SUMMER-15 EXAMINATION

Model Answer

Subject code :(17312)

Important Instructions to examiners:

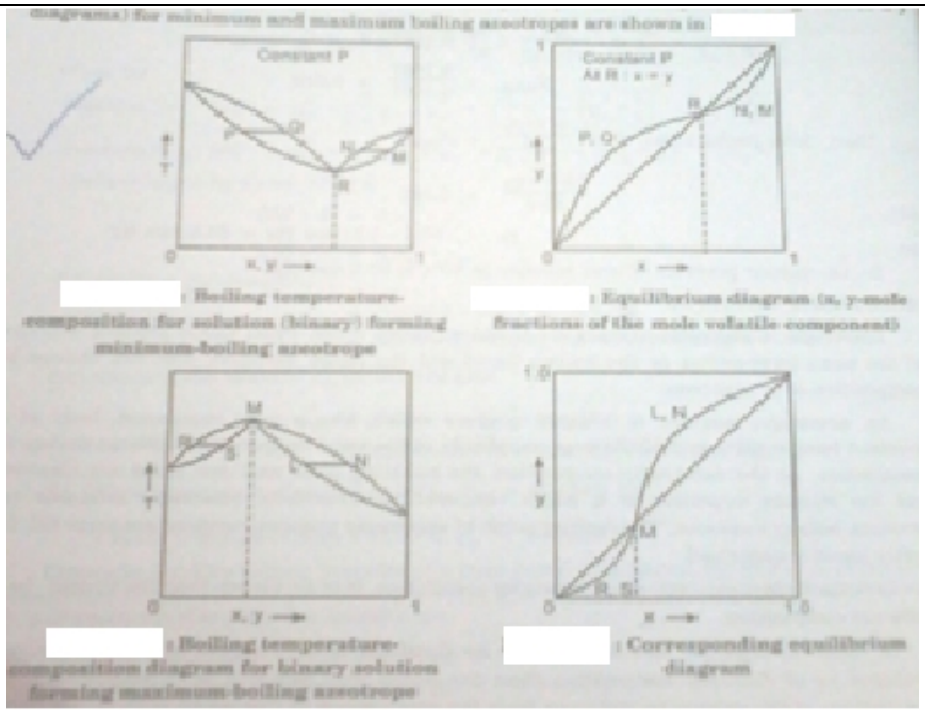
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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	Total marks
1-a	**Isomerism:**-The compounds which have same molecular formula with different structural formula are said to exhibit isomerism.Eg:-Alkyl halides, alcohol etc.	2	2
1-b	**First four elements of homologous series.** CH_4, C_2H_6, C_3H_8, C_4H_{10}.	2	2
1-c	**Physical properties of alkanes.** • First four alkanes methane, ethane, propane, and butane are gases, next 13 members are liquids and higher alkanes are solids. • Liquid alkanes are lighter than water. • They are insoluble in water but soluble in organic solvents. Boiling point and specific gravity increases with molecular wt	1mark each for Any 2	2
1-d	**Nitration.** It is the substitution of hydrogen atom from aliphatic or aromatic compound with-NO_2 group. It is carried out either with dilute or concentrated nitric acid at high temperature to yield corresponding nitro derivative. Eg:-Methane at 450^o c gives nitro methane.	2	2
1-e	**Uses of aromatic compound:** Uses of aromatic compounds: For making plastic,polymers,resins,adhesives,nylon,rubbers,lubricants,dyes,detergents,drugs,explosives,pesticides etc.	2	2

1-f	**Uses of phenols.** • Manufacturing of drugs like salol, aspirine, salicylic acid and phenacetin. • As an antiseptic-carbolic lotion and carbolic soap.	2	2
1-g	**Grignard Reagent** Aryl magnesium halide with alkyl halide(C_6H_5MgBr)	2	2
1-h	**General formula for alkene and cycloalkane.** Alkene-C_nH_2n Cycloalkane- C_nH_2n	 1 1	2
1-i	**Raoult's law.** The partial pressure of a component of a solution in the vapour is equal to the product of mol fraction in the liquid phase and the vapour pressure of the pure component.	2	2
1-j	**Define azeotrope.** Azeotropic mixtures are called azeotropes. This mixture when distilled, it gets distilled at a certain fixed temperature as a whole, so an azeotropic mixture cannot be separated into its constituents by distillation.	2	2
1-k	**Define polymerization.** It is the process of combination of two or more monomer, either of same	2	2

	or different type under specific conditions of temperature, pressure, and catalyst to give large polymer with or without the elimination of H_2O, HCl, etc.		
1-l	**Give the structure of ethyl methyl ether and formic acid.** ethyl methyl ether: $CH_3CH_2OCH_3$ formic acid:- O II H-C-OH	 1 1	2
2-a	**How organic compounds are classified? State example of each.** Organic compounds are classified as follows:- • Open chain or aliphatic compounds: eg Propane, ethyl alcohol. • Closed chain or cyclic compounds:- 1)Carbocyclic compounds:- a.Alicyclic compounds:-eg Cyclohexane b)Aromatic compounds:-eg Benzene. 2) Heterocyclic compounds:-eg Pyridine, pyrrole.	4	4
2-b	**Explain Wurtzs reaction to prepare alkanes.** Higher alkanes are prepared by heating alkyl halide with sodium metal in dry ether solution. Two molecules of alkyl halide lose their halogen atoms as NaX. Two alkyl groups are joined to yield symmetrical alkane. $CH_3Br + 2Na + Br\text{-}CH_3 \rightarrow H_3C - CH_3 + 2Na\ Br$ Methyl bromide ethane	3 1	4

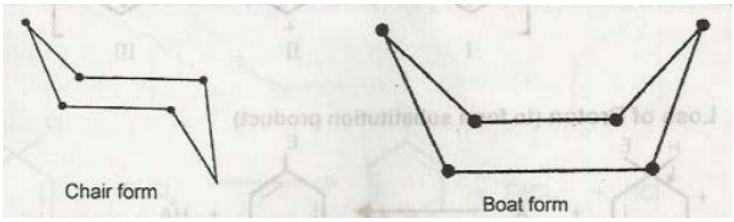
2-c	**Define pyrolysis. Explain it with reaction.** The decomposition of a compound by heat is called as pyrolysis When alkanes are heated to a high temperature in absence of air, thermal decomposition takes place, higher alkanes broken down into lower, requir temp 500-800 ^{0}c and silica alumina catalyst. Ethane heated at 500^{0}c in absence of air gives mixture of methane, ethylene and hydrogen. $H_3C\text{-}CH_3 \rightarrow H_2C{=}CH_2 + CH_4 + H_2\uparrow$ Ethane ethylene methane	2 2	4
2-d	**Explain Quinonoid theory for indicator.** According to this theory:- a. An acid base indicator is either weak acid or weak base. b. indicator consists of equilibrium mixture of at least two tautomeric forms one is benzenoid and other quinonoid form. c. two forms possess different colours. d. one exists in acid solution and other in alkaline solution. e. quinonoid form is deeper in colour than benzenoid form. f. as the pH of solution containing indicator changes, one form of indicator changes to other as a result of this solution shows a change of colour.	4	4
2-e	**Draw x-y and T-x-y diagram for minium and maximum boiling azeotrope.**	4	4

			
2-f	**Write IUPAC rules for alkanes.** • The longest carbon chain present in the molecule is selected and the complex hydrocarbon is named as alkyl derivative of parent alkane. • The positions of substituent attached to the parent chain are determined by numbering this chain from end which puts them on carbon having lowest numbers. • The position numbers of substituent are indicated in front of the names of substituent and the names of substituent are arranged in alphabetical order and are prefixed to the name of parent alkane. • The substituent names are hyphened on either side, except the last one which is merged with the name of the alkane.	1 mark each for any 4	4

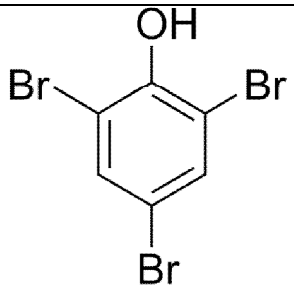
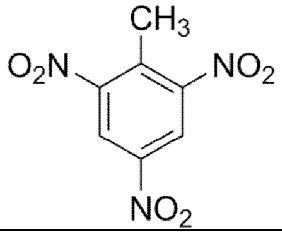
<table>
<tr><td></td><td>

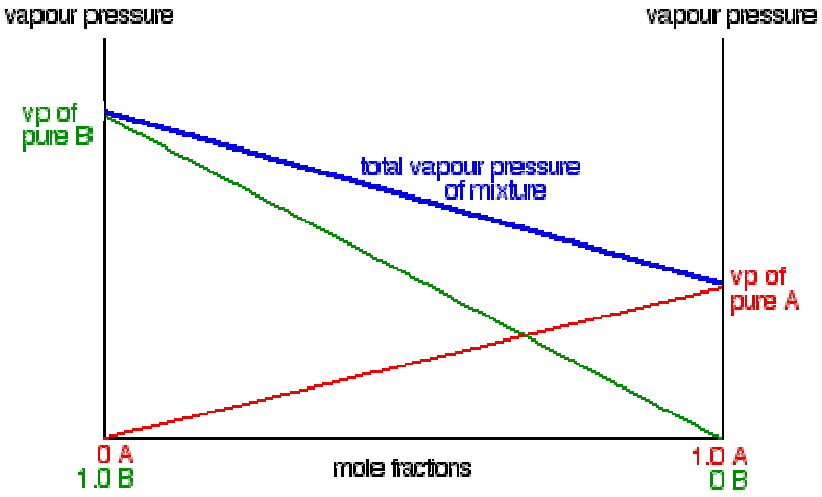
- If the same substituent appears on parent chain more than once, the position numbers are separated by commas and prefixes di -, tri-, tetra-etc are used to indicate the number of times it appears.

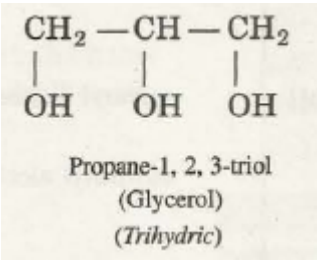
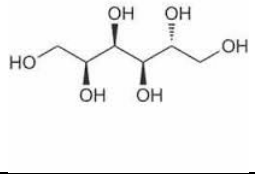
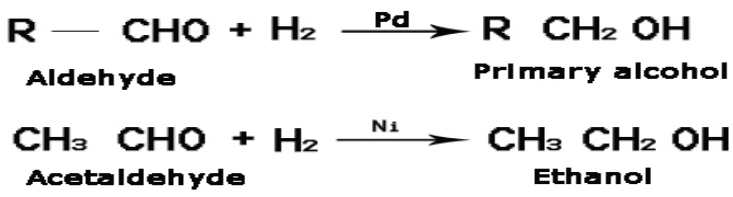
</td><td></td><td></td></tr>
<tr><td>3-a</td><td>
<table>
<tr><th rowspan="2">Ideal solutions</th><th colspan="2">Non-ideal solutions</th></tr>
<tr><th>Positive deviation from Raoult's law</th><th>Negative deviation from Raoult's law</th></tr>
<tr><td>1.Obey Raoult's law at every range of concentration.</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 dissolution.</td><td>2. $\Delta H_{mix} > 0.$ Endothermic dissolution; heat is absorbed.</td><td>2. $\Delta H_{mix} < 0.$ Exothermic dissolution; heat is evolved.</td></tr>
<tr><td>3. $\Delta V_{mix} = 0;$ total volume of solution is equal to sum of volumes of the components.</td><td>3. $\Delta V_{mix} > 0.$ Volume is increased after dissolution.</td><td>3. $\Delta V_{mix} < 0.$ Volume is decreased during dissolution.</td></tr>
<tr><td>4. $P = p_A + p_B = p_A^0 X_A + p_B^0 X_B$ i.e., $p_A = p_A^0 X_A \; ; p_B = p_B^0 X_B$</td><td>4. $p_A > p_A^0 X_A ;$ $p_B > p_B^0 X_B$ $\therefore$ $p_A + p_B > p_A^0 X_A + p_B^0 X_B$</td><td>4. $p_A < p_A^0 X_A ; \; p_B < p_B^0 X_B$ $\therefore$ $p_A + p_B < p_A^0 X_A + p_B^0 X_B$</td></tr>
<tr><td>5. $A-A, A-B, B-B$ Interactions should be same, i.e., 'A' and 'B' are identical in shape, size and character.</td><td>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.</td><td>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.</td></tr>
<tr><td>6. Escaping tendency of 'A' and 'B' should be same in pure liquids and in the solution.</td><td>6. 'A' and 'B' escape easily showing higher vapour pressure than the expected value.</td><td>6. Escaping tendency of both components 'A' and 'B' is lowered showing lower vapour pressure than expected ideally.</td></tr>
<tr><td>7.Examples:
benzene + toluene:
n-hexane + n-heptane;</td><td>7. Examples:
Acetone +ethanol</td><td>7. Examples:
Acetone + aniline;</td></tr>
</table>
</td><td>1 mark each for any 4</td><td>4</td></tr>
<tr><td>3-b</td><td>i)Dehydration of Alcohols:</td><td>2</td><td>4</td></tr>
</table>

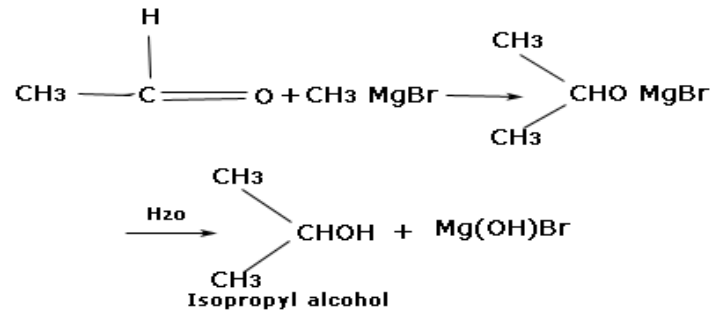
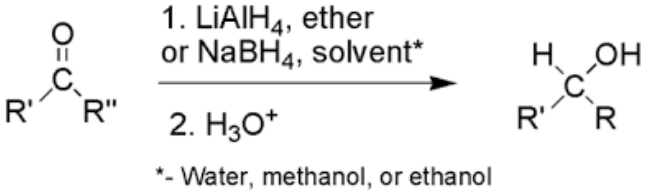
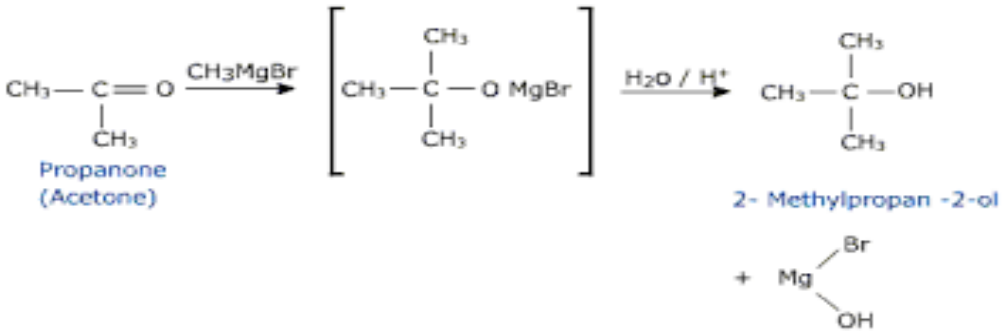
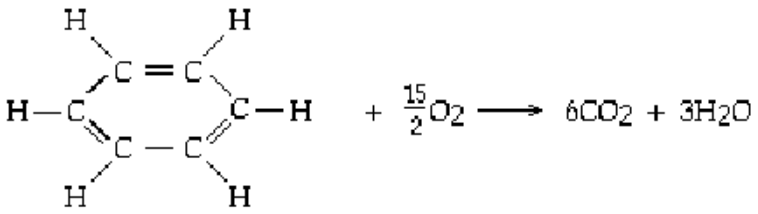
	$RCH_2-CH_2OH \xrightarrow[-H_2O]{\text{conc. } H_2SO_4,\ 453K} R-CH=CH_2$ (alcohol → alkene) $C_2H_5OH \xrightarrow{Al_2O_3,\ 623K} CH_2=CH_2$ (ethanol → ethene) ii)Dehydration of R-X: $^{\beta}CH_3-^{\alpha}CH_2Cl + KOH \longrightarrow CH_2=CH_2 + KCl + H_2O$ (Ethyl Chloride → Ethene) $CH_3-CH_2-CH_2Cl + KOH \longrightarrow CH_3-CH=CH_2 + KCl + H_2O$ (1-Chloropropane → Propene) $CH_3-CHCl-CH_3 + KOH \longrightarrow CH_3-CH=CH_2 + KCl + H_2O$ (2-Chloropropane → Propene)	2	
3-c	**Bayer's strain theory**: German chemist, H. Sachse, in 1890 suggested that in rings of six or more atoms the strain can be relieved completely if the ring is not planar but puckered, as in the so-called chair and boat conformations of cyclohexane. These large rings should then be as stable as those of five atoms—a conclusion that has been verified experimentally. For example, no significant difference referable to strain has been found between the stability of cyclotriacontane, with 30 atoms in the ring, and that of cyclopentane, with only 5. They exist in two strain less forms boat form and Chair form  	4	4
3-d	**Ostwald's theory:** According to this theory: (a) The colour change is due to ionisation of the acid-base indicator. The	1	4

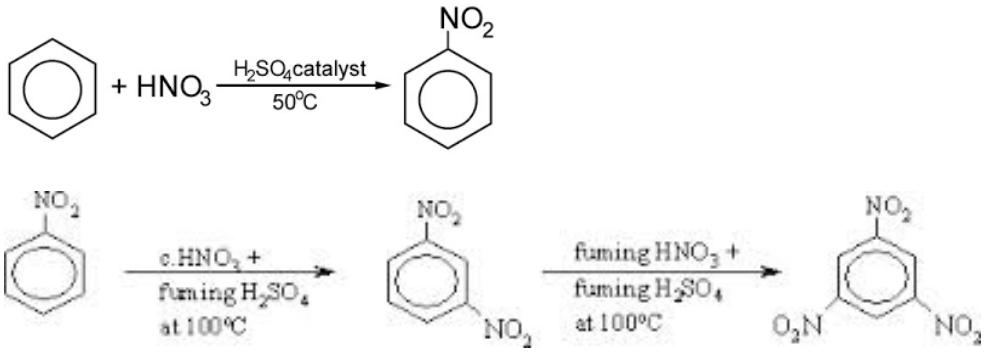
	unionised form has different colour than the ionised form. (b) The ionisation of the indicator is largely affected in acids and bases as it is either a weak acid or a weak base. In case, the indicatoris a weak acid, its ionisation is very much low in acids due to common H+ions while it is fairly ionised in alkalies. Similarly if the indicatoris a weak base, its ionisation is large in acids and low in alkalies due to common OH-ions. Considering two important indicators phenolphthalein(a weak acid) and methyl orange(a weak base), Ostwald theory can be illustrated as follows: Phenolphthalein : It can be represented as HPh. It ionises in solution to a small extent as: HPh ↔H++ Ph-Colourless Pink Applying law of mass action, K = [H+][Ph-]/[HpH] The undissociated molecules of phenolphthalein are colourless while Ph-ions are pinkin colour. In presence of an acid the ionisation of HPh is practically negligible as the equilibrium shifts to left hand side due to high concentration of H+ions. Thus, the solution would remain colourless. On addition of alkali, hydrogen ions are removed by OH-ions in the form of water molecules and the equilibrium shifts to right hand side. Thus, the concentration of Ph-ions increases in solution and they impart pink colour to the solution	1 1 1	
3-e	**Common names are:** i)Formaldehyde ii)Isopropyl alcohol iii)Ethyl bromide iv)Dimethyl ketone or Acetone	1 mark each	4
3-f	i)2,4,6-tribromophenol	2	4

	 ii)Trinitrotoluene 	2	
4-a	Raoult's Law only works for ***ideal mixtures***. In equation form, for a mixture of liquids A and B, this reads: $p_A = x_A \times P_A^o$ $p_B = x_B \times P_B^o$ In this equation, $\mathbf{P_A}$ and $\mathbf{P_B}$ are the partial vapour pressures of the components A and B. In any mixture of gases, each gas exerts its own pressure. This is called its partial pressure and is independent of the other gases present. Even if you took all the other gases away, the remaining gas would still be exerting its own partial pressure. The total vapour pressure of the mixture is equal to the sum of the individual partial pressures. $\text{Total vapour pressure} = p_A + p_B$ The $\mathbf{P^o}$ values are the vapour pressures of A and B if they were on their own as	1 1	4

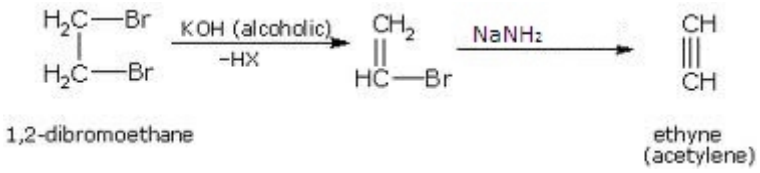
	pure liquids. x_A and x_B are the mole fractions of A and B. That is exactly what it says it is - the fraction of the total number of moles present which is A or B. You calculate mole fraction using, for example: $x_A = \frac{\text{moles of A}}{\text{total number of moles}}$  	2	
4-b	1. Alcohols with one hydroxyl group - Monohydric alcohol CH_3CH_2OH Ethanol (Ethyl alcohol) *(Monohydric)* 2. Alcohols with two hydroxyl groups - Dihydric alcohol $CH_2(OH)-CH_2(OH)$ Ethane-1, 2-diol (Ethylene glycol) *(Dihydric)*	1 1	4

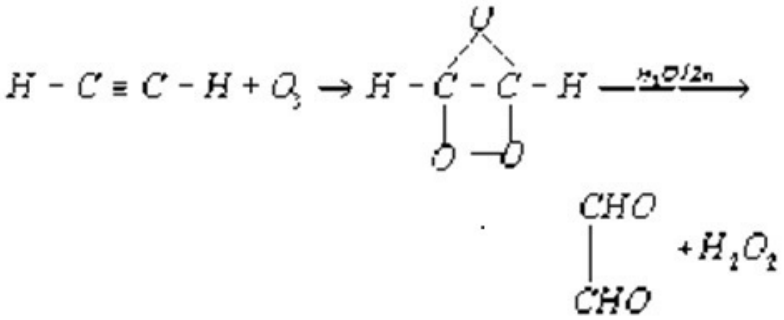
	3. Alcohols with three hydroxyl groups - Trihydric alcohols  Propane-1, 2, 3-triol (Glycerol) (*Trihydric*) 4. Alcohols with four or more hydroxyl groups - Polyhydric alcohols 	1 1	
4-c	A : CH_3Cl B : CH_2Cl_2 C : $CHCl_3$ D : CCl_4	1 mark each	4
4-d	i)4,5-dimethyl -1-heptanol ii)5-methyl-1-hexanal	2 2	4
4-e	i)Aldehyde:  Aldehyde Primary alcohol Acetaldehyde Ethanol **OR**	2	4

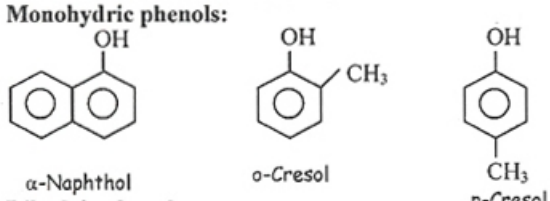
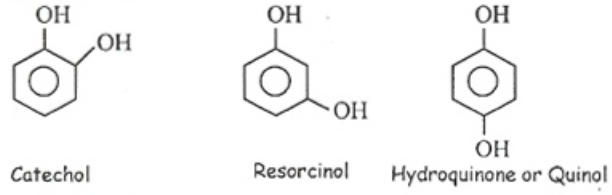
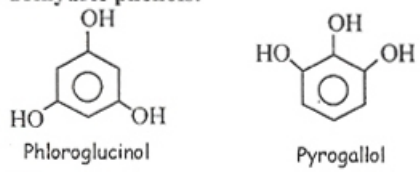
	 ii)Ketone:  *- Water, methanol, or ethanol **OR** 	2	
4-f	i) Oxygen:  ii)HNO_3 :	2	4

		2	
5-a	i) Amines ii) Nitro compounds iii) Halogen derivatives iv) Cyanides or Nitriles	1 mark each	4
5-b	**Reaction of alcohol with PCl_3** $3C_2H_5OH + PCl_3 \rightarrow 3\ C_2H_5Cl + H_3PO_3$ Ethyl alcohol ethyl chloride Reaction of alcohol with PCl_5 $C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl + POCl_3 + HCl$ The hydroxyl group is replaced by the corresponding halogen atom & an alkyl halide is formed.	2 2	4
5-c	**Physical properties of alcohol-** 1) Alcohols are neutral substances. 2) The lower members are colorless mobile liquids & higher members are colorless waxy solids. 3) Lower members have a pleasant smell but a burning taste & the higher ones are odorless & tasteless. 4) Their boiling points rise with molecular weight.	2	4

	Uses of alcohols- 1)used in drinks 2)Industrial feedstock 3)As a fuel 4)As a solvent	2	
5-d	**Toluene from benzene-** By the action of alkyl halides on benzene in the presence of anhydrous aluminum chloride catalyst. $C_6H_6 + CH_3Cl \rightarrow C_6H_5CH_3 + HCl$ Benzene toluene **Toluene from phenyl bromide-** $C_6H_5Br + 2Na + CH_3I \rightarrow C_6H_5CH_3 + NaBr + NaI$ Phenyl bromide toluene By heating halogen derivative of benzene & an alkyl halide with metallic sodium in dry ether.	2 2	4
5-e	**Friedal- Craft's reaction:** Benzene gives toluene when heated with methyl chloride & anhydrous $AlCl_3$ $C_6H_6 + CH_3Cl \rightarrow C_6H_5CH_3 + HCl$ Benzene toluene Fridel Crafts alkylation may be carried out using alkenes as alkylating agent & H_3PO_3, HF as catalyst. $C_6H_6 + CH_2=CH_2 \rightarrow C_6H_5C_2H_5$	4	4
5-f	The dehydrohalogenation (removal of HX) can be carried out in two stages. The first stage involves the removal of one molecule of hydrogen halide by boiling with alcoholic KOH, to form vinyl halide. The vinyl halides are very unreactive. So under mild conditions dehydrohalogenation stops. Under more	2	4

	vigorous condition i.e.by using a strong base such as sod amide the second stage can be accomplished to give alkynes.  	2	
6-a	1. Aliphatic compounds are open chain compounds whereas aromatic compounds are closed chain compounds or ring compounds. 2. Aromatic compounds contains large % of carbon than aliphatic compounds. 3. Aromatic halogen compounds are chemically much less active than aliphatic compounds. 4. Alkanes, alkenes are aliphatic compounds & benzene is aromatic compound.	1 mark each	4
6-b	**Sulphonation of Benzene**: Substitution of a sulphonic acid group ($-SO_3H$) for a hydrogen atom of the benzene nucleus is known as sulphonation. When benzene is heated with conc. H_2SO_4 at 373K it undergoes sulphonation to give benzene sulphonic acid. $C_6H_6 + H_2SO_4 \rightarrow C_6H_5SO_3H + H_2O$ Benzene sulphonic acid	2 2	4
6-c	**Ozonolysis:** A molecule of ozone adds to acetylene to form an ozonide, which when decomposed with water gives glyoxal.	4	4

	 (Glyoxal)		
6-d	i) At about 473K & in the presence of catalyst like finely divided nickel or platinum, benzene takes up six hydrogen atoms to form cyclohexane. $C_6H_6 + 3H_2 \rightarrow C_6H_{12}$ Benzene cyclohexane ii) In the presence of sunlight or uv light, three molecule of chlorine are added up to benzene to give benzene hexachloride. $C_6H_6 + 3Cl_2 \rightarrow C_6H_6Cl_6$ Benzene benzene hexachloride	2 2	4
6-e	a) By fusing sodium benzene sulphonate with caustic soda. NaOH HCl $C_6H_5SO_3Na \rightarrow C_6H_5ONa \rightarrow C_6H_5OH$ This is the oldest synthetic method for the manufacture of phenol. b)By heating chlorobenzene under pressure with 10% solution of sodium carbonate or sodium hydroxide at about 300^0c in the presence of copper salt (catalyst)	2 2	4

	$C_6H_5Cl + NaOH \xrightarrow[200\ atm]{300\ ^0C} C_6H_5OH + NaCl$		
6-f	Compounds containing hydroxyl group directly attached to the nucleus are called phenols. Phenols are aromatic hydroxyl compounds. Phenols are classified as monohydric, dihydric, trihydric phenols depending on no of hydroxyl groups attached. **a) Monohydric phenols:**  α-Naphthol o-Cresol p-Cresol **b) Dihydric phenols:**  Catechol Resorcinol Hydroquinone or Quinol **c) Trihydric phenols:**  Phloroglucinol Pyrogallol	2 2	4