Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA ENGINEERING – SEMESTER – 3 • EXAMINATION – WINTER - 2017

Subject Code:3330504 **Date:13-11-2017**

Subject Name: Industrial 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.**
4. **Use of programmable & Communication aids are strictly prohibited.**
5. **Use of only simple calculator is permitted in Mathematics.**
6. **English version is authentic.**
7. **Mol. Wt. H=1,Cl=35.5,C=12,O=16,S=32,N=14,Na=23,C=12**

Q.1 Define any seven out of ten **14**

1. Heat
2. Mole
3. Molality
4. Equivalent weight
5. STP
6. NTP
7. Yield
8. Excess Reactant
9. Specific Gravity
10. Write down the fundamental quantity name with SI unit.

Q.2 (a) Discuss SI system in brief. **03**

OR

(a) Define: Mole and Normality **03**

(b) Find the grams of HCL to prepare 3 litre 0.5N HCl solution. **03**

OR

(b) The concentration of an aqueous solution of acetic acid is specified as 35% on weight basis. Find the Molality of solution. **03**

(c) Nitrogen is to be marketed in cylinder having volume of 0.08 m^3 each containing 3.5 kg of Nitrogen. Calculate the pressure for which cylinders must be designed if they are subjected to a maximum temperature of 50 ^oC. **04**

OR

(c) A cylinder contains 900 kg of liquid chlorine. What Volume in m^3 will chlorine occupy if it is released and brought to NTP condition? **04**

(d) Define: Dalton's law and Amagat's law with statement and formula. **04**

OR

(d) Prove that Volume % = Mole % **04**

Q.3 (a) Describe the material balance of the Distillation operation. **03**

OR

(a) Describe the Bypass operation with sketch. **03**

(b) Calculate the available nitrogen content of solution having 30% urea (NH_2CONH_2), 20% ammonium sulphate ($(NH_4)_2SO_4$) and 20% ammonium nitrate (NH_4NO_3). **03**

OR

(b) State STP and NTP conditions. **03**

(c) Soya bean seeds are extracted with hexane in batch extractors. The flaked Seeds are found to contain 18.6% oil, 69% solid and 12.4% moisture by weight. At the end of the extraction process, cake is separated from hexane-oil mixture. The cake is analyzed to contain 0.8% oil, 87.7% solids and 11.5% moisture by weight. Find the percentage recovery of oil. **04**

OR

(c) A waste acid from a nitrating process contains 23% HNO_3, 57% H_2SO_4 and 20% water by weight. This acid is to be concentrated to contains 27% HNO_3, 60% H_2SO_4 by addition of concentrated H_2SO_4 containing 93% H_2SO_4 and concentrated nitric acid containing 90% HNO_3.Calculate the amounts in kg of waste and concentrated acids that must be combined obtain 1000 of desired mixture. **04**

(d) Define: Sensible Heat, Latent heat of vaporization and Sublimation. **04**

OR

(d) Prove that Cp - Cv =R. **04**

Q.4 (a) Give the classification of fuels with example. **03**

OR

(a) Give the importance of Energy balance in chemical Industries. **03**

(b) Pure ethylene is heated from 303 K (30 ^oC) to 523 K (250 ^oC) at atmospheric pressure. Calculate the heat added per kmol ethylene using heat capacity data given below: **04**

$C_p^o = 4.1261 + 155.0213*10^{-3}\ T - 81.5455*10^{-6}\ T^2 + 16.9755\ *10^{-9}\ T^3$

OR

(b) A single effect evaporator is fed with 1000 kg/hr of week liquor containing 20% caustic by weight and is concentrated to get thick liquor containing 50% caustic by weight. Calculate (a) kg/hr of water evaporated (b) kg/hr of thick liquor obtained. **04**

(c) Calculate the net calorific value (NCV) at 298 K at a sample of fuel oil having C/H ratio 9.33 (by weight) and containing sulphur to the extent of 1.3% by weight. The GCV of the fuel oil at 298K = 41785 kJ/kg and latent heat of water vapour at 298 K =2442.5 kJ/kg. **07**

Q.5 (a) Calculate the energy required to dissociate 1 kg of sodium bicarbonate at 298 K (25 ^oC). The dissociation reaction is : **04**

$2NaHCO_3(s) \longrightarrow Na_2CO_3\,(s) + CO_2\,(g) + H_2O\,(g)$

At 298 K (25 ^oC), $\Delta H_f\, NaHCO_3 =$ - 950.81 kJ/kmol, $\Delta H_f\, Na_2CO_3 =$ - 1130.68 kJ/kmol, $\Delta H_f\, CO_2 =$ -393.51 kJ/kmol and $\Delta H_f\, H_2O =$ - 241.82 kJ/kmol,

(b) A combustion chamber is fed with butane and excess air. Combustion of butane is complete. The composition of combustion gases on volume basis is given below: CO_2 = 9.39%, H_2O = 11.73%, O_2 = 4.70% and N_2 = 74.18%.Find the % excess air used and mole ratio of air to butane used. **04**

(c) Define Gross calorific value with formula. **03**

(d) Describe Heat of formation. **03**

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