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Seat No.	
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**[5559]-214**

**S.E. (Chemical Engineering) (I Sem.) EXAMINATION, 2019**

**PROCESS CALCULATIONS**

**(2015 PATTERN)**

**Time : Two Hours**

**Maximum Marks : 50**

**N.B. :—** (i) Attempt Question No. 1 or 2, 3 or 4, 5 or 6, 7 or 8.

(ii) Figures to the right indicate full marks.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Assume suitable data, if necessary.

(v) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

Q1) a)	Calculate the available nitrogen content of solution having 30% urea, 20% ammonium Sulphate & 20% ammonium nitrate.	[6]
Q1) b)	A single effect evaporator is fed with 10000 kg/hr of weak liquor containing 15 % caustic by weight and is concentrated to get thick liquor containing 40 % by weight caustic (NaOH). Calculate (a) kg/hr of water evaporated and (b) kg/hr of thick liquor obtained.	[6]
OR		
Q 2) a)	An Aqueous solution of $K_2CO_3$ is prepared by dissolving 43Kg of $K_2CO_3$ in 100Kg of water at 293K. Find Molarity, Normality & Molality of Solution. Take Density of solution 1.3Kg/L.	[6]
Q 2) b)	It is desired to make up 1000 kg of solution containing 35% by weight of a substance 'A' two solutions are available, one containing 10 weight % 'A' and other containing 50 weight percent of 'A' how many kilogram of each solution required?	[6]
Q 3) a)	A Coke is known to contain 90% carbon and 10% non-combustible ash (by weight) : 1) Find the moles of oxygen therotically required to burn 100 kg of coke completely? 2) If 50% excess air is supplied, calculate the analysis of gases at the end of combustion.	[6]
Q 3) b)	Stream of carbon dioxide flowing at a rate of 100 kmol/ min is heated from 298K(25°C) to 383 K (110°C). calculate the heat that must be transferred using $C_p^0$ data.  DATA: $C_p^0 = a + bT + cT^2 + dT^3$ . kJ/(kmol.K)	[6]

P.T.O.

	Gas	a	$b \times 10^3$	$c \times 10^6$	$d \times 10^9$	
	CO <sub>2</sub>	21.3655	64.2841	- 41.0506	9.7999	
Q 4) a)	The gaseous reaction $A \longrightarrow 2B+C$ takes place isothermally in a constant pressure reactor. Starting with a mixture of 75% A & 25 % of inerts (both on Volume basis) in a specified time the volume doubles. Compute the % Conversion of A achieved.					[6]
Q 4) b)	Calculate the heat of formation of liquid ethyl acetate at 298 K (25°C) <b>Data:</b> Standard heat of formation of CO <sub>2</sub> (g) = -393.51 kJ/mol Standard heat of formation of H <sub>2</sub> O (l) = - 285.83 kJ/ mol Standard heat of combustion of liquid ethyl acetate C <sub>4</sub> H <sub>8</sub> O <sub>2</sub> = $\Delta H_c^\circ = -2230.91$					[6]
Q 5) a)	Define 1) Dry Bulb Temperature 2) Wet Bulb Temperature 3) %Relative Humidity 4) Dew Point 5) Humid Heat					[5]
Q 5) b)	The crystallizer is fed with a saturated solution of MgSO <sub>4</sub> at 353 K (80 C). the mass is cooled to 303K (30 C) to obtained MgSO <sub>4</sub> . 7H <sub>2</sub> O crystals. During cooling, 4% solution is lost by evaporation of water. Calculate the quantity of saturated solution that should be fed to crystallizer in order to obtained 1000 kg of MgSO <sub>4</sub> . 7H <sub>2</sub> O crystals. DATA: The solubility of MgSO <sub>4</sub> in water at 353 K = 64.2 kg MgSO <sub>4</sub> / 100 kg H <sub>2</sub> O The solubility of MgSO <sub>4</sub> in water at 303 K = 40.8 kg MgSO <sub>4</sub> / 100 Kg H <sub>2</sub> O					[8]
	OR					
Q 6) a)	The dry bulb temp. and dew point of ambient air were found to be (29 C) and 29 K(18 C) respectively, barometer reads 100kpa ,calculate a) absolute molal humidity b) absolute humidity c) % RH d) % saturation e) Humid Heat f) Humid volume					[7]

	Data- Vapour pressure of water at 291K = 2.0624 Kpa. Vapour pressure of water at 302K = 4.004Kpa.	
Q 6) b)	A gas mixture containing benzene vapors is saturated at 101.325 kpa and 323 K(50 C), calculate the absolute humidity if the other components of mixture is (a) Nitrogen and (b) carbon di oxide. Data :- Vapour Pressure of benzene at 323K =36.664 Kpa	[6]
Q 7) a)	Define calorific value, GCV, NCV.	[3]
Q 7) b)	1) Explain Different Types of Fuels ? 2) Calculate the net calorific value (NCV) at 298K of a sample of fuel oil having C/H ratio 9.33(by weight) & containing sulphur to the extent of 1.3% by weight. Data- The GCV of the fuel oil at 298K( 25 <sup>0</sup> C) = 41785 KJ/Kg Latent heat of water vapour at 298K( 25 <sup>0</sup> C) = 2442.5 KJ/Kg	[4] [6]
	OR	
Q 8) a)	Write Short note on Proximate analysis and ultimate analysis of coal	[5]
Q 8) b)	The Orsat analysis of the flue gases from a boiler house chimney by volume is as given as given below: CO <sub>2</sub> :11.4%, O <sub>2</sub> :4.2%, & N <sub>2</sub> :84.4%. Assuming the complete combustion takes place, 1) Calculate the % excess air and 2) Find the C:H ratio	[8]