MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

SUMMER-13 EXAMINATION

Model Answer

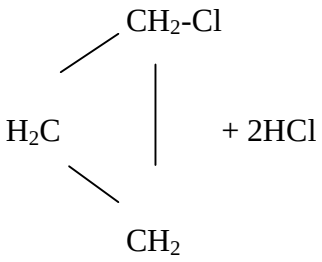
Subject code : ICE(12077)

Important instructions to examiners :

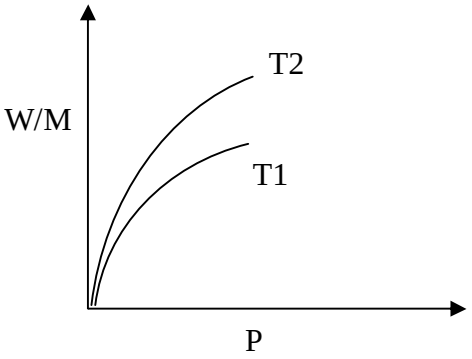
1. The answers should be examined by keywords and not as word to word as given in the model answer scheme.
2. The model answer and the answer written by candidate may vary, but the examiner may try to assess the understanding level of the candidate.
3. The language errors such as grammatical, spelling errors should not given more importance.
4. While assessing figures, examiner may give credit for principal components indicated in a 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 answer and model answer.
6. In case of some questions credit may be given by judgment of relevant answer based on candidates understanding.

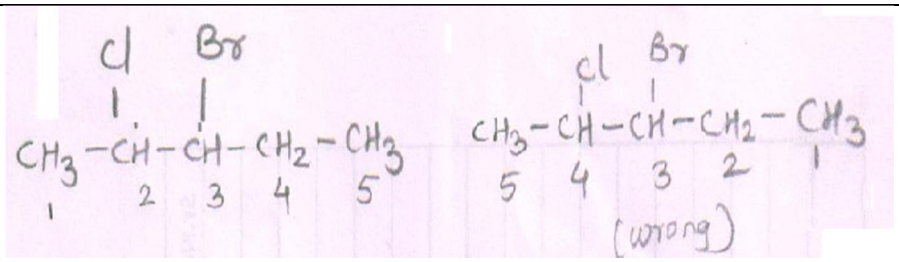
Q No:	**Answer**	**Mark**	**Total marks**
1.a	Iso-is used for those alkanes which have a methyl group(CH_3-)attached to the second last carbon atom of the continuous chain. CH_3 |. CH_3-CH-CH_3 Isobutane Neo-is used for those alkanes which have two methyl group attached to the second last carbon atom of the continuous chain. CH_3 | CH_3-C-CH_3 | CH_3 Neopentane	½ ½ ½ ½	02

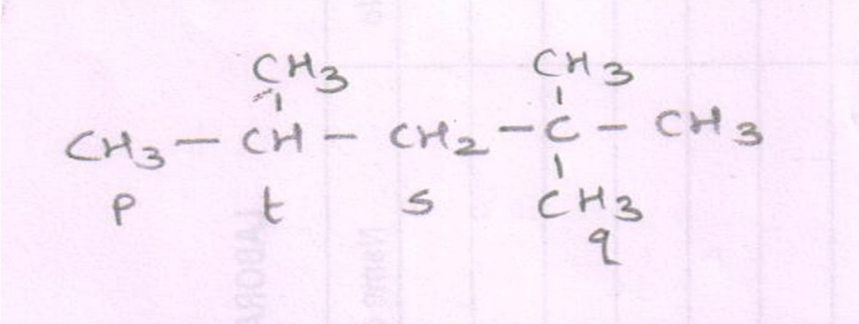
1.b	Saturated-The hydrocarbons in which all the bonds of carbon atoms are fully utilized and cannot take up more hydrogen are known as saturated hydrocarbon.e.g.-alkanes,CH_4,C_2H_6 Unsaturated-The hydrocarbons in which all the bonds of carbon atoms are not fully utilized and can take up more hydrogen or other atoms are known as unsaturated hydrocarbon.e.g.alkenes,alkynes,ethylene,C_2H_4,C_2H_2	½ ½ ½ ½	02
1.c	1. Aromatic compounds are ring OR closed chain compounds, whereas aliphatic compounds have open chain formulae. The ring structure of the aromatic compounds gives extreme stability in spite of their unsaturated nature 2. They give nitro derivatives, when heated with concentrated nitric acid. In case of aliphatic compounds, the nitro derivatives are not formed easily.	01 01	02
1.d	**Adsorbate**-The substance that gets adsorbed is called the Adsorbate. It can be a gas or vapor or a solute in a solution. for e.g. ammonia, hydrogen **Adsorbent**-The substance on whose surface adsorption takes place is called the adsorbent. For e.g. charcoal	01 01	02
1.e	Azeotropic mixtures are liquid mixtures which when boiled produce vapours of the same compositions as the boiling liquid & the liquid therefore does not change in compositions as it vapouries. e.g. Ehanol-water	01 01	02
1.f	i) amine group-NH_2 ii) acid group-COOH	01 01	02
1.g	Dehydration of alcohols-Alcohols when heated with a suitable dehydrating agent such as concentrated sulfuric acid undergoes loss of water to form corresponding alkenes	01	02

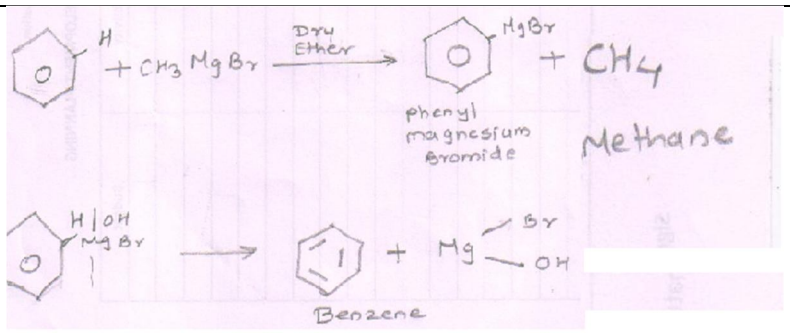
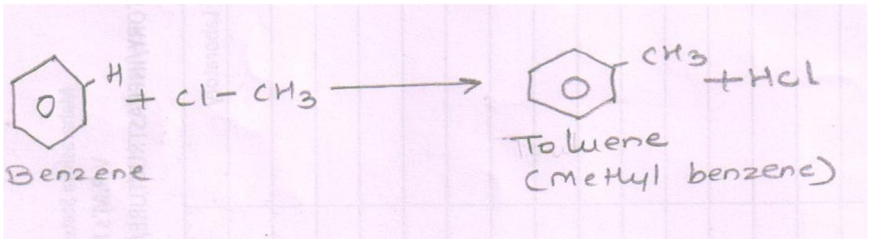
	$CH_3\text{-}CH_2\text{-}OH \xrightarrow{95\%H_2SO_4 \text{ at } 443K} CH_2{=}CH_2{+}H_2O$	01	
1.h	The Gibbs phase rule gives the relationship between the degrees of freedom of a system & the number of components & phases in equilibrium in the system. F=C-P+2	01 01	02
1.i	PH scale-A scale called the PH scale, is introduced to indicate H+ ion concentration. When PH=7, the solution is neutral, pure water.	01 01	02
1.j	By heating an aromatic acid or its sodium salt with soda lime(Removal of COOH group) $C_6H_5COONa+NaOH \rightarrow C_6H_6+Na_2CO_3$	01 01	02
1.k	) 3-ethyl-1-butene ii) 1-bromo-2-ethyl-2-methyl propane	01 01	02
1.l	i) Chlorocyclopropane  ii) $CH_2\text{-}CH_2\text{-}CH_2$ | | Cl Cl 1,3-Dichloropropane	01 01	02
2.a	i) Methyl butanoate ii) 4-chloro-1-pentene	02 02	4
2.b	**Chlorination**- alkanes react with chlorine in the presence of ultra violet light or at temperature of 300-400degC gives a mixture of products $CH_4 + Cl_2 \xrightarrow{UV\ light} CH_3Cl+HCl$	02	4

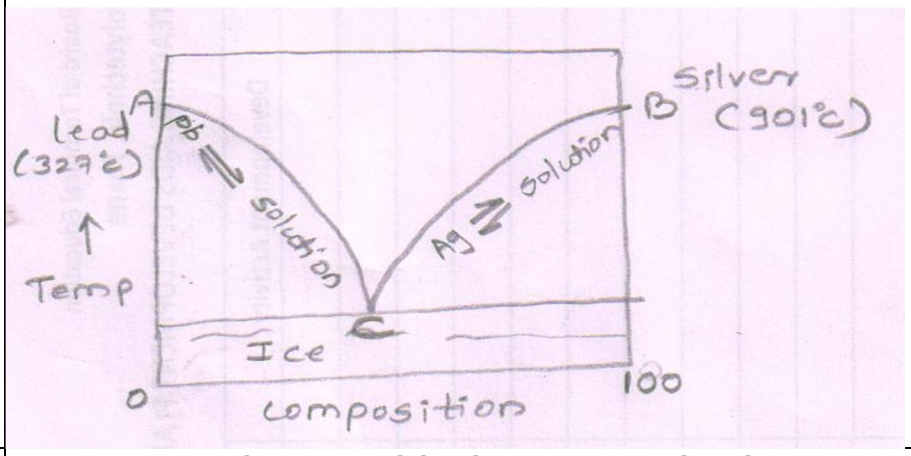
	or Δ Methyl chloride The reaction does not stop at this stage $CH_3Cl + Cl_2 \longrightarrow CH_2Cl_2 + HCl$ Dichloromethane $CH_2Cl_2 + Cl_2 \longrightarrow CHCl_3 + HCl$ Trichloromethane/chloroform $CHCl_3 + Cl_2 \longrightarrow CCl_4 + HCl$ Tetrachloromethane/carbon tetra chloride. **Nitration**- reaction of alkenes with nitric acid. When mixture of an alkane & nitic acid vapors is heated at 400-500degC, one hydrogen atom on the alkane is replaced by a nitro group $CH_4 + HNO_3 \xrightarrow{450degC} CH_3NO_2 + H_2O$ Methane Nitromethane	02	
2.c	**Position isomerism**-This isomerism exhibited by alkyl halides is due to the difference in the position of the halogen atom in the same chain & is known as position isomerism. e.g. CH3CH2.CH2I n-propyl iodide CH3.CHI.CH3 isopropyl iodide Both have straight chain formulae but differ in position of the halogen atom which is linked with the end carbon atom in the first case & with the middle carbon atom in the other. **Chain isomerism**-Paraffins exhibit chain isomerism. Alkyl halides show chain isomerism depending upon nature of the chain whether it is straight or branched. e.g.	02 02	04

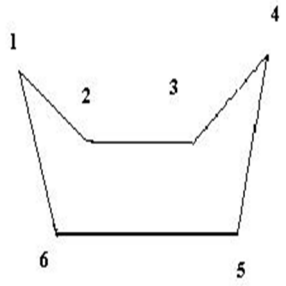
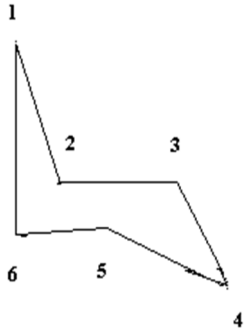
	CH3.CH2.CH2.CH2Br n-Butyl bromide &isobutyl bromide.		
2d	Monohydric alcohols are further classified as primary, secondary & tertiary alcohols according as the carbon atom to which the hydroxyl group is attached, is primary, secondary & tertiary carbon atom. Primary alcohol contain the primary alcoholic group,-CH2OH,e.g. methanol CH3OH Secondary alcohol-CH3)2CHOH isopropyl alcohol Tertiary alcohol-(CH3)3COH tert-butyl alcohol	02 02	04
2e	Frenundlich adsoption isotherm $W/m = kp^n$ (for gases) at const. temperature  The Freundlich adsorption isotherm is represented by the above mathematical equation. Where W-mass of adsorbate m- mass of adsorbent w/m-is the mass of adsorbate per gram of the adsorbent at pressure p. p is the equilibrium pressure & c is equilibrium concentration(for solutions) k & n are constants that depend upon the nature of adsorbent & adsorbate. The values of k & n are determined by plotting ln (w/m) against ln C(or log of P) In actual practice if the plot of ln(w/m) v/s lnC or ln P comes out to be a straight line then the Freundlich adsorption isotherm is verified. The freundlich adsorption isotherm holds good for medium pressures of	02 02	04

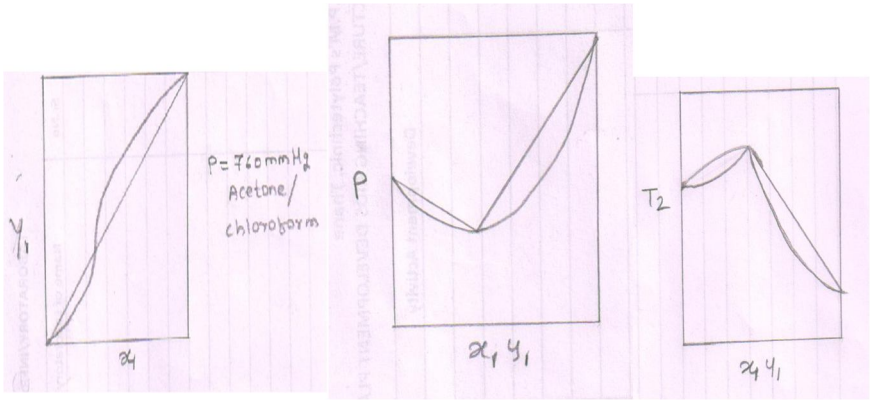
	gases.		
2f	This theory is based on the phenomenon of ionization. According to the theory 1) an acid base indicator is a weak organic acid or a weak organic base.2)the acid base indicators ionize to liberate a small no. of H+ ions or OH- ions.3) the colour imparted to the solutions depends upon the relative proportions of the dissociated molecule & the ions provided by the indicator, on dissociation in solution. Consider that the indicator to be used be an acid of chemical formula HIn. The dissociation can be represented as $HIn \longleftrightarrow H^+ + In^-$ Colour P Colourless colour R For the above equilibrium,we can write $K_{ln} = [H^+][In^-]/[HIn]$ Where Kln-is called as the indicator constant/indicator dissociation constant.	02 02	04
3a	 The IUPAC rules for nomenclature of branched chain hydrocarbons – for eg. Selection of the longest carbon chain, parent carbon chain is Pentane. 1. There are two functional groups are attached namely –Cl and-Br . Then naming of chain is done as per the alphabetical order. In the above example , IUPAC rule give name as 3- Bromo – 2, Chloro pentane and not 3- Bromo- 4, Chloro pentene. 2. When substituent are present , then numbering is started from that side	2	4

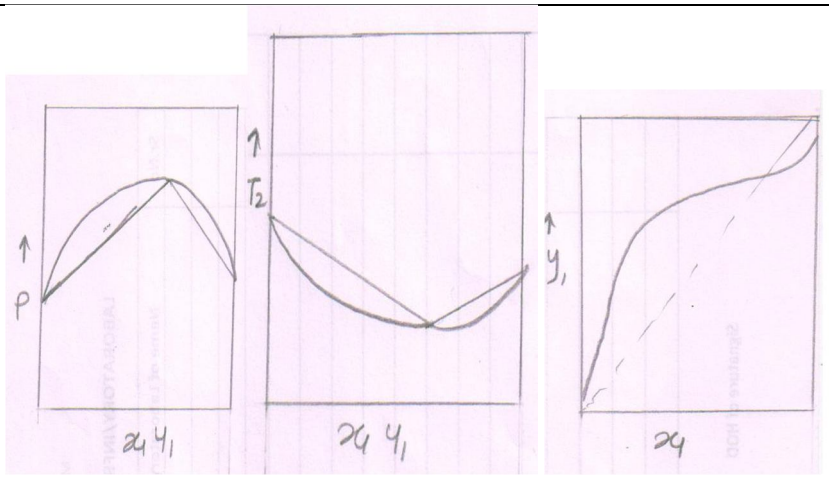
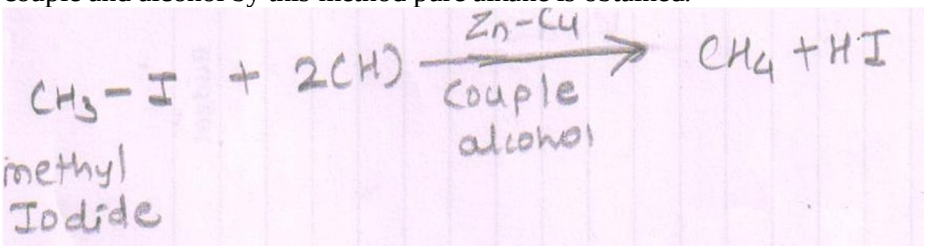
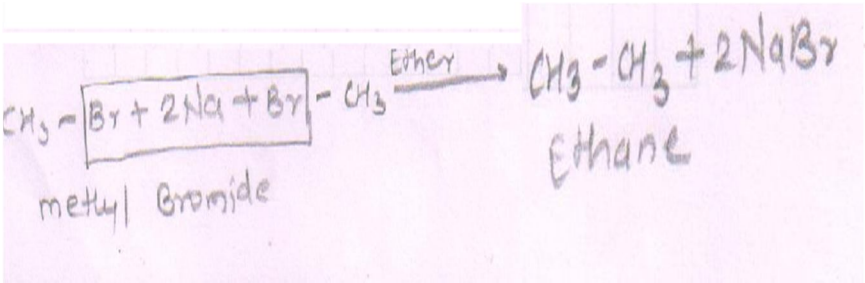
	which gives lowest numbers. 3. If there are two , three or four identical groups are present on the compound then di, tri or tetra prefix are used 4. Numbering is started from that side of the chain where the functional group is attached 5. CH3  P= primary carbon atoms. T= tertiary carbon atom S= Secondary carbon atom q= quaternary carbon atom	2	
3b	<table><tr><td>Physisorption</td><td>Chemisorption</td></tr><tr><td>It is due to physical forces such as vander waal's force of attraction.</td><td>It is due to forces of chemical nature.</td></tr><tr><td>Bond formed is very weak</td><td>Bond formed is very strong</td></tr><tr><td>It take place at low temperature</td><td>It take place at high temperature</td></tr><tr><td>Rate of absorption is fast</td><td>Rate of absorption is low</td></tr><tr><td>Reversible in nature</td><td>Irreversible in nature</td></tr></table>	1 ark each	4
3c	1.Grignard's Reaction	2	4

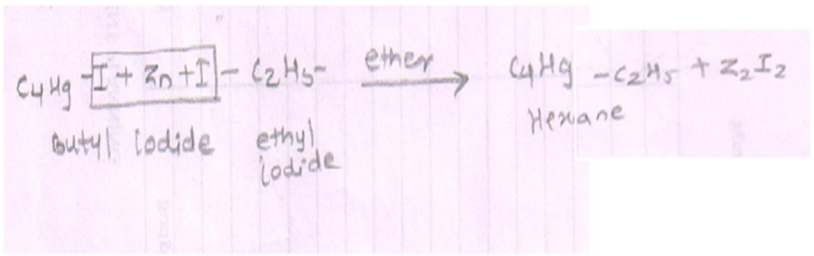
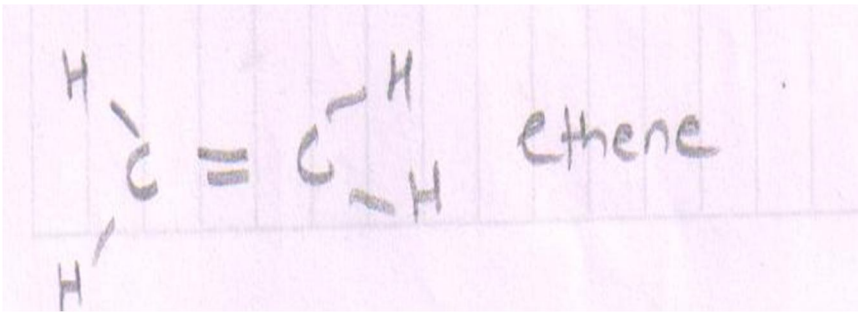
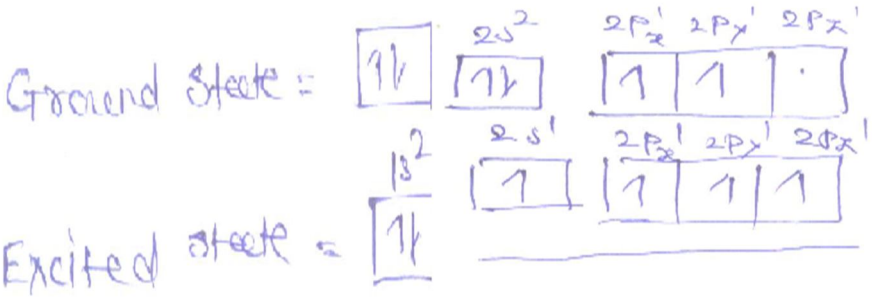
	 2. Friedel craft reaction When Benzene is treated with methyl chloride, methyl benzene (Toulene) is formed. 	2	
3d	The minimum number of phase is one and maximum of degree of freedom is 3. For two component system e.g. Lead – Silver system 1. Three metals are completely miscible in liquid state and don't give rise to any compound formation. 2. Pure lead melts at 327^0 C and addition of Silver, lower it's M.P. along curve AC. Thus curve AC is Freezing point curve of Lead. 3. BC isfreezing point curve for silver. Pure silver melts at 901^0 C and addition of Lead lowers its M.P. along the curve BC. 4. Along AC solid lead and solution coexist in equation. 5. Along curve BC Silver and solution coexist in equation. 6. ' C is the triple point where 3 phases are in equation. These are lead and solid Silver and there liquid solution. 7. These triple point is having zero degree freedom. 8. The triple point is 303^0C . The composition of solution contains 2.6% silver. 9. The application of lead silver system is in connection with desilverisation of lead.	2	4

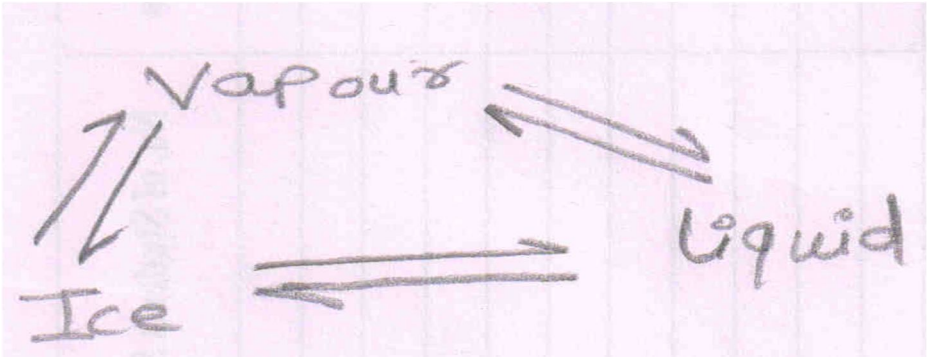
		2	
3e	In 1890 Sche suggested that the ring compounds with 6 or more 'C' atoms could exist without (-) strain . According to Bayer's strain theory If the 'c' atoms forming the ring diden't lie in the same plane but took up multiplanes fokled conformations retaining the normal valency angle and there by producing strainless ring containing 6 or more 'c' atoms may become strainless by assuming a folded form. By folded form or conformation the angle between two valency bond is 109^0 28'. According to Bayer strain theory put forward the valency angle can be altered from the normal value($109^0$28') by bending of the valency bonds. But due to bending of valency bond a strain is set in molecule. Greater the deviation from the normal angle, greater the strain and greater the instability of organic compounds. According to Bayers Cyclohexane being more stable due to multiplaner structure and retaining normal valency angle. This can be conform by heating Cyclohexane and Cyclopentane separately at 300^0C, it is observed that cyclopentane ring gets opened but Cyclohexane ring do not get opened.	4	4

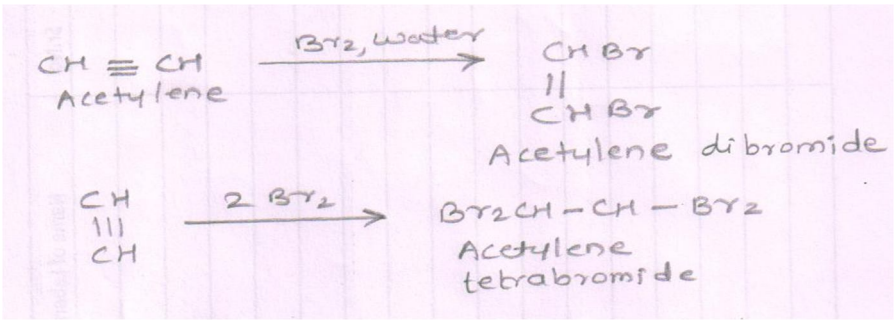
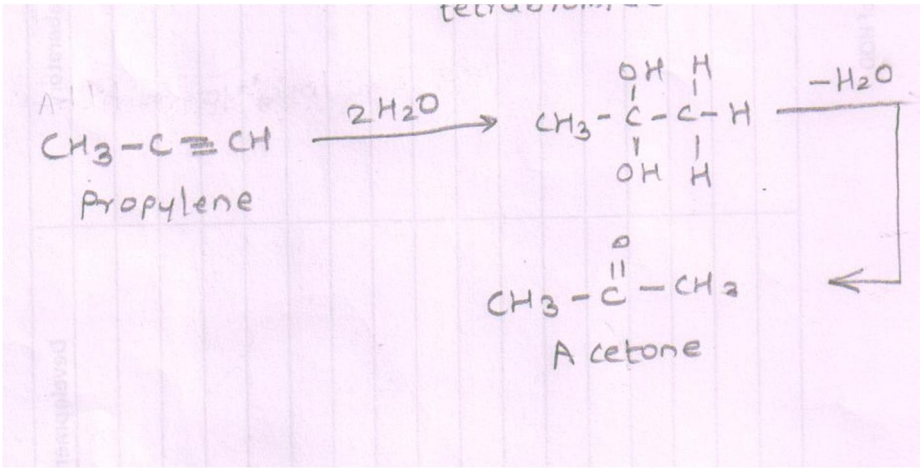
	  Boat form chair form Because of folded conformation and retaining normal valency $109^0 28'$ Cyclohexane is stable without any strain.		
3f	It has been postulated that Raoult's law is applicable to the solvent. It is very true that Raoult's law holds good approximation in dilute solution although deviation accure at higher concentration. These solutions are clearly not ideal. The various equations for rise of boiling point, lowering of freezing point and osmotic pressure will apply to them in the same region the Raoult's law apply to the solvent. Such solutions are called ideal solutions. Ideal solution obey Raoult's law, which is, $p= p^0 x_1$ x_1= mole fraction of the solvent p^0= vapour pressure of pure solvent p= vapour pressure of solution The vapour pressure of solvent is lowered by the addition of non volatile solute because there is formation between solute and solvent association to form complex molecule. Two constituents may be fundamentally in capable of forming an ideal system.	3 1	4
4a	i) Decarboxylation of fatty acid Heating sodium salt of fatty acids with soda lime (NaOH+CaO) an alkane is form. The alkane obtained by this method contains 1 carbon atom less than the acid from which it is prepared.	2	4

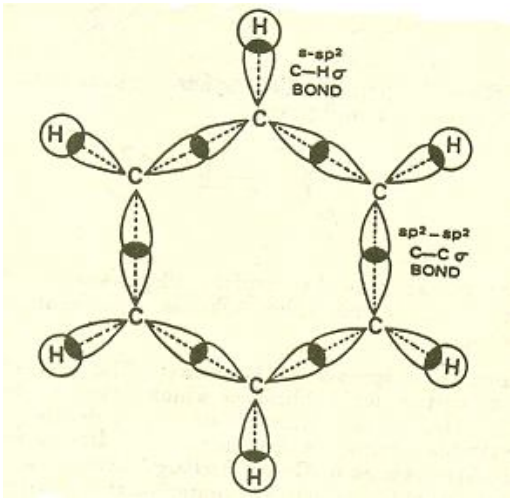
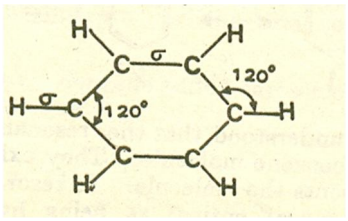
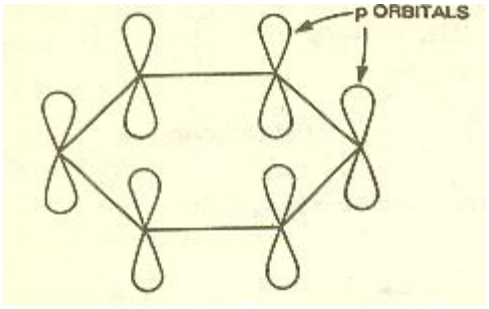
	$CH_3CaOONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$ ii) Hydrogenation of unsaturated hydrocarbon (2 marks) $CH_2 = CH_2 + H_2 \xrightarrow[300^0C]{Ni} CH_3\text{-}CH_3$ Ethene Ethane $CH \equiv\equiv CH + 2H_2 \xrightarrow[300^0C]{Ni} CH_3\text{-}CH_3$ A mixture of unsaturated hydrocarbon alkane or alkines and hydrogen gas when passed over finely divided Ni or Pt at 250^0C, 2300^0C gives an alkane.	2	
4b	Non ideal mixture shows deviation from Raoult's law and can be separated into pure component by fractional distillation. The minimum or maximum constant boiling mixture, boil without change in composition are called azeotropes. Like a pure liquid, Azeotrope boil at constant temp. and constant preesure without change in a composition are called as azeotropes . Azeotropic system are those which shows a maxima or minima on Tx-y and Px-y diagrams. A mixture which shows maxima on Tx-y is called maximum boiling Azeotrope. A mixture which shows a minima on Px-y diagram is called minimum boiling Azeotrope .  Maximum Boiling Azeotrope	2 2	4

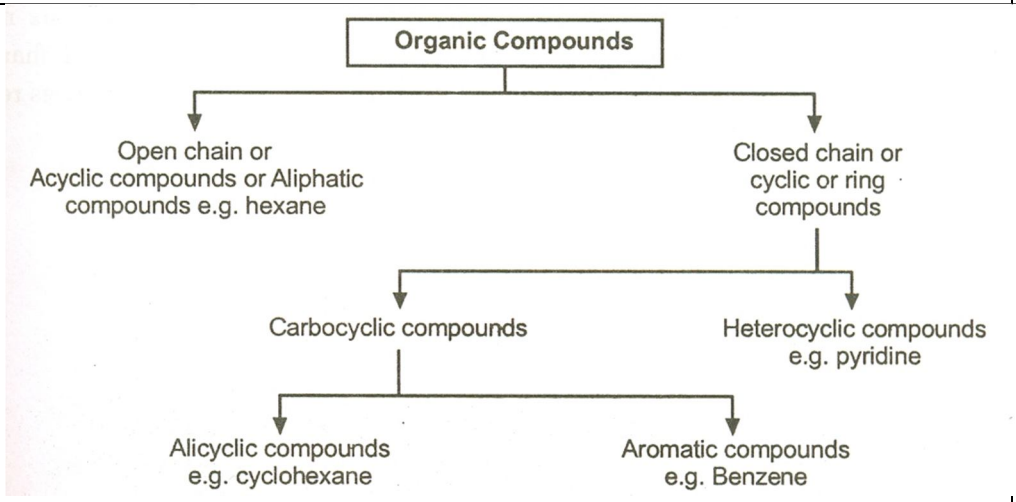
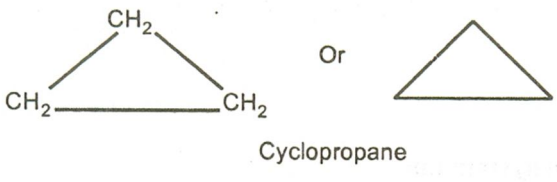
	 Minimum Boiling Azeotrope		
4c	i) Reduction reaction Alkyle halides when reduce with reducing agent such as Zn and HCl or Zn-Cu couple and alcohol by this method pure alkane is obtained.  ii) Wurtz reaction = Alkyle halides on heating with Na or Zn metal in dry solution produce alkane and method is useful for higher alkanes. 1) 	2 2	4

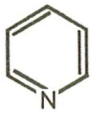
	2)  The majore limitions of Wurtz reaction is that only even member alkanes can be produced effectively.		
4d	Ethene molecule C2H4, there are 2 carbon and 4 hydrogen in formation of Ethene molecule, two carbon atoms are bonded with double bonds, 1 sigma bond and one Π bond this can be explained by SP^2 hybridization   When hydrogen atoms approaches to form a covalent bond to S electrons is parallel into the orbital Sn2p orbitals in the formation of C-C bond hybridized to give Sp2 hybride orbital of 1p orbital of C. Each carbon atom overlap with similar P orbital of another C atom Π bond. Thus two C-H bonds one C-C bond are formed while P orbitals ovelaped gives Π bond.	4	4

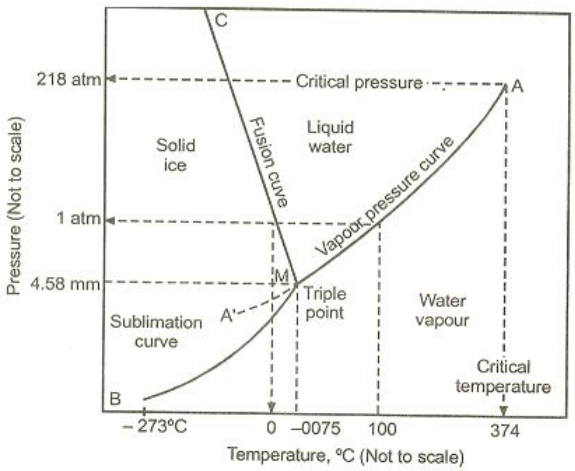
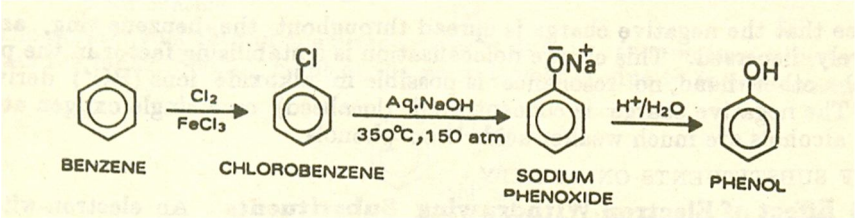
4e	i) Phase: A phase is defined a part of system which is chemically and physically uniform through out. This is intensive property such as d, T, P (not depend upon quantity). A system consisting of more than 1phase is called heterogeneous system. A homogeneous solution in which there are two chemical species is to be considered as one phase, for e.g (NaCl + H2O) though this are present Na+ and Cl- ions still it is a one phase system. Completely miscible liquids constitute a one phase system (H2O+C2H5OH). A mixture of diamond and graphite will constitute a two phase system as they have different crystal structure. ii)Component(C): It is defined as the minimum no. of chemical species necessary to described the composition of each and every phase of the system in equilibrium. For e.g. Equillibria between three phase (water).  Each phase can be represented by water therefore component is one. Aqueous sugar solution, phase is one but components are two sugar and water. Iii0 Degress of freedom(F) The number of degrees of freedom is defined as the no of intensive variables that can be independently varied without changing no of phases at equilibrium of the system. Foe e.g P=1 F=3-P =3-1 =2	1 1 2	4

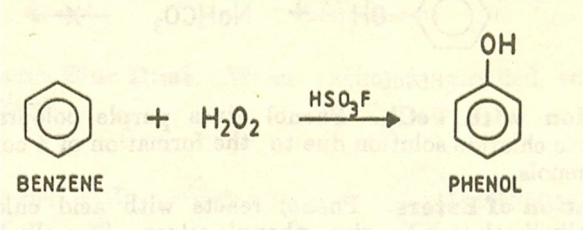
	Two independent variables are to be specified to describe the system P=3 F=3-3 =0 We need not fix any variable.		
4f	Two physical properties of alkynes 1) alkynes are gases and lighter than air. 2)They are sparingly soluble in water but very soluble in organic solvents like alcohol and acetone.  i)Two chemical properties of alkynes ii)Addition of water.  	2 2	4

5a	**Structure of Benzene** :    In the structure of benzene, all six carbon atoms in benzene are sp2 hybridised. The sp2 hybrid orbitals overlap with each other & with a orbitals of the sic hydrogen atoms forming C-C & C-H σ bonds. Since the σ bonds result the overlap of planar sp2 orbitals, all carbon & hydrogen atoms in benzene lie in the same plane. All bond angles are 120°.Also each carbon atom in benzene possess an unhybridized p-orbitals containing electron. These p-orbitals are perpendicular to the plane of σ bonds. The lateral overlap of these p-orbitals produces a π molecular orbital containing six electrons. The six electrons of p-orbitals cover all six carbon atoms, and are said to be delocalized. As a result of delocalization is formed a stronger π bond and a more stable molecule.	02 02	04

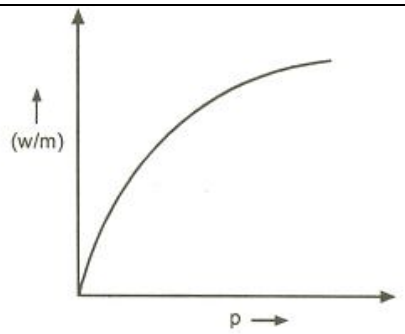
5b		02	04
	Aliphatic compounds : Compounds which consist of open chain of carbon atoms are called aliphatic compounds. There is no limit to the number of carbon atoms involved. These are acyclic or noncyclic. **e.** g. (a) Propane (b) Ethyl alcohol $CH_3 - CH_2 - CH_3$ $CH_3 - CH_2 - OH$ **Alicyclic compounds:** These are cyclic compounds composed of ring of carbon atoms having properties similar to aliphatic compounds. e.g. (a) Cyclopropane 	01	
	1. **Aromatic compounds:** These are cyclic compounds usually having six membered rings of carbon atoms with alternate single and double bonds and show typical characteristic properties. **e.** g. Benzene	01	

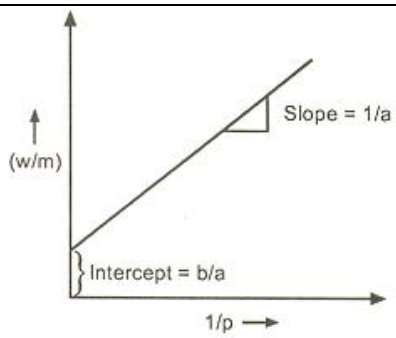
	 2. **Heterocyclic compounds**: These are cyclic compounds in which the ring consists of carbon atoms & some other elements such as oxygen, nitrogen or sulphur. **e**.g. Pyridine 		
5c	**The Water System :** Water can exist in three phases i.e solid, liquid & vapour. The water system is a three-phase one component system. All the three phases i.e ice, liquid water & water vapour have one chemical species& hence it is a one component system. From the phase rule, When C=1 F= C-P+2 =1-P+2 = 3-P i.e the degree of freedom depends on the number of the phases present at equilibrium. Three different cases are possible. P=1 , F=2 Bivariant system P=2 , F=1 Univariant system P=3 , F=0 Invariant system	02	04

	 The curve MA is the vapour pressure curve of water along which liquid water is in equilibrium with water vapour i.e along which the liquid water & water vapour coexist in equilibrium. This curve gives vapour pressure of water at different temperatures. The system is univariant ie.e has one degree of freedom. This curve terminates at point A is called as critical point. The curve MB represents the vapour pressure curve of ice along which the ice & water vapour coexist in equilibrium. It is also called as sublimation curve. The two phases along MA are liquid & water & those along MB are solid & vapour. These two curves meet at the point M at which three phases namely ice, liquid &water vapour coexixt at equilibrium. The point M at which all the three phases coexist in equilibrium is known as the triple point. The dotted curve OA is a continuation of vaporization curve represents the vapour pressure curve of super cooled water. This curve represents a metastable system.	02	
5d	**Two method of preparation of monohydric phenol**: 1) From chlorobenzene (dow Process): This involves the hydrolysis of chlorobenzene with aqueous NaOH at high temp. & pressure followed by treatment with dilute HCl 	2 marks each for any two	04

	2.From Benzene :  Benzene reacts with hydrogen peroxide in the presence of fluorosulphonic acid to form phenol. 3 **By fusing sodium sulphonate with sodium hydroxide :** $ArSO_3Na + NaOH \longrightarrow ArOH + Na_2SO_3$ Sod. sulphonate — A phenol $C_6H_5SO_3Na + NaOH \longrightarrow C_6H_5OH + Na_2SO_3$ Sodium Benzene sulphonate — A phenol 4 **By steam distilling an aqueous solution of diazonium sulphate or chloride :** $ArN_2HSO_4 + H_2O \longrightarrow ArOH + N_2 + H_2SO_4$ Diazonium sulphate — Phenol $C_6H_5N_2Cl + HOH \longrightarrow C_6H_5OH + N_2 + HCl$ 5 **By distilling a phenolic acid with soda-lime (Decarboxylation) :** $C_6H_4(OH)(COONa) + NaOH(CaO) \longrightarrow C_6H_5OH + N_2CO_3$ Sodium salt of o-, m- or p-hydroxybenzoic acid — Phenol 6 **By means of Grignard's reagent :** $ArMgBr \xrightarrow{O_2} Ar.O.MgBr \xrightarrow[acid]{H_2O} ArOH + Mg(OH)Br$ Grignard's reagent — Addition product — A phenol $Mg(C_6H_5)Br \xrightarrow{O_2} Mg(CH(OH)C_6H_5)Br \xrightarrow[acid]{H_2O} C_6H_5OH + Mg(OH)Br$ Phenyl magnesium bromide — Addition product — A phenol		
5e	**Adsorption:** The phenomenon of concentration of a chemical substances at the surface of a solid is called as adsorption. Adsorption is used to dehumidify air, to remove objectionable odours from industrial gases, to remove moisture dissolved in gasoline, etc. In adsorption, the molecules of the substances adsorbed concentrate only at the surface of a solid or a liquid.	02	04

	Absorption : The phenomenon in which a fluid permeates or dissolved by a liquid or solid is called as absorption. In absorption the molecules of the absorbed substance are dispersed/uniformly distributed throughout the bulk/body of a solid or a liquid e.g. water is absorbed by a sponge & is distributed uniformly throughout it.	02	
5f	The Langmuir adsorption isotherm is represented by the equation $\frac{w}{m} = \frac{ap}{1+bp}$ At very high pressure , it transforms into the limiting form, $\frac{w_o}{m} = \frac{a}{b} = \text{constant}$ According to equation,a given adsorbent cannot adsorb more than w_0/m of the adsorbate. w is the mass of the adsorbate, m is the mass of adsorbent, p is the equilibrium pressure of the adsorbate , a and b are constant. In order to determine the constant a and b of equation 1 , it is written in its reciprocal form as $\frac{m}{w} = \frac{1+bp}{ap} = \frac{b}{a} + \frac{1}{ap}$ A plot of m/w vs. 1/p yields a straight line with a slop = 1/a and an intercept = b/a. Hence, both the constant a and b can be determined	02 02	04





Langmuir made some assumptions :

1. The surface is uniform.
2. Only a unimolecular adsorbed layer of the adsorbed gas is formed.

Langmuir considered that the gas molecules strike the solid surface and get assorbed. Hence, in the end a dynamic equilibrium is set up between these two opposing processes i.e. between the adsorbed molecules and the free molecules.

If A is the gas molecule and M is the surface site, then

$$A(g) + M(surface) \underset{k_2}{\overset{k_1}{\rightleftharpoons}} AM$$

If p is the equilibrium pressure of the adsorbate and $\theta = w/w_0$ is the fraction of the surface covered by the adsorbed molecules at any instance, the fraction of the uncovered surface is $(1-\theta)$

Rate of adsorption = $k_1 (1-\theta) p$

Rate of desorption = $k_2 \theta$

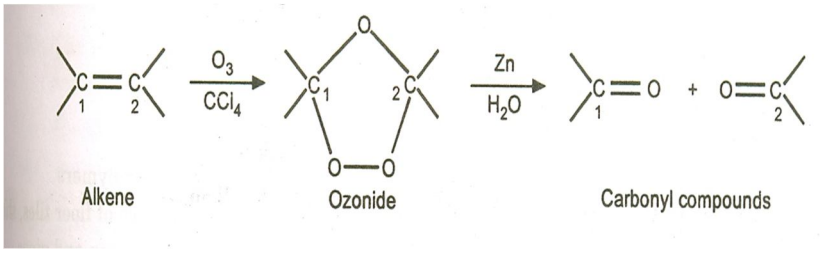
$k_1 (1-\theta) p = k_2 \theta$

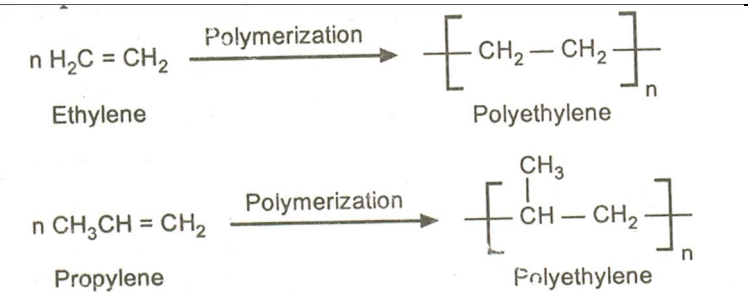
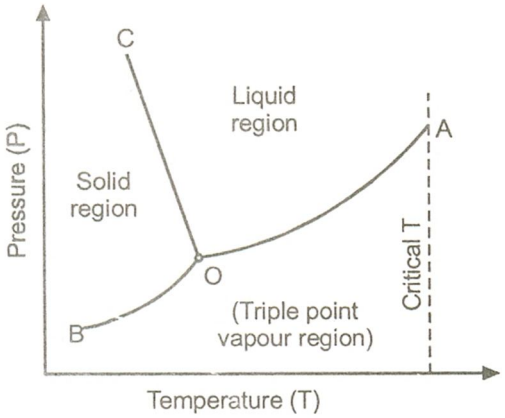
$$\theta = \frac{w}{w_o} = \frac{w/m}{w_o/m} = \frac{bp}{1+bp}$$

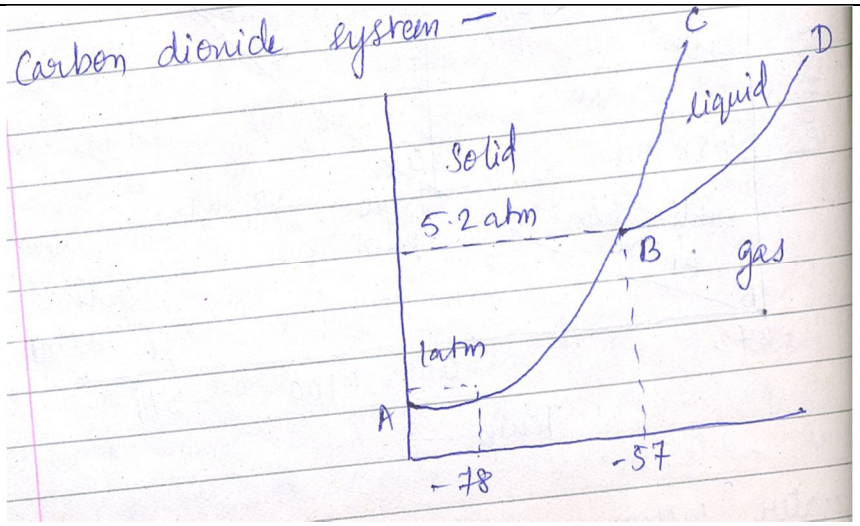
$$\frac{w}{m} = \frac{(w_o/m)\, bp}{1+bp} = \frac{ap}{1+bp} \quad \text{where} \quad a = (w_o/m) \cdot b$$

The above equation is known as Langmuir adsorption isotherm.

6a	**Pyrolysis :** the decomposition of a compound by heat is called pyrolysis. It requires temperature in the range 500 - 800°C.In the presence of silica-alumina catalyst, the reaction is carried out at less high temp. This is called	02	04

	catalytic cracking CH_3-CH_3 $\xrightarrow{500°C}$ $CH_2 = CH_2 + CH_4 + H_2$ Ethane Ethylene methane **Uses of alkane** : 1) It is used as domestic fuel in the form of natural gas. e.g. methane. 2) Used as refrigerants, solvents, etc.	02	
6b	**Properties of Phenol**: 1) Phenols are colorless crystalline solids or liquids. 2) They posses characteristic odours 3) They are soluble in alcohol & ether. 4) They are toxic in nature & possess antiseptic properties. **Properties of Ethyl 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.	02 02	04
6c	**Reaction of Ethene:** 1) **Ozonolysis** : When ozone is passed through an alkene in an inert solvent like CCl_4,it forms ozonide. On warming with zinc & water the ozonides bonds cleave at the double bond.  2) **Polymerisation:** The process by which simple molecules join together to form large molecules is known as polymerization. These reaction are catalysed by HF,H_2SO_4 or organic peroxides. They require high temp. & pressure.	02 02	04

			
6d	**Phase Diagram** :  A phase diagram is a plot of the temp. & pressure at which each phase of a pure substance is the most stable. The diagram is divided into three single phase region & are called solid, liquid & vapour region. These regions are separated by three curves. These three curves represent for the coexistence of the three phases in equilibrium. The three curves meet at the triple point where all three phases solid, liquid & vapour coexists. According to the phase rule the triple point is invariant. The system existing along any of these curves is monovariant & bivariant in the single phase region.	02 02	04
6e	**Applications of adsorption:** 1)Heterogenous catalysts: Metals like Pt, Ni, Pd, etc have tendency to adsorb gases like H_2,N_2,O_2,etc on their surfaces. In sulphuric acid manufacture,SO_2 is converted to SO_3 in presence of Pt or V_2O_5 catalyst. 2) Gas masks: In gas masks, the adsorption of toxic, poisonous gases takes place on the surface of activated charcoal. The activated charcoal, removes the toxic,	1 mark each for any four	04

	poisonous gases by adsorption & thus purifies air for breathing. 3)Removal of colored impurities from solution: The charcoal adsorbs the colored impurities from the solution & makes its cleared. Hence, it is used for decolorization purpose. 4) Higher vacuum production: If we connect a partially evacuated vessel to a container of activated charcoal or silica gel, cooled with liquid air, all the molecules from the vessel are adsorbed. 5) Chromatographic anaylsis: It involves the principle of selective adsorption. 6) Water purification: In purification of water by using a charcoal bed, it acts as a filter & as a good adsorbent , it adsorbs the impurities like organic waste matter.		
6f	 The phase diagram has three different regions in which CO_2 can exist as solid, liquid or gas. Curve AB is the sublimation curve, curve BD is the vaporization curve & curve CB is the fusion curve. Point B is the triple point at which all the three phases coexists in equilibrium. A slight increase or decrease in temp. or pressure at the triple point may result in the disappearance of atleast one phase.	02 02	04