



SF-8196

B. E. - II (Sem. IV) Examination
May / June - 2011
Fundamental Chemical Engineering
Calculations & Stoichiometry
(Institutive Elective - I)
(New Syllabus)

Time : 3 Hours]

[Total Marks : 100

Instruction :

(1)

नीचे दृष्टावेक निशानीवाणी विगतो उत्तरवही पर अवश्य कभवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 2 (SEM. 4)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="FUNDAMENTAL CHEM. ENGG. CALCULATIONS & STOICHIOMETRY"/>	<input type="text"/>
Subject Code No. : <input type="text" value="8"/> <input type="text" value="1"/> <input type="text" value="9"/> <input type="text" value="6"/>	<input type="text"/>
Section No. (1, 2,.....) : <input type="text" value="1&2"/>	
Student's Signature	

- (2) Answer to each section must be written in separate answer book.
(3) Assume suitable data whenever necessary and mention it clearly.
(4) Figures to right indicate full marks.

SECTION - I

- 1 (a) (i) Define conversion and yield. 12
(ii) Define molarity.
(iii) Give the statement of Raoult's Law
(iv) Define NTP conditions
(v) 1 poise g/cm.sec
(vi) 1 bar = _____ Pa
- (b) The diameter and height of a vertical cylindrical tank 6
are 5 ft and 6 ft 6 inch respectively. It is full upto 70%
height with carbon tetrachloride (CCl₄). The density of
which is 1.6 kg/L. Find the mass in kilograms.
- 2 Solve any two : 16
(a) An aqueous solution of sodium chloride is prepared by
dissolving 25 kg of sodium chloride in 100 kg of water.
Determine
(i) Wt. % and
(ii) Mole % composition of solution.

- (b) A mixture of H_2 and O_2 contains 11.1% H_2 by weight calculate :
- Average molecular weight of gas mixture and
 - Partial pressure of O_2 and H_2 at 100 KPa and 303 K (30°C). Take the amount of O_2 as 88.9% by wt.
- (c) A H_2SO_4 solution has a molarity of 11.24 and molality of 94. Calculate the density of solution.

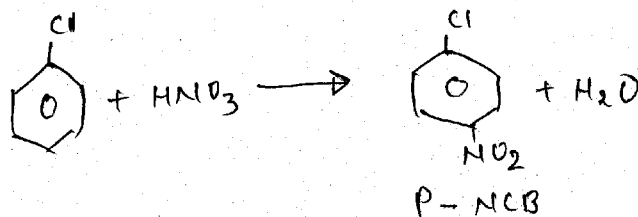
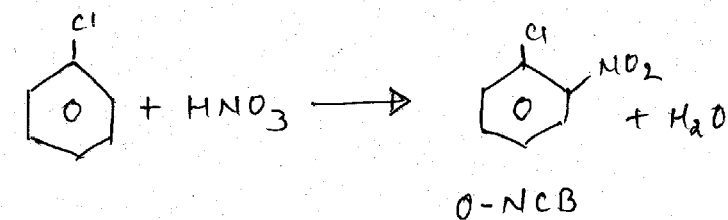
3 Solve any two : **8×2=16**

- (a) A single effect evaporator is fed with 1000 kg/h of weak liquor containing 15% caustic by weight and is concentrated to get thick liquor containing 40% by weight caustic (NaOH) calculate
- kg/h of water evaporated and
 - kg/h thick liquor obtained.
- (b) The waste acid from a nitrating process contains 30% H_2SO_4 , 35% HNO_3 and 35% H_2O by weight. The acid is to be concentrated to contain 39% H_2SO_4 and 42% HNO_3 by addition of concentrated sulphuric acid containing 98% H_2SO_4 and concentrated nitric acid containing 72% HNO_3 (by wt.). Calculate the quantities of three acids to be mixed to get 1000 kg of desired mixed acid.
- (c) The NH_3 -air mixture containing 0.2 kg NH_3 per kg air enters into absorption system where ammonia is absorbed in water. The gas leaving the system is found to contain 0.004 kg NH_3 per kg of air. Find the percentage recovery of ammonia.

SECTION - II

- 4** (a) Answer the followings : **18**
- Define : % of conversion
 - Write equation of Enthalpy.
 - What is latent heat of fusion ?
 - Write Antoine Equation to calculate pressure.
 - What is distillation ?
 - Define : Heat capacity.
 - Define : Std heat of formation.
 - Explain : drying operation briefly.

- (b) Chlorobenzene is nitrated using a mixture of nitric acid and sulphuric acid. During the pilot plant studies, a charge consisted of 100 kg chlorobenzene 106.5 kg 65.5% (by wt %) nitric acid, and 108 kg 93.6% (by wt %) sulphuric acid. After 2 hours of operation the final mixture was analyzed. It was found that final product contained 2% unreacted chlorobenzene. Also the product distribution was found to be 66% P-nitro chlorobenzene and 34% O-nitro chlorobenzene) calculate : 10
- The analysis of change
 - The percentage conversion of chlorobenzene
 - The composition of the product mixture.



- 5 (a) A vapour of 138°C and atmospheric pressure, containing 0.72 mole fraction benzene and 0.28 mole fraction toluene serves as a feed to a fractionating column in which it is separated into a distillate containing 0.995 mole fraction benzene and bottoms with 0.97 mole fraction toluene, the reflux ratio is 1.95 moles mole distillation product for a feed of 100 kg mol. compute the overall material and energy balances. Assume that there is no heat loss to the surrounding and the heat of solution is negligible. 10

OR

- (a) A solution of ethyl alcohol containing 8.6% alcohol is fed at the rate of 1000 kg/hr to a continuous distillation column. The product (i.e. distillate) is a solution containing 95.5% alcohol. The waste solution from the column carries 0.1% alcohol all % by wt. calculate. 10
- The mass flow rate of top and bottom product in kg/hr.
 - % loss of alcohol.

- (b) Temperature of pure oxygen is raised from 350 k to 1500 k calculate the amount of heat to be supplied for raising temp. of 1 kg mol oxygen using the following Cp data. 6

C_p	a	$b \times 10^3$	$c \times 10^6$	$d \times 10^9$
$kJ / kmol^\circ K$	26.0257	11.7551	-2.3426	-0.5623

- 6 (a) Calculate the std. heat of reaction at 25°C when gaseous ammonia is dissolved in water to form 2% by wt. of its solution for the regeneration of a weak anion exchanger of a water treatment plant. 10
- $NH_3(g) + H_2O(l) \rightarrow NH_4OH(l)$
 heat of formation at 25°C
 for Ammonia = -11.02 Kcal/gmol
 Water = -68.315 Kcal/g mol
 Ammonium hydroxide = -86.33 Kcal/gmol.

OR

- (a) Prepare the following solutions as per calculations : 10
- (i) 1 lit 1 N NaOH
 (ii) 1 lit 1 N H_2SO_4
 (iii) 1 lit 1N HCl
 (iv) 1 lit 1 N Na_2CO_3
- (b) A heat exchanger for a hot hydrocarbon liquid used 10,000 kg/hr of cooling water, which enters the exchanger at 294 K. The hot oil at the rate of 5000 kg/hr enters at 423 °K and leaves at 338°K and has an average heat capacity of 25% kj/kg °K. Calculate the outlet temp. of water. 6

OR

- (b) Define the following terms : 6
- (i) Specific heat
 (ii) Latent heat
 (iii) Heat of Reaction.