Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

Subject Code: 2143507 **Date: 16/12/2019**

Subject Name: Fundamentals of Stoichiometry

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Explain Raoult's law.	**03**
	(b)	The gaseous reaction A = 2B + C takes place isothermally in a constant- pressure reactor. Starting with a mixture of 75 % A and 25 % inerts (by volume), in a specified time the volume double.	**04**
	(c)	Calculate the heat of reaction for the esterification of ethyl alcohol with acetic acid if the standard heats of combustion are : ethyl alcohol: -1366.91 kJ/mol, acetic acid: -871.69 kJ/mol, ethyl acetate: -2274 kJ/mol	**07**
Q.2	**(a)**	Differentiate between: Endothermic and exothermic reactions.	**03**
	(b)	Prove that, mole fraction = Volume fraction = Pressure fraction.	**04**
	(c)	A solution of sodium chloride in water contains 25% NaCl (by mass) at 333 K. The density of the solution is 1.129 kg/L. Find the molarity, normality and molality of the solution. Atomic mass: Na: 23, Cl:35.5	**07**
		OR	
	(c)	Calculated the enthalpy of zinc vapour at 1200 ^{0}C and atmosphere pressure, relative to solid at 10 ^{0}C. Data: Melting point of Zn = 419 ^{0}C (at 1 atm) Boiling point of Zn = 907 ^{0}C (at 1 atm) Mean Cp of solid Zn = 0.105 kcal/kg ^{0}C Mean Cp of liquid Zn = 0.109 kcal/kg ^{0}C Heat of fusion of Zn = 1660 kcal/kgmole Heat of vaporization of Zn = 26900 kcal/kgmole Mean Cp of Zinc vapour = 4.97 kcal/kgmole ^{0}C Atomic weight of Zn = 65.4 kg/kgmole	**07**
Q.3	**(a)**	Explain Recycle, Purge, bypass with suitable diagram	**03**
	(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 (b) kg/hr of thick liquor obtained	**04**
	(c)	Iron pyrite is burned in 50 % excess air. The following reaction occurs: $4FeS_2 + 11O_2$ ----- $2Fe_2O_3 + 8SO_2$ For 100 kg of iron pyrite charged, calculate following: a) The amount of air supplied in kg. b) The composition of exit gases if the percent conversion of iron pyrite is 70 %	**07**
		OR	
Q.3	**(a)**	Explain: Limiting Reactant, Excess reactant and percent conversion.	**03**
	(b)	Explain : (1) Wet bulb temperature (2) Absolute humidity	**04**
	(c)	1 kg nitrogen is mixed with 3.5 m3 of hydrogen at 300 K and 101.3 kPa and sent to the ammonia converter. The product leaving the converter analyzed 13.7 % ammonia, 70.32 % hydrogen and 15.98 % nitrogen. i. Identity the limiting reactant. ii. What is the present	**07**

excess of excess reactant? iii. What is the present conversion of the limiting reactant?

Q.4	**(a)**	Define: (1) single pass conversion (2) overall conversion (3) ^{0}Be`	**03**
	(b)	Explain: Fundamental quantities and Derived quantities?	**04**
	(c)	The heat of combustion of methane, carbon and hydrogen are -890.4 kJ/mol, 393.51kJ/mol and -285.84 kJ/mol respectively. Calculate the heat of formation of methane.	**07**

OR

Q.4	**(a)**	Explain sensible heat and latent heat.	**03**
	(b)	What is an adiabatic flame temperature? State its significance and explain the procedure for its calculation.	**04**
	(c)	Define the following terms with respect to humidification operation: (1) Absolute humidity (2) Relative humidity (3) Percent humidity (4) Dry bulb temperature (5) Wet bulb temperature (6) Dew point temperature (7) Humid Heat	**07**
Q.5	**(a)**	Explain standard heat of formation and standard heat of combustion	**03**
	(b)	150 L oxygen cylinder contains gas at 300 K & 10 bar. Calculate the mass of oxygen in the cylinder?	**04**
	(c)	Convert 1 atm into equivalent N/m^2, m H_2O, ft H_2O, psi ,in Hg ,mm Hg, and kgf/cm^2.	**07**

OR

Q.5	**(a)**	Explain Dalton's law.	**03**
	(b)	Write about methods of solving material balance problems without chemical reaction.	**04**
	(c)	A soap plant produced raw soap containing 50 % moisture. This is to be dried 20 % moisture before it is pressed into cakes for sale. How many 100 g soap piece can be obtained from 1000 kg of original raw soap ?	**07**

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