SUMMER-16 EXAMINATION

Model Answer

Subject code :(17206)

Important Instructions to examiners:

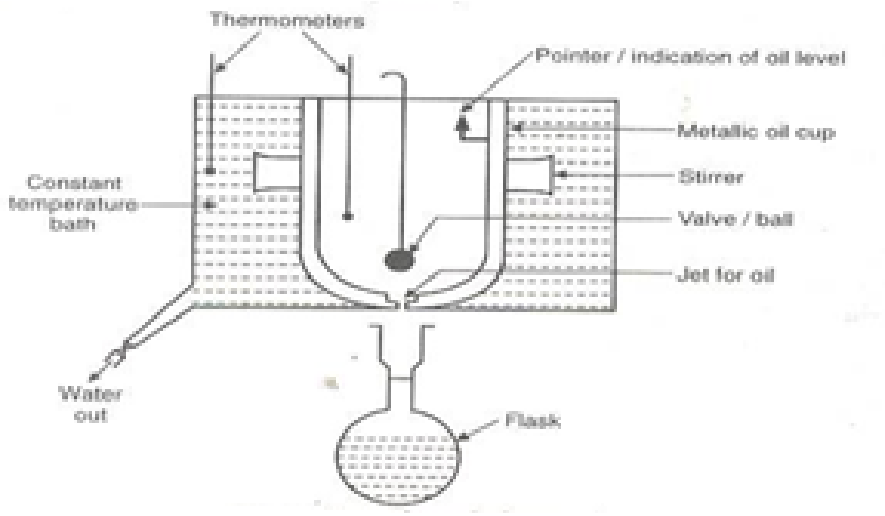
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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	Any ten		
1-a	**Dalton's law:** Daltons law states that total pressure of a gas mixture is equal to the sum of partial pressures $P=P_1+P_2+P_3$ where P is total pressure of gas mixture and P_1,P_2,P_3 are partial pressures. **Amagat's law:** Amagats law states that total volume of a gas mixture is equal to the sum of pure component volumes $V=V_1+V_2+V_3$ where V is total volume of gas mixture and V_1,V_2,V_3 are pure component volumes.	1 1	2
1-b	**Methods of expressing composition of mixtures and solutions:** **1.**Normality 2.Molarity 3.Molality 4. Concentration	 ½ mark each	2
1-c	**Methods of expressing composition of mixture**: 1**. weight %** Let a mixture contains components A,B & C of weights W_A, W_B & W_C Weight % of A =(Weight of A/ Total weight of mixture) * 100 $= W_A/(W_A+W_B+W_C)*100$ **2. mole %** Let the moles of the components be n_A,n_B & n_C	 1 1	2

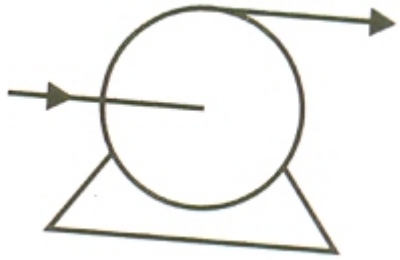
	Mol% of A = (moles of A/total moles)*100 = ($n_A/n_A+n_B+n_C$) *100		
1-d	**Temperature:** It is the measure of hotness or coldness of a body. **Different temperature scales are**: 1. degree Celsius (^0C) 2. degree Farenheit (^0F) 3. Kelvin (K)	1 1	2
1-e	0.5 HP to J/s HP = 735.5 W (J/s) 0.5 HP = 0.5 * 735.5 = **367.75 J/s**	 1 1	2
1-f	**Normality:** N = gmequivalent of solute/ volume of solution in liter **Molarity:** M = gmmole of solute/ volume of solution in liter	1 1	2
1-g	Phenol is reacted with con.HNO_3 to produce **2,4,6 trinitro phenol** Benzyl alcohol is Oxidised with air to produce **Benzoic Acid**	1 1	2
1-h	**Properties of nitric acid :** 1. It is colourless to yellow, highly corrosive and poisonous liquid 2. It is completely soluble in water 3. It has unpleasant bitter odour 4. It is toxic and cause severe burns **Uses of nitric acid :** 1. It is used in the production of explosives like TNT and nitro glycerine 2. In the production of nitrogen fertilizers	½ mark each for any 2 ½ mark each for	2

	3. In the purification of gold, silver and platinum 4. As laboratory rea gent 5. To prepare aqua regia to dissolve noble metal	any 2	
1-i	**Hydration:** It is a unit process of adding water molecule to an organic compound. Example: $C_2H_4 + H_2O \rightarrow C_2H_5OH$ $CH_3CH= CH_2 + H_2O \rightarrow CH_3CH(OH)CH_3$	1 1	2
1-j	**Vapor pressure** : It is the pressure exerted by vapor on the surface of liquid at equilibrium conditions. OR It is the absolute pressure at which the liquid and its vapour are in equilibrium at a given temperature **Boiling point:** It is the temperature at which vapour pressure of a liquid equals atmospheric pressure.	1 1	2
1-k	$^0F= 1.8\ ^0C +32$ $= 1.8 * 95 + 32$ $^0F =$ **203** $^0K= {}^0C +273$ $= 95 + 273$ $^0K =$ **368**	1 1	2
1-l	**Types of Chemical Process Industry :** Chemically industry embraces a wide range of industries, according to the industrial classification types of chemical process industries are: i) Fertilizer industry	1 mark each for any 2	2

	eg: Rashtriya Chemicals and fertilizers ltd. Deepak Chemicals and fertilizers ltd. ii) Petrochemical Industry eg: Reliance Industries ltd. Supreme Petroleum ltd. iii) Pharmaceutical industries eg: Hindustan Antibiotics ltd. iv) Paper industries eg: Mysore Paper Mills LTD. v) Paint Industries eg: Asian Paints Limited.		
2	**Any four**		
2-a	Kmol= 210 Mol.wt of C_2H_6 = 30 Weight in Kg = Kmol* molecular weight = 210 * 30 = **6300 Kg**	1 1 1 1	4
2-b	Basis: 200 kg NaCl and 600 kg KCl Total weight of mixture = 800 kg Weight % of NaCl = (wt of NaCl/ Total wt)*100 = (200/800)* 100 = **25 %** Weight % of KCl = (wt of KCl/ Total wt)*100 = (600/800)* 100 = **75%** gmoles of NaCl = Weight/ mol.wt = 200/58.5= 3.42	 1 1	4

	gmoles of KCl = Weight/ mol.wt = 600/74.5 = 8.05 Total moles = 3.42+8.05 =11.47 Mol% of NaCl = (Moles of NaCl/Total mole)*100 = (3.42/11.47)* 100 = **29.8%** Mol% of KCl = (Moles of KCl/Total mole)*100 = (8.05/11.47)* 100 = **70.18%**	1 1	
2-c	**Redwood Viscometer:**  **Construction:** (1) It consists of cylindrical oil cup made of brass. (2) The cup is open at the top and Its bottom is shaped concave internally to permit a complete drainage of content of cup. (3) The cup has a tapered central hole centrally at the bottom in which a jet is fixed for oil flow from the cup. (4) A pointer is provided at the side of the cu which gives idea regarding a level	2 2	4

	to which oil is to be filled in the cup. (5) The cup is surrounded by a constant temperature water bath made up of copper **Working :** 1) Oil at given temperature is filled into the oil cup upto the tip of the pointer. 2) The temperature of oil is kept at a constant temperature by the addition of hot water in the heating bath. 3) When the oil temperature remains constant at a desired value for five minutes, the oil is allowed to flow through the jet by lifting the metal ball. 4) The time in seconds required to fill the oil in the flask up to the Mark is noted accurately with the help of a stop-watch. 5) The viscosity of oil is described in seconds		
2-d	**Packed column:**  **Centrifugal pump**	2	4

		2	
2-e	**Distillation:-** Distillation is an operation in which the components of a liquid mixture are separated using thermal energy. It depends upon the difference in boiling points of the individual components. The difference in vapour pressure of the components of a liquid mixture at the same temperature is responsible for separation by distillation. In this operation, liquid and vapour phases are involved. The vapour phase is created by supplying heat to the liquid phase. The concentration of more volatile component of the liquid mixture is higher in vapour phase than in the feed solution, while that of the less volatile component is higher in the liquid phase. When a liquid mixture containing more volatile and less volatile components are heated, more volatile component will vaporize first and the vapours are collected and condensed to get it in pure form. **Industrial application:** Petroleum industry for separation of fractions of crude petroleum Separation of ethanol- water mixture	3 1	4

2-f	**Drying:** Drying is an operation in which the moisture of a substance is removed by means of thermal energy. In this operation, moisture is removed by circulating hot air or gas over the material in order to carry away the water vapour. In this operation, heat and mass transfer occur simultaneously. Heat is transferred from the gas phase to the solid phase and mass is transferred from the solid phase to the gas phase. Usually a solid or nearly solid materials are processed in dryer. **Reasons for carrying out drying:** Drying operations may be carried out for i)reducing the transportation cost, ii)making materials more suitable for handling and storage, iii)preventing corrosion arising due to the presence of moisture and iv)providing definite properties to materials.	2 2	4
3-a	**Equivalent weight** : Equivalent weight = molecular weight/ valency. **Gram mole** Gram mole = weight in grams /molecular weight. **Gram equivalent:** Gram equivalent = weight in gram/ equivalent weight **Molecular weight** : It is the sum of atomic weights of all elements present in a compound.	1 1 1 1	4
3-b	Basis: 100 gm solution Weight of solution = 100 g Weight of acetic acid= 30 g Weight of water= 70 g = 0.07 Kg Gm moles of acetic acid = 30/60 =0.5	 1 1 1	4

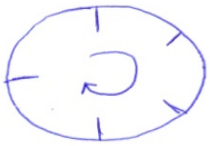
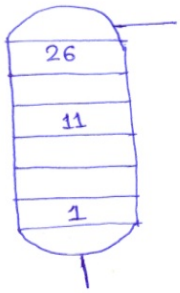
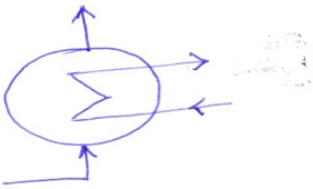
	Molality = gmoles of acetic acid/ mass of water in kg Molality= 0.5/ 0.07 = **7.143 gmoles/kg**	1	
3-c	Basis: 500 ml solution. Weight of solute = 20 gm Molecular weight of NaOH = 40 Gram moles of solute = 20/40 = 0.5 Molarity = Gram moles/ Volume of solution in lit 0.5/0.5 = **1 M** Normality = gram equivalent of solute/ volume of solution in lit = 0.5/0.5 = **1N**	1 1 1 1	4
3-d	**Modes of heat transfer are:** 1. Conduction: It is the transfer of heat without the movement of particles. Heat flow occurs due to exchange of energy from one molecule to another without appreciable motion of the molecules or due to the motion of free electrons. Eg: heating of a metal rod 2. Radiation: It is the transfer of heat through space by electromagnetic waves. When radiation passes through matter, it is transmitted, reflected or absorbed. Eg. Transport of energy from the sun to earth.	2 2	4
3-e	**Reactions involved in nitric acid manufacture:** $4\ NH_3 + 5O_2 \rightarrow 4\ NO + 6\ H_2O$ $4\ NH_3 + 3O_2 \rightarrow 2\ N_2 + 6\ H_2O$ $2\ NO + O_2 \rightarrow 2\ NO_2$ $3\ NO_2 + H_2O \rightarrow 2\ NHO_3 + NO$	1 1 1 1	4

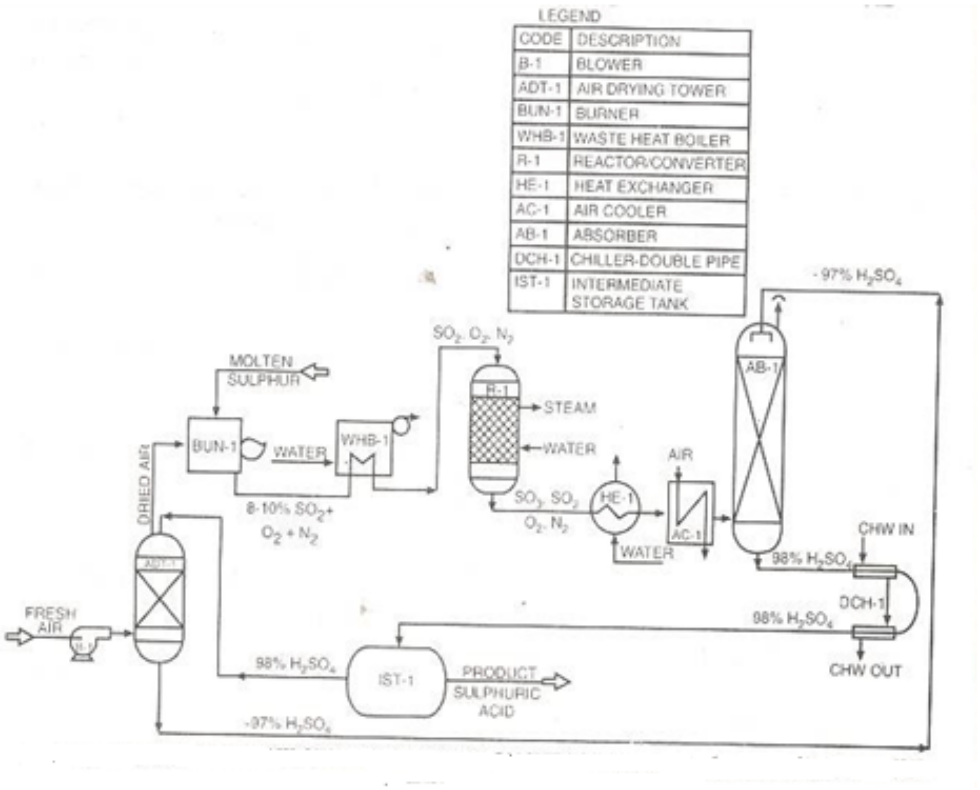
3-f	**Esterification reaction:-**The reaction of an alcohol with a carboxylic acid to produce an ester is termed as esterification. Esterification of an acid such as acetic acid by an alcohol such as ethyl alcohol results in the production of ethyl acetate.Sulphuric acid and hydrochloric acids are the catalysts used for esterification. **Chemical Reaction for esterification:** $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$	2 2	4
4	**Any 4**		
4-a	**Fluid:** A fluid is a substance which is capable of flowing if allowed to do so. **Handling of fluid:** In industry, pumps, fans , blowers and compressors , pipelines, ducts, valves and fittings are the essential components of a system used for transportation of fluids from one location to another. Pumps are used for handling liquids, solutions and slurries, while fans, blowers and compressors are used for handling gases. In these machines, mechanical work is transformed into fluid energy and the energy input to a fluid by means of any these machines causes the fluid to be transported through piping systems.The machines commonly used in in the chemical process industries include centrifugal pumps, rotary pumps and reciprocating pumps for handling liquids and fans, blowers and compressors for gases.	1 3	4
4-b	800 mm Hg pressure = 800/760= **1.053 atm** 760 mm Hg = 1.01325 bar = (800/760) * 1.01325 =**1.0666 bar** 760 mm Hg = 101.325 KPa = (800/760) * 101.325 =**106.66 KPa**	1 1 1 1	4
4-c	**Storage of liquids**:	2	4

	1. Open atmospheric tanks are used for storing liquids that will not be harmed by water or atmospheric prolusion. 2. Closed tanks with fixed roof . 3. Closed tanks with floating roof. 4. Tanks with curved surface. **Storage of Gas** : 1. Stored by dissolving in liquid. 2. Stored under high pressure in pressure vessels. 3. Small portable pressure vessels. 4. Pipes buried under ground	2	
4-d	**Unit Operation**: It is the operation in which only physical changes occur, but no chemical changes **Salient feature of unit operations** : 1. No chemical reactions are involved 2. Only physical changes occur 3. These are common to all types of industries. 4. Practical methods of carrying out may be different in different industries.	2 2	4
4-e	**Uses of blower:** 1. Conveying gas stream at medium pressure. 2. Getting at air at medium pressure **Uses of pump:** 1. For transportation of thin liquids and suspension of solids in liquid 2. For transportation of high corrosive and viscous liquids **Uses of fans:** 1. For supplying air to dryers, for ventilation work, removal of fumes	1 1 1	4

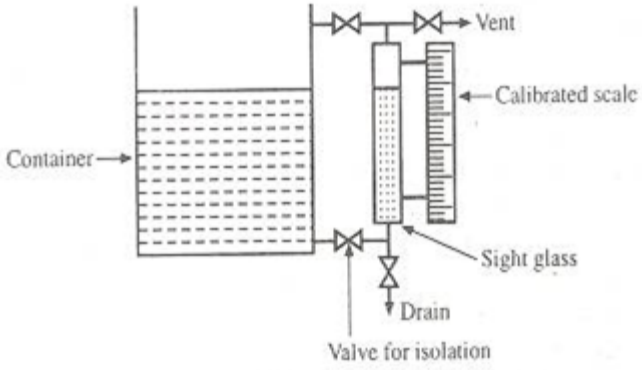
	2. For handling high volumes of air at low pressure **Uses of compressors:** 1. For getting compressed air 2. For transportation of gases	1	
4-f	**Chlorination:** It refers to the process in which one or more chlorine atoms are introduced into an organic compound. **Chlorination of methane:** Chlorination of methane in presences of ultraviolet light or at a temperature of 300 – 400 C results in the formation of polyhalogen derivatives. U.V.light $CH_4 + Cl_2$ ----------→ $CH_3Cl + CH_2Cl_2 + CHCl_3 + CCl_4 + HCl$ 300-400 C	2 2	4
5	**Any 4**		
5-a	**(I)** When benzene react with concentrated nitric acid in presence of sulphuric acid it produce nitrobenzene H_2SO_4 $C_6H_6 + HNO_3$ ----------→ $C_6H_5NO_2 + H_2O$ 50 ^{O}C **(II)** When Benzene react with concentrated sulphuric acid at 120oC it gives benzene Sulphonic acid 120 ^{O}C $C_6H_6 + H_2SO_4$ ----------→ $C_6H_5SO_3H + H_2O$ **(III)** When ethyl acetate react with Sodium hydroxide it gives Sodium acetate	1 1 1	4

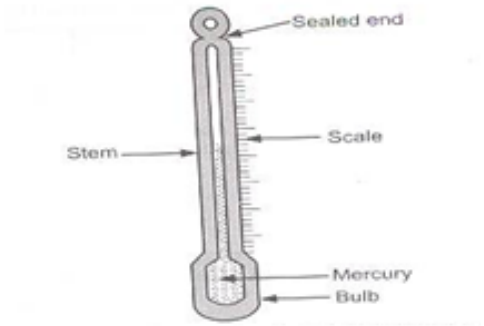
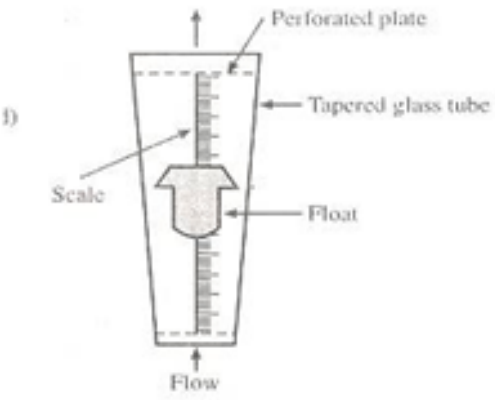
	$CH_3COOC_2H_5 + NaOH \dashrightarrow CH_3COONa + C_2H_5OH$ **(IV)** When Propylene react with water it gives Propanol $CH_2=CH-CH_3 + H_2O \dashrightarrow CH_3-CH(OH)-CH_3$	1	
5-b	**Size reduction:** It is an operation wherein large solid particles are subdivided to smaller ones. **It is carried out in industry to make it** : 1. Easy handling 2. Easy transportation 3. Increase in reaction rate 4. For having intimate mixing of solid 5. To separate various ingredients.	1 3	4
5-c	**Process flow sheet symbols:**		4

	① Mixer  or  ② plate column  ③ vaporiser  ④ air cooler 	1 1 1 1	
5-d	**Pyrolysis:** The decomposition of a compound by heat is called pyrolysis. **Cracking:**	1	4

	Pyrolysis when applied to alkane is known as cracking. Large alkane molecules are broken down to give lower molecular weight alkanes, alkenes and hydrogen. Eg: When ethane is heated to 500 ^{0}C in the absence of air, it gives a mixture of methane, ethylene and hydrogen. $C_2H_6 \rightarrow C_2H_4 + CH_4 + H_2$	2 1	
5-e	**Flow sheet for manufacturing of H_2SO_4:**  	4	4
5-f	**Gas Absorption:** -This operation is used to separate the components of gas mixture . -It is carried out for the recovery or the removal of a soluble components of a gas mixture depending upon the situation.	2	4

	-Absorption is an operation in which a gas mixture is contacted with a liquid solvent for the purpose of dissolving a definite component of the gas mixture in the liquid. - Gas absorption is usually carried out in packed columns. Example: 1) Absorption of ammonia from an air- ammonia mixture by water 2) Removal of hydrogen sulfide from naturally occurring hydrocarbon gases.	2	
6	**Any 4**		
6-a	**Sight Glass :** It is a level indicator. Sight glass level indicator consists of a simple vertical glass tube connected at both ends of a container or vessel containing liquid. The glass tube is connected to the vessel through valves which enable it to be isolated from the vessel .As the level of the liquid in a container rises or fall ,so does the level of liquid in the sight glass. The height of liquid in the tube always equalizes with the level of liquid in the container. The level of liquid is measured by simply reading the position of the liquid level on a calibrated scale attached to the sight glass.	2	4

	 Sight glass level indicator	2	
6-b	**Personal protective equipments used in Chemical industries (any 4)** The purpose of PPE is to provide a safety barrier a hazard and the body of a person working in a hazardous environment. **1) Hard hat** : It is used for protection of head **2) Safety goggles :** It is used for protection of eye **3)Safety shoes:** It is used for protection of legs and foot **4)work clothes:** It is used for protection of whole body **5)Ear muff:** It is used for protection of ear **6)Ear plug :** It is used for protection of ear **7)Guard cuff's :** It is used for protection of body **8)Face Shield:** It is used for protection of face	4	4
6-c	**Mercury thermometer:** **Construction:** It consists of a glass stem having fine capillary and glass bulb. The bulb is at lower end of glass stem. Mercury is filled in the bulb; after filling, open end of capillary is sealed under vacuum so that no air is left in capillary.	2	4

	 **Working:** When the thermometer bulb gets heated after immersion in a bath .The mercury expands much more than the glass and is therefore forced to rise up the stem to indicate the temperature .For each particular temperature, the mercury rises to a certain point in the stem.	1 1	
6-d	**Rotameter**  **Construction:** It consists of a tapered glass tube mounted vertically in a frame with the large end up. The tube is made of glass and contains a freely moving solid float which is smaller in diameter than the diameter of bottom of the tapered tube. A linear flow scale is marked on the glass tube.	1 1	4

	Working: In Rotameter as flow varies, the float rises or falls, thus altering the flow area, which is the annular space/opening between the float and tube. As the flow increases, the float moves upward, thus increasing the area. At a given flow rate, float stabilizes at a certain fixed position in the tube and at steady-state, it is recorded as rotameter reading from the scale provided. It is used for flow measurements of liquids and gases	2	
6-e	**Determination Density of a liquid using Specific gravity bottle:** 1) In order to determine the density by specific gravity bottle, first weigh the clean, dry, empty and stoppered bottle. 2) Then fill the bottle completely with the liquid ,stopper it ,clean the bottle from the outside with blotting paper to remove the excess liquid that spills on it outside 3) Weigh it again. Mass/Weight of empty bottle = W_1 g Mass/Weight of bottle filled with liquid = W_1 g Mass/Weight of the liquid = $W_2 - W_1$ Volume of the specific gravity bottle = V ml Density of the liquid in g/ml = $\frac{\text{Mass}}{\text{Volume}} = \frac{W_2 - W_1}{V}$ To avoid error due to the volume ,a certificate regarding the exact, accurate	4	4

<table>
<tr><td></td><td>volume of the bottle should be taken from the supplier</td><td></td><td></td></tr>
<tr><td>6-f</td><td>Difference Between Conversion and Yield :
<table>
<tr><th>Conversion</th><th>Yield</th></tr>
<tr><td>1.Conversion is the ratio of the amount of reactant reacted to the initial amount of the reactant</td><td>1. Yield of a desired product is the ratio of the quantity of the desired product actually obtained to its quantity maximally obtainable.</td></tr>
<tr><td>2. Conversion gives us idea regarding how efficient a given chemical process is from the point of view of utilization of the starting materials.</td><td>2. The Yield of a desired product tell us how efficient is a given chemical process is in terms of the reaction product.</td></tr>
<tr><td>3. Higher values of Conversion is the indication of minimum amount of the limiting reactant left unreacted.</td><td>3. Higher values of Yield is the indication of minimum occurrence of side reactions.</td></tr>
<tr><td>4. Conversion is applicable to single reactions as well as to Complex reaction.</td><td>4. Yield is applicable to Complex reaction</td></tr>
</table></td><td>1 mark each</td><td>4</td></tr>
</table>