SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

ROLL No: | | | | | | | | | | | | |

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B.Tech. || CHE || 3rd Sem.

Chemical Process calculations (RP)

Subject Code:BTCH-302A/302

Paper ID: M/18

(2011 batch onwards)

Time allowed: 3 Hrs **Max Marks: 60**

Important Instructions:

- **All questions are compulsory**
- **Assume any missing data**
- **Additional instructions, if any**

PART A (2×10)

Q. 1. Short-Answer Questions: All COs

(a) What is dimensional homogeneity?
(b) What is SO_2 free basis?
(c) Give the vanderwaal's equation and explain the terms.
(d)How we select the basis?
(e)How many pound moles of Na_2CO_3 are there in 100 lb?
(f)If 2 kg of benzene is oxidized with oxygen, how many kilograms of O_2 is required?
(g) Define "Standard heat of formation".
(h) Define theoretical flame temperature.
(i) Calculate value of R in F.P.S. system.
(j) Define Hess law.

PART B (8×5)

Q. 2. A container holds 1.704 lb of HNO_3/lb of H_2O and has specific gravity of 1.382 at 20^0C. compute CO1

a) Weight percent of HNO_3
b) Pounds HNO_3 per cubic foot of solution
c) Molarity of solution.

OR

A solution contain 35% salt by weight in water. The solution density is 1.2 g/cm^3. Express the composition as: CO1

a) Kilogram salt per kilogram of water.
b) Pounds of salt per cubic foot of solution.

Q. 3. Antimony is produced by heating stibnite with scrap iron and molten antimony is drawn from the bottom. CO2

$$Sb_2S_2 + 3Fe \longrightarrow 2Sb + 3FeS$$

Suppose that 0.600 kg of stibnite and 0.25 kg iron are heated to give 0.2 kg of antimony. Determine

a) The limiting reactant.

b) The percentage excess reactant.
c) The degree of completion.
d) Yield.

OR

The Burning of lime stone, $CaCO_3 \longrightarrow CaO+CO_2$, goes only 70% complete in a certain kiln. CO2

a) What is the composition (mass %) of the solids withdrawn from the kiln?
b) How many kilograms of CO_2 produced per kilogram of limestone fed. Assume pure limestone.

Q. 4. Air at 60°C and 745 mm Hg having a percent humidity of 10 is supplied to a drier at the rate of 1000m^3/hour. Water is evaporated in the drier at a rate of 20 kg/hr. The air leaves the drier at 35°C and 742 mm Hg. Calculate : CO3

(a) Percent humidity of the air while leaving the drier.
(b) Volumetric flow rate of wet air leaving the drier.

Given: Vapor pressure of water
at 60°C = 150 mm Hg
at 35°C = 42 mm Hg.

OR

If 100 g of Na_2SO_4 is dissolved in 200 g of water and solution is cooled until 100 of $Na_2SO_4.10\ H_2O$ Crystallizes out, find CO3

(a) The composition of remaining solution.
(b) The grams of crystals recovered per 100 g of initial solution.

Q. 5. It is required to make 5000 kg per hour fresh acid (H_2SO_4 55%,HNO_3 25%, H_2O 20%), by using spent acid(H_2SO_4 35%,HNO_3 25%, H_2O 30%), conc H_2SO_4 98.5%, and conc. HNO_3 75 %. Find the amount required of various streams. CO4

OR

A cellulose solution contains 5.2% cellulose by weight. How many kilograms of 1.2% solution are required to dilute 100 kg of the 5.2% solution to 4.2%. CO4

Q. 6. Statement A gas containing 20% CO and 80% N_2 is burnt with 100% excess air, both air and gas initially being at 25°C. A flame temperature of 942°C is attained during combustion. Calculate the enthalapy of the products. Given mean molar heat capacities between 25°C and 942°C as: CO_2—11.74, O_2—7.90 and N_2—7.45 cal/gm mol K. CO5

OR

Calculate the theoretical flame temperature of a gas containing 22% CO and remaining N_2 when burnt with 100% excess air. Both gas and air are initially at 25°C. The standard heat of combustion of CO(g) at 25°C and 1 atm pressure is 67.64 Kcal/gm mole. The mean molal heat capacities in cal/gm mole °K with in temperature range involved are as $C0_2$ -11.82,0_2 -7.9 and N_2-7.5. CO5