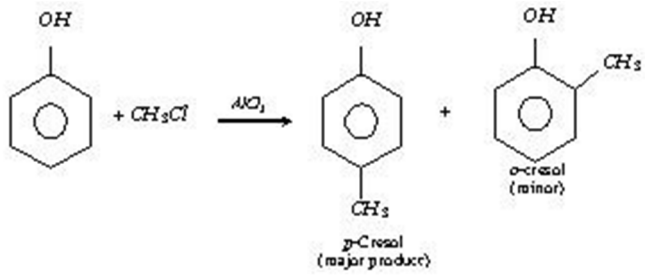


In any sigma bond, the most likely place to find the pair of electrons is on a line between the two nuclei.

The shape of ethane around each carbon atom

The shape is again determined by the way the sp^3 orbitals are arranged around each carbon atom. That is a tetrahedral arrangement, with an angle of 109.5°.

1

	When the ethane molecule is put together, the arrangement around each carbon atom is again tetrahedral with approximately 109.5° bond angles. Why only "approximately"? This time, each carbon atoms doesn't have four identical things attached. There will be a small amount of distortion because of the attachment of 3 hydrogens and 1 carbon, rather than 4 hydrogens.		
4-c	**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 methyl chloride on phenol** Phenol when treated with methyl chloride in presence of anhydrous aluminium chloride, *p*-cresol is the main product. A very small amount of *o*-cresol is also formed 	2 2	4
4-d	PHENOL / ALCOHOL phenol reacts with $FeCl_3$ whereas normal / alcohol can not Phenols are acidic / Alcohols are not acidic Phenols are acidic and dissolve in a basic solution. / Alcohols are not acidic and will not dissolve in a basic solution	1 mark each for any four	4

	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		
4-e	Different theories have been put forward to explain the role of indicators in the acid-base titrations's like Ostwald's ionic theory, Quinonoid theory etc. 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 phenolphthalein is a weak acid (PhH) PhH <_-_-_-_-_-_-> Ph- + H+ .....(1) (colourless (Pink in base) in acid) H+ + OH- <-_-_-_-_-_-_> H2O 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	1 1 1 1	4

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.

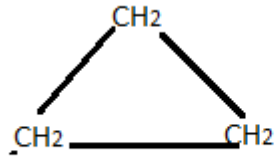
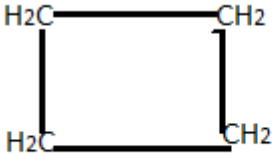
4-f

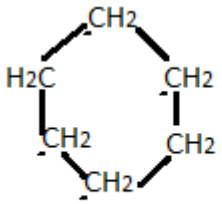
Ideal solutions	Non-ideal solutions	
	Positive deviation from Raoult's law	Negative deviation from Raoult's law
1. Obey Raoult's law at every range of concentration.	1. Do not obey Raoult's law.	1. Do not obey Raoult's law.
2. $\Delta H_{mix} = 0;$ neither heat is evolved nor absorbed during dissolution.	2. $\Delta H_{mix} > 0.$ Endothermic dissolution; heat is absorbed.	2. $\Delta H_{mix} < 0.$ Exothermic dissolution; heat is evolved.
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	5. $A-B$ attractive force should be weaker than $A-A$ and $B-B$ at	5. $A-B$ attractive force should be greater than $A-A$ and $B-B$ a

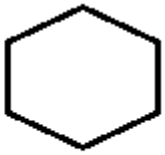
1 mark each

4

	character.	tractive forces. 'A' and 'B' have different shape, size and character.	ttractive 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.
	Examples: Dilute solutions; benzene + toluene: n-hexane + n-heptane; chlorobenzene + bromobenzene; ethyl bromide + ethyl iodide; n-butyl chloride + n-butyl bromide	Examples: Acetone +ethanol acetone + CS_2: water + methanol; water + ethanol; CCl_4 + toluene; $CCl_4 + CHCl_3$; acetone + benzene; $CCl_4 + CH_3OH$; cyclohexane +	Examples: Acetone + aniline; acetone + chloroform; $CH_3OH + CH_3COOH$; $H_2O + HNO_3$ chloroform + diethyl ether; water + HCl; acetic acid + pyridine; chloroform + benzene

	ethanol		
5-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 b)  OR  Cyclobutane	1 1	4

c) 

OR 

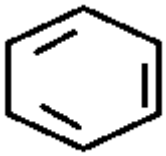
Cyclobexane

3. Aromatic compounds:

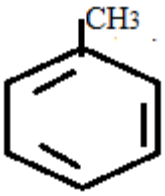
These are cyclic compounds having six membered ring of carbon atoms with alternate single and double bonds

Example :

a) Benzene



b) Teluene

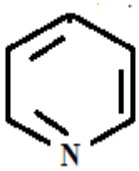
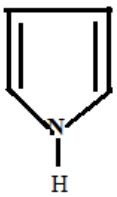
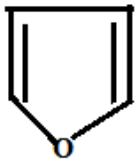


1

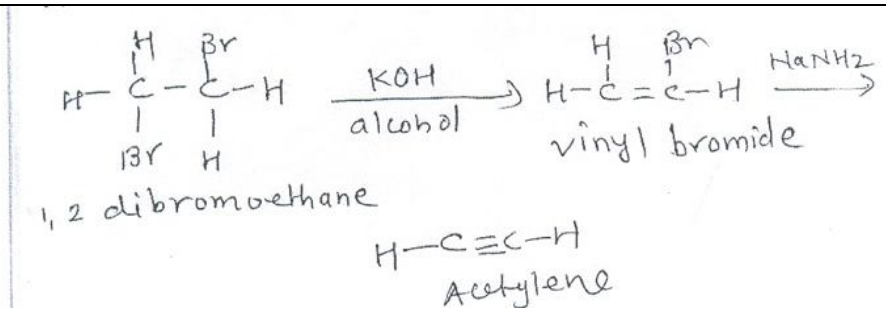
4. Heterocyclic compounds:

These are cyclic compounds in which ring consist of atoms atoms and some other element such as oxygen, nitrogen, sulphur.

1

	Example : (Any 1) a) pyridine  b) pyrrole  c) furan  d) Thiopheno 		
5-b	**Raschig process**: On industrial scale, phenol is prepared by healing chlorobenzene (obtained by raschig method) with steam at 42525^0c in presence of catalyst. $2C_6H_6 + 2HCl + O_2 \xrightarrow{Cucl2} 2C_6H_5Cl + 2H_2O$ $C_6H_6Cl + H_2O \longrightarrow C_6H_5OH + HCl.$ Chlorobenzene Phenol **Physical properties of phenol** : (Any 2) 1) Colourless, crystalline substance (m.p=43^Oc , b.pt. 182^Oc) 2) Moderating soluble in water , more in alcohol and either. 3) The needle shaped crystal are hygroscopic, corrosive and poisonous. 4) These turn pink on exposure to air and light.	2 2	4
5-c	**The action of alcohol and grignard reagent**.: Hydrocarbons are obtained when alcohols react with grignard's reagent. $H + C_2H_5$	4	4

	RO MgI $\longrightarrow$ C_2H_6 + RO – MgI Alcohol Ethyl magnetisum iodide Ethane		
5-d	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 : (Any 1) a) Mercury in zinc , Mercury in Gold, b) $CuSO_4$.$5H_2o$ 2) Liquid in liquid Example : Alcohol in water 3) Gas in liquid Example : water vapours in air, mist.	1 1 1 1	4
5-e	**Minimum boiling azeotrope** : Minimum boiling azeotrope is mixture of some definite composition which boils at a definite temperatures which is lower than the boiling point of both the component of the solution. Example : Water ethanol system boils at a temperature 78.1 ^{O}c , which is lower than the boiling point of both components. Water (100 ^{O}c), & ethanol (78.3 ^{O}c)	2 2	4
5-f	**Methods of preparation of acelylene**. 1) **By dehydrohalogenation of vicinal dihalides**. The compounds that contain halogen atoms on adjacent carbon atoms, are called as vicinal dihalides	 2	4



2

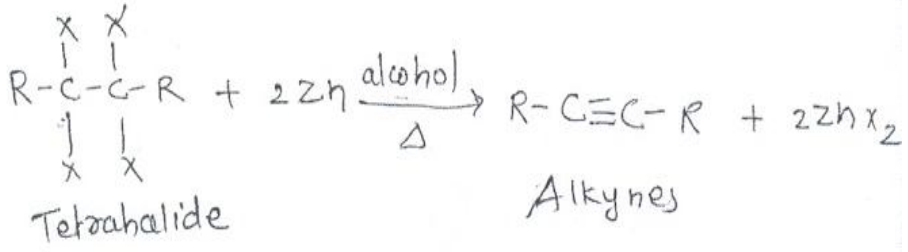
2) Reaction of calcium carbide with H_2O

$CaC_2 + H_2O \longrightarrow H-C\equiv C-H + Ca(OH)_2$

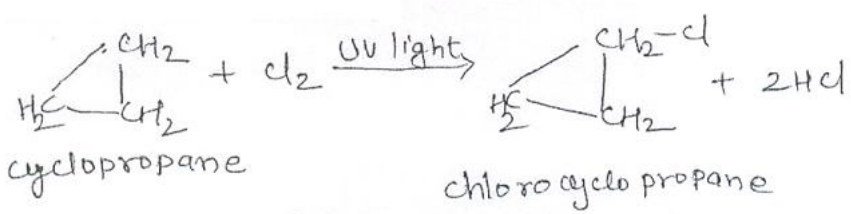
Calcium carbide Acetylene

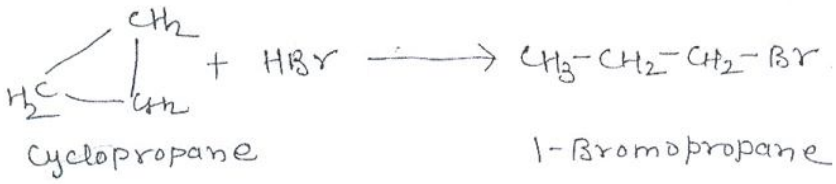
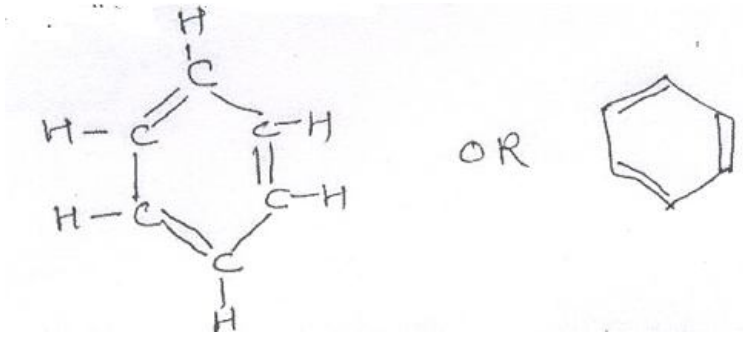
3) **Dehalogenation of Tetrahalides** :

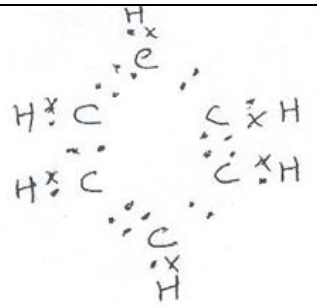
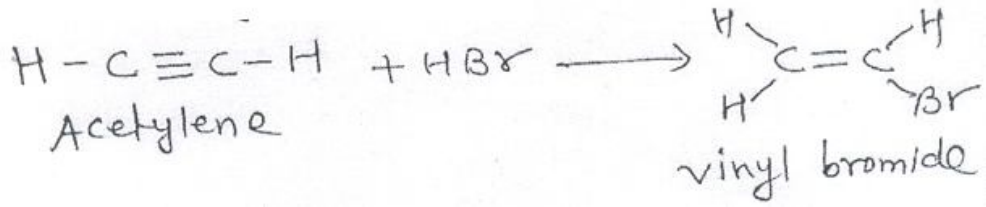
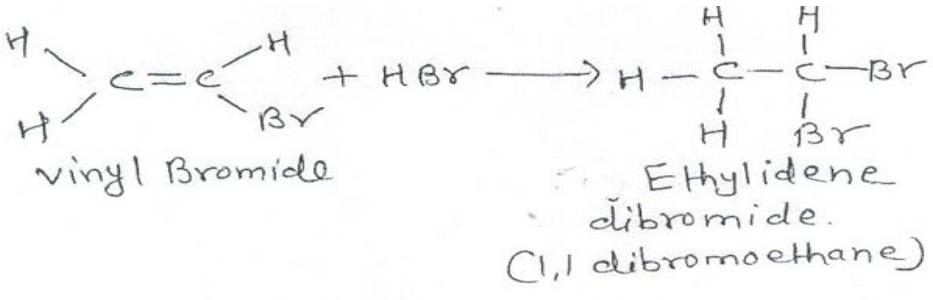
When 1, 1, 2, 2 – tetrahalides are heated with Zn dust in alcohol, they produces alkynes.

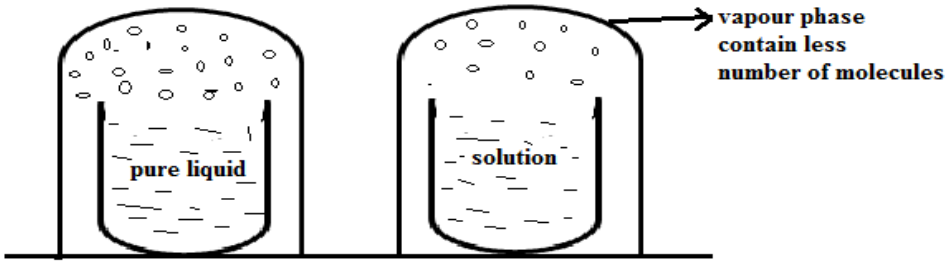


6-a	i)	**Action of chlorine** : Cyclopropane reacts with chlorin in presence of uv light to give substitution product.	2	4



	ii) Action of Hydrogen Bromide : Cyclopropane reacts with concentrated HBr to yield 1-Bromopropane.  	2	
6-b	**Structure of Benzene** : Benzene was isolated by Michael faraday in 1825. The molecular formula of benzene C_6H_6 indicates high degree of unsaturation. It has unique properties and unusual stability. So, after several years Fredrich August Kekute proposed the structure for benzene having cyclic arrangement of six carbon atoms with alternate single and double bonds and one hydrogen attached to each carbon atom.  Electronic structure of benzene may be represented as :-	2 2	4

			
6-c	**Markovnikov's Rule** : When an unsymmetrical reagent is added to an unsymmetrical alkene, the negative part of the reagent gets attached to that carbon atom which carries less number of hydrogen atoms. Example : Halogen acids adds to symmetrical alkynes in two stages, in first stage only one molecule of haloacid is added to give vinyl halide.  Addition of second molecule of HBr takes place to give geminal dibromide (Markovnilov's Rule)  	2 1 1	4
6-d	**Theory of hydrogen ion indicator** :	3	4

	This theory is based on ionization process. According to this theory : 1) An acid base indicator is a weak organic acid or weak organic base. 2) These acid base indicator ionizes to liberate a small number of H^+ ions OH^- ions. 3) The indicator have different colours in the undissociated or dissociated forms. 4) The colour imparted to the solution by the indicator depends on the relative proportions of the dissociated molecule and ions provided by the indicator on dissociation in the solution. Example :- Phenolphthalein (Hph) is a colourless weak acid. Methyl orange is a weak base.	1	
6-e	**Vapour pressure of solvent is lowered by addition of non-volatile solute** : If a non-volatile solute is added to a volatile liquid, the vapour pressure of the solution is lower than the vapour pressure of pure solvent.  In pure liquid, the whole, surface of the liquid is occupied by the molecules of the liquid. In case of solution , a part of surface of the solution is occupied by the solute particles. This decreases number of molecules of liquid at the surface of the solution. This reduces escaping tendency of solvent molecules, thereby lowering vapour pressure of the liquid (solvent)	4	4

6-f	**The difference between aliphatic and aromatic compound :** 1. Aromatic compounds are ring or close chain compounds, whereas aliphatic compounds are open chain compounds. 2. Aromatic compounds gives nitro-derivative with conc. HNO_3, aliphatic compounds does not give nitro-derivative easily. 3. Aromatic compounds have larger % of carbon than aliphatic compounds. 4. Aromatic radicals are acidic in nature whereas aliphatic radicals are basic. 5. Aromatic compounds shows name reactions like Friedel-craft's reaction, perkin reaction. Aliphatic compounds does not show this reactions. 6. Aromatic halogen compounds are less active than aliphatic compounds.	One mark each for any four	4