SE III B.T. PC 20/12/13

Ash8-D:\Data-9

Process Calculation

Con. 9988-13.

GX-12215

(3 Hours) [Total Marks : 80

N.B. : (1) Question No. 1 is **compulsory.**
(2) Attempt any **three** questions from remaining **five** questions.
(3) Assume **suitable** data wherever **necessary.**

1. (a) Define :– 8
(i) Stoichiometry.
(ii) Stoichiometric ratio.
(iii) Limiting reactant.
(iv) % excess.

(b) Write an outline of procedure for material balance calculations. 12

2. (a) Ammonia is produced by following reaction :– 10

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

Calculate :–
(i) Molal flow rate of Hydrogen corresponding to Nitrogen feed rate of 25 kmol/h if they are Fed in Stoichiometric proportion.
(ii) Kg of ammonia produced per hour if percent conversion is 25 and Nitrogen feed rate is 25 kmol/h.

(b) A gas mixture containing benzene vapour is saturated at 101·325 KPa and 323 K. 10
Calculate absolute humidity if other component of mixture is :–
(i) Nitrogen and
(ii) Carbondioxide.
Data :– Vapour pressure of benzene at 323 K = 36·664 KPa.

3. (a) How many moles of H_2SO_4 will contain 64 kg of (s) [Sulfur] ? 5
(b) How many kilograms of ethane are there in 210 k–mol ? 5
(c) Calculate the available Nitrogen content of solution containing 30% Urea, 20% ammonium sulfate and 20% ammonium nitrate. 10

4. (a) The waste acid from nitrating process contains 30% H_2SO_4, 35% HNO_3 and 35% H_2O by weight acid is to be concentrated to contain 39% H_2SO_4 and 42% HNO_3 by addition of concentrated sulfuric acid containing 98% H_2SO_4 and concentrated nitric acid containing 72% HNO_3 (by weight). 12
Calculate the quntities of 3 acids to be mixed to get 1000 kg of desired mixed acid.

(b) A natural gas has following composition by volume :–

$CH_4 = 82\%$

$C_2H_6 = 12\%$

$N_2 = 6\%$

Calculate the density of gas at 288 K and 101·325 KPa and composition in weight percent. 8

TURN OVER

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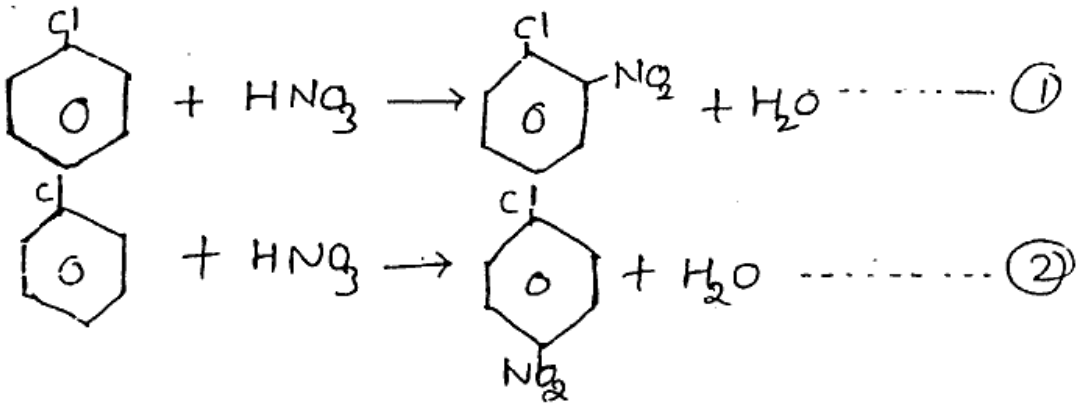
5. (a) Write short notes on :– **12**
   (i) Normality.
   (ii) Recycle ratio.
   (iii) Hess's law.
   (iv) Yield.
   (v) Selectivity.
   (vi) Extraction.

   (b) Prove for ideal gas :– **8**
   Pressure % = mole %
   = volume %

6. (a) Chlorobenzene is nitrated using a mixture of Nitric acid and Sulfuric acid during the pilot run, charge consists of 100 kg of chlorobenzene, 106·5 kg of Nitric acid of 65·5% strength, 108 kg of Sulfuric acid of 93·6% strength, after 2 hours of operation, final product mixture was analyzed and found to contain 2% unreacted chlorobenzene also the product distribution was found to be 66% paranitrochlorobenzene and 34% orthonitrochlorobenzene (by weight). reactions are, **12**



   Calculate (i) Analysis of charge.
   (ii) % conversion of chlorobenzene.
   (iii) Composition of product mixture.
   (atomic Wt. data, H = 1, N = 14, S = 32, $C\ell$ = 35·5)

   (b) Stream of nitrogen flowing at a rate of 100 kmol/h is heated from 303 K to 373 K. Calculate the heat that must be transferred. **8**
   Data :–
   C_p° for nitrogen = $29.5909 - 5.141 \times 10^{-3}\,T + 11.1819 \times 10^{-6}\,T^2 - 4.968 \times 10^{-9}\,T^3$
