WINTER-14 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.

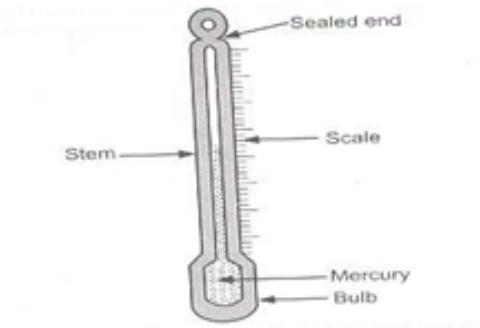
Q No.	Answer	marks	Total marks
1-a	**Viscosity:** It is the resistance to the flow. **Unit in SI**: N-sec/m^2	1 1	2
1-b	**Dalton's law:** Daltons law states that total pressure of a gas mixture is equal to the sum of partial pressures $P=P_1+P_2+P_3$ where P is total pressure of gas mixture and P_1,P_2,P_3 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-c	**Conduction**: It is the transfer of heat without the movement of particles. Eg: heating of a metal rod **Convection**: It is the transfer of heat within a fluid by the actual migration of particles. Eg. Boiling of liquid	1 1	2
1-d	**Temperature:** It is the 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	**Mercury i**s filled in thermometer because its coefficient of thermal expansion	2	2

	is high.		
1-f	**Molarity**: It is the number of gram moles of solute present in one litre of solution. M= gram moles of solute/ volume of solution in litres **Normality**: It is the number of gram equivalent of solute present in one litre of solution. N= gram equivalent of solute/ volume of solution in litres	1 1	2
1-g	**Halogenation:** It is the reaction between a compound and a halogen (Cl_2, Br_2, I_2 etc.) Eg: Chlorination of methane to monochloroethane $CH_4 + Cl_2 \text{-----} \rightarrow CH_3Cl$	1 1	2
1-h	**Excess reactant**: It is the reactant added in excess quantity than the theoretical requirement. **Limiting reactant**: It is the reactant which is added in limited quantity or that disappears first in a chemical reaction.	1 1	2
1-i	**Hydrogenation**: It is the reaction where hydrogen is added in a compound. $C_2H_4 + H_2 \text{------} \rightarrow C_2H_6$ **Oxidation:** It is defined as the reaction in which addition of oxygen or removal of hydrogen. $2SO_2 + O_2 \text{-------} \rightarrow 2SO_3$	1 1	2
1-j	**Unit Operation**: It is the operation in which only physical changes occur, but no chemical changes **Unit process**: It is the process where chemical reactions or chemical changes takes place.	1 1	2
1-k	$^0F = 1.8\ ^0C + 32$ $= 1.8 * 95 + 32 =$ **$203\ ^0F$**	 1	2

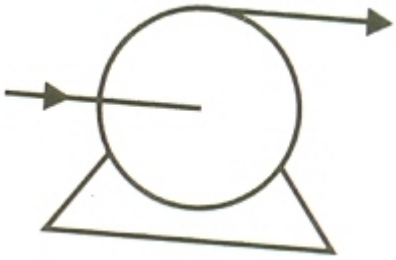
<table>
<tr><td></td><td>K = 273+^oC
= 273 + 95 = 368 K</td><td>1</td><td></td></tr>
<tr><td>1-l</td><td>Equipments used for solid mixing:
1. Sigma mixer
2. Ribbon blender
3. Muller mixer
4. double cone blender</td><td>1 mark each for any 2</td><td>2</td></tr>
<tr><td>2-a</td><td>Total moles = 0.7 kmoles
<table><tr><th>Gas</th><th>kmoles</th><th>Mol%</th></tr><tr><td>HCl</td><td>0.274</td><td>39.14</td></tr><tr><td>O_2</td><td>0.337</td><td>48.14</td></tr><tr><td>N_2</td><td>0.089</td><td>12.71</td></tr><tr><td>Total</td><td>0.7</td><td></td></tr></table></td><td>4</td><td>4</td></tr>
<tr><td>2-b</td><td>Methods of expressing composition of mixture:
1. By 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.By mole
Let the moles of the components be n_A,n_B & n_C
Mol% of A = (moles of A/total moles)*100
= $(n_A/n_A+n_B+n_C)$ *100</td><td>2

2</td><td>4</td></tr>
<tr><td>2-c</td><td>Mercury thermometer:
Construction:
It consists of a glass stem having fine capillary and glass bulb. The bulb is at lower end</td><td>2</td><td>4</td></tr>
</table>

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

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.</td><td>2</td><td></td></tr>
<tr><td>2-d</td><td><table><tr><th>Sedimentation</th><th>Filtration</th></tr><tr><td>Gravitational force is acting</td><td>Pressure force is acting</td></tr><tr><td>Sedimentation tanks or settling tanks are used.</td><td>Filters are used</td></tr><tr><td>No filter medium is used</td><td>Filter medium is used</td></tr></table></td><td>2 marks each for any 2 points</td><td>4</td></tr>
<tr><td>2-e</td><td>Centrifugal Pump:</td><td>1 mark each</td><td>4</td></tr>
</table>



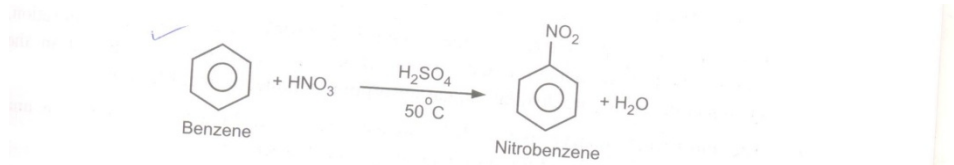
Packed column :

Jaw crusher

Plate column

			
2-f	**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
3-a	**Molecular weight** : It is the sum of atomic weights of all elements present in a compound. **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	1 mark each	4
3-b	Weight of solution = 100 kg Density of solution= 1.196 Kg/lit Volume of solution= mass/ density = 100/1.196 = 83.61 lit Weight of NaOH = 20 kg Gm moles of NaOH = 20000/40 =500	1	4

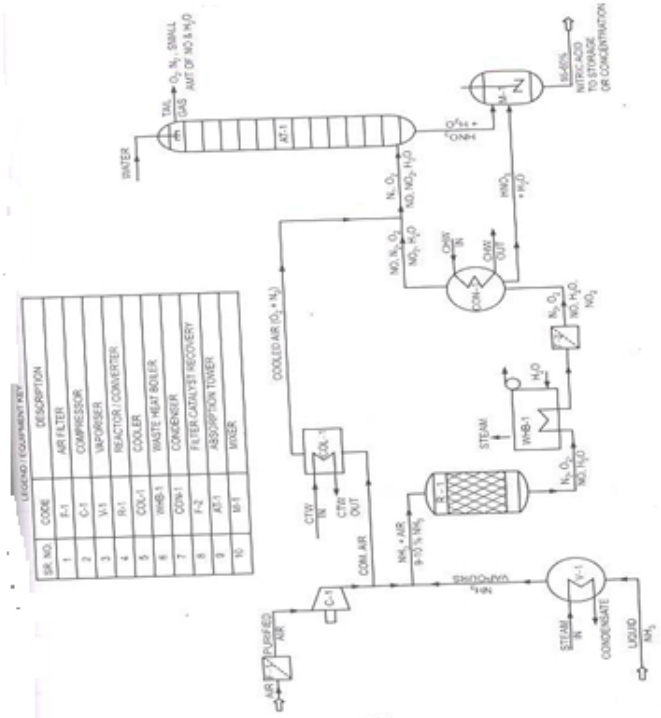
	Molarity = 500/83.61 =**5.98 M** Gram equivalent of NaOH = 20000/40 =500 Normality = 500/ 83.61 = **5.98 N** Weight of solvent = 100-20 = 80 Kg Molality= 500/ 80 = **6.25 gmoles/kg**	1 1 1	
3-c	2 Molar HCl solution Normality = Molarity * valency Molarity = 2M Valency of HCl = 1 Normality = 2*1 = 2N Normality of 2M HCl solution = **2N**	 1 1 1 1	4
3-d	**Distillation:-** - Distillation is an operation in which the components of a liquid mixture are separated using thermal energy. **Methods for separation of solid-liquid mixture:** 1. Sedimentation 2. Filtration 3. Centrifuging	2 1mark each for any 2	4
3-e	**Unit Process and unit operation:** **Unit process** | **Unit operation** Chemical changes takes place | Physical changes takes place, Chemical reactions involved | no chemical reactions involved Eg; oxidation, reduction, nitration, sulphonation | Eg; drying, distillation, mechanical separation	2mark each for any 2	4
3-f	**Nitration reactions** : It is the reaction with nitrating mixture to introduce nitro(NO_2) group into an	4	4

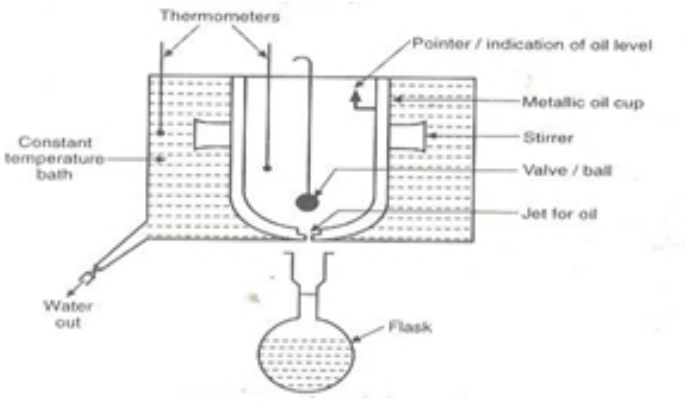
	organic compound. $C_2H_6 + HNO_3$ ------>$C_2H_5NO_2 + H_2O$ 		
4-a	**Distillation:**- Distillation is an operation in which the components of a liquid mixture are separated using thermal energy. It depends upon the difference in boiling points of the individual components. The difference in vapour 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.	4	4
4-b	Weight of ethyl alcohol =20 kg Weight of water =120 kg Total weight = 140 kg Weight fraction of ethyl alcohol = weight of ethyl alcohol/ Total weight = 20/140 **= 0.143**	1	4

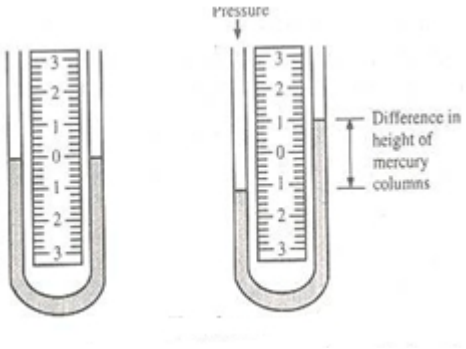
	Molecular weight of ethyl alcohol = 46 Molecular weight of water = 18 Moles of ethyl alcohol = 20/46 = 0.435 Moles of water = 120/18 = 6.67 Total moles = 7.10 Mole fraction of ethyl alcohol = moles of ethyl alcohol/ Total moles = 0.435/7.1 = **0.061**	1 1 1	
4-c	1 kg=1000gm $1m^3 = 100^3\ cm^3$ $0.8\ gm/cm^3 = 0.8*100^3/1000$ $= 800\ kg/m^3$	1 2 1	4
4-d	**Industrial example of:** **1. Drying:** Drying of dyes, food products, paper, pharmaceutical products etc.. **Distillation** : Petroleum industry for separation of fractions of crude petroleum **Filtration** : Separation of solid material from their slurry, separation of suspended impurities from water **Size reduction** : In cement industry raw materials are ground, food industry, ore processing etc	 1 1 1 1	4
4-e	**Pump**: It is a device used to transport liquids, solutions and slurries in which mechanical energy is transformed into energy necessary for transporting the fluid. **Classification of pump:** 1. positive displacement pump(reciprocating and rotary)	2 2	4

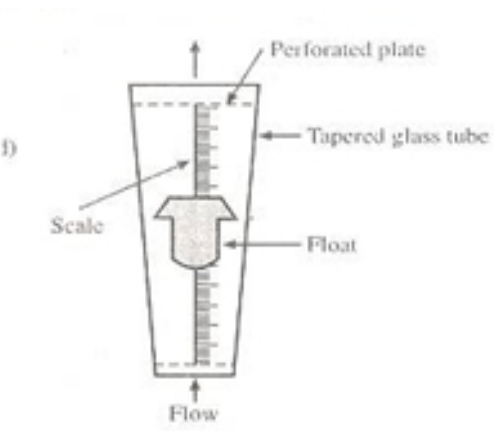
	2. Centrifugal pump		
4-f	**Hydrogenation of benzene:** Benzene reacts with hydrogen gas in presence of Ni at 150 ^{0}C under pressure to give cyclohexane. $C_6H_6 + H_2$ -------→ C_6H_{12} Benzene cyclo hexane **Reduction of nitro benzene:** Nitrobenzene can be reduced to aniline by using Fe + HCl $C_6H_5NO_2 + 2Fe + 6HCl$ ------→ $C_6H_5NH_2 + 2\ H_2O + 2FeCl_3$	2 2	4
5-a	**Name a product produced with the corresponding reaction when:** (1)Acetic acid is reacted with ethyl alcohol to produce **Ethyl Acetate** (2)Benzene is reacted with concentrated nitric acid to produce **Nitrobenzene** (3)Benzyl alcohol is Oxidised with air to produce **Benzoic Acid** (4) Benzene is reacted with H_2SO_4 to produce **Benzene Sulphonic Acid**	1 mark each	4
5-b	**Drying :** Drying refers to the removal of moisture of a substance by thermal means (i.e. with the help of thermal energy) **Purpose of Drying:** -To obtain the products almost in the dried form is the purpose of drying. -In this operation, Moisture is removed by circulating hot air or hot gas (drying medium) over the material in order to carry away the water vapours. - In this operation ,heat and mass transfer occur simultaneously.	2 2	4
5-c	**Difference Between Conversion and Yield :** **Conversion** | **Yield**	2 mark each for any 2	4

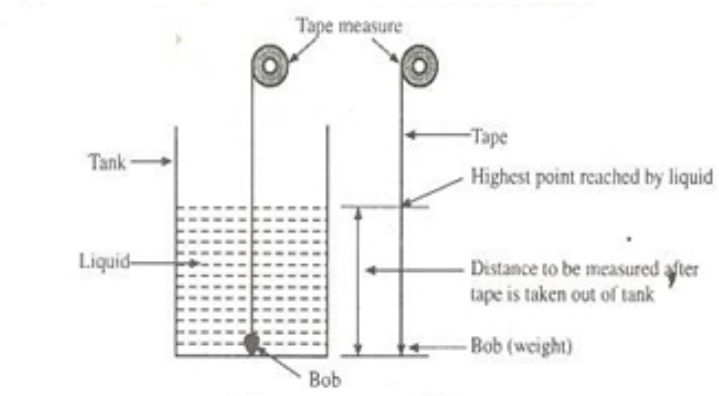
	1.Conversion is the ratio of the amount of reactant reacted to the initial amount of the reactant **2. Conversion** gives us idea regarding how efficient a given chemical process is from the point of view of utilization of the starting materials. **3.** Higher values of **Conversion** is the indication of minimum amount of the limiting reactant left unreacted. **4. Conversion** is applicable to single reactions as well as to Complex reaction.	**1. Yield** of a desired product is the ratio of the quantity of the desired product actually obtained to its quantity maximally obtainable. **2.** The **Yield** of a desired product tell us how efficient is a given chemical process is in terms of the reaction product. **3.** Higher values of **Yield** is the indication of minimum occurrence of side reactions. **4. Yield** is applicable to Complex reaction		
5-d	**Oxidising Agents employed in chemical Industries:** -Potassium Permanganate with sulphuric acid - Potassium dichromate with sulphuric acid **Reducing Agents employed in chemical Industries:** - Fe + HCl or Zn + HCl - Lithium aluminium hydride		2 2	4
5-e	**Flow sheet for manufacturing of Nitric acid:**		4	4

			
5-f	**Saponification:** The alkaline hydrolysis of an ester to form sodium salt of the parent acid and alcohol is referred to as saponification Example : $CH_3COOC_2H_5 + NaOH \xrightarrow[H_2O\ ,\ Heat]{reflux} CH_3COO\ Na + C_2H_5OH$ Ethyl acetate Sodium acetate	4	4
6-a	**Personal protective equipments used in Chemical industries :** 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	1 mark each for any four	4

	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		
6-b	**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 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	2 2	4

	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		
6-c	 **Construction :** 1) U-tube manometer is simplest form of manometer 2) It consists of small diameter U-shaped glass tube. 3) The tube is clamped on a wooden board and between two arms or leg of the manometer. 4) A scale is fixed on the same boared.which is marked in centimeter and zero on scale is marked in the center.	2	4

	5) The mercury is poured into the tube until the level in the both the arm reaches the zero marks **Working :** 1)The pressure in the inlet line can be measured by connecting it by plastic tubing to one of the arms of the U-tube. 2) By measuring the difference in the height of the fluid in two arms of the U-tube pressure can be measured by the equation. $\Delta P = P_1 - P_2 = h(\rho_m - \rho)\, g$ Where , ΔP= Pressure difference, h= difference in levels of two arms ρ_m= density of manometric fluid	2	
6-d	**Rotameter**  **Construction:** 1)It consist of tapered glass tube mounted vertically in a frame with large end up. 2)The tube is usually made of glass and contains a freely moving solid float is smaller in diameter than diameter of bottom of the tapered tube. 3)The float is generally made of stainless steel and positioned centrally of the tube with the help of a guide.	2 1	4

	4) A nearly linear flow scale is marked n the glass tube or mounted close to the tube so that reading is obtained. **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	1	
6-e	 1) Bob and tape is the most simple direct liquid level measurement devices. 2) It is consist of a bob (Weight) suspended from a tape marked in centimeter and meter. 3) Bob is lowered to the bottom of a tan or vessel containing liquid. 4) The liquid in the tank wets the part of the tape that is dipped into the pool of liquid.	2 2	4

	5) The bob and tape assembly is then removed from the tank and a reading of liquid level is made by noting the point on the tape reached by the liquid.		
6-f	**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 volume of the bottle should be taken from the supplier	4	4