

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)**

**CLASS: B.TECH.
BRANCH: BIOTECHNOLOGY**

**SEMESTER: III
SESSION: MO/2022**

SUBJECT: BE206 CHEMICAL PROCESS CALCULATIONS

TIME: 2 HOURS

FULL MARKS: 25

INSTRUCTIONS:

1. The total marks of the questions are 25.
 2. Candidates attempt for all 25 marks.
 3. Before attempting the question paper, be sure that you have got the correct question paper.
 4. The missing data, if any, may be assumed suitably.
 5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.
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		Marks	CO	BL
Q1	(a) A gaseous mixture is composed of 20% CO ₂ , 40% O ₂ and 40% N ₂ by mole. What is the mass fraction of N ₂ ?	[2]	CO1	Knowledge
Q1	(b) A container holds 50 g of water (B) and 50 g of NaOH (A). Calculate the weight fraction and mole fraction of NaOH. Also, calculate the lbm of NaOH (A) and H ₂ O (B).	[3]	CO1	Knowledge
Q2	(a) A compound contains 12% of carbon, 16% of oxygen, 28% of nitrogen, 4% of hydrogen and 40% calcium by weight, then what can be the possible molecular formula of the compound?	[2]	CO1	Understanding
Q2	(b) At 25 °C, an aqueous solution containing 35% H ₂ SO ₄ has a specific gravity of 1.2563. A quantity of 35% H ₂ SO ₄ solution that contains 195.5 kg of H ₂ SO ₄ is needed. i. Calculate the required volume of the solution in liters. ii. Estimate the percentage error that would have resulted if pure component specific gravities (SG for H ₂ SO ₄ = 1.8255) were used instead of the specific gravity of the aqueous solution.	[3]	CO1	Analysis
Q3	(a) A mixture containing 45% benzene (B) and 55% toluene (T) by mass is fed to a distillation column. An overhead stream of 95 wt% B is produced, and 8% of the benzene fed to the column leaves in the bottom stream. The feed rate is 2000 kg/h. Determine the overhead flow rate and the mass flow rates of benzene and toluene in the bottom stream.	[2]	CO1 CO2	Application
Q3	(b) You are asked to prepare a batch of 18.63% battery acid as follows. A tank of old weak battery acid (H ₂ SO ₄) solution contains 12.43% H ₂ SO ₄ (the remainder is pure water). If 200 kg of 77.7% H ₂ SO ₄ is added to the tank, and the final solution is to be 18.63% H ₂ SO ₄ , how many kilograms of battery acid have been made?	[3]	CO2	Application
Q4	(a) An evaporator system concentrating a weak liquor from 5% to 50% solids, handles 220.46 pounds of solid per day. If the same system is to concentrate a weak liquor from 4% to 35%, find the capacity (in kg) of the system in terms of solid that can be handles per day assuming water evaporation capacity to be same in both the cases.	[3]	CO2	Analysis
Q4	(b) A mixture contains 23 g of ethanol and 36 g of water, some acetic acid is added to the mixture and its mole fraction becomes 0.5, how much acetic acid was added?	[2]	CO1	Understanding

PTO

- Q5 (a) Acrylonitrile is produced by the reaction of propylene, ammonia, and oxygen. [3] CO2 Analysis
$$\text{C}_3\text{H}_6 + \text{NH}_3 + 1.5 \text{O}_2 \rightarrow \text{C}_3\text{H}_3\text{N} + 3 \text{H}_2\text{O}$$

The feed contains 10 mole% propylene, 12% ammonia, and 78% air. A fractional conversion of 30% of the limiting reactant is achieved. Determine which reactant is limiting, the percentage by which each of the other reactants is in excess, and the molar flow rates of all product gas constituents for a 30% conversion of the limiting reactant, taking 100 mol of feed as a basis.
- Q5 (b) A bob is hanging from a ceiling and time period of oscillations depends on 'length "l" of the thread, mass "m" of the bob and gravity "g". Find the relation between time and other physical quantities. [2] CO1 Understanding

:::::: 01/10/2022 :::::M