Q. Code: 562648

Reg. No. | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Third Semester

BT18302 – PROCESS CALCULATIONS

(Biotechnology)

(Regulation 2018)

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	How many grams of Na is present in 40g of sodium hydroxide?	1	U
2.	Define specific gravity.	1	U
3.	Distinguish limiting and excess reactants.	2	AP
4.	For the reaction $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. What is the theoretical requirement of oxygen per Kmol of methane?	2	AP
5.	State Henry's law.	3	U
6.	A container holds 100 ml of CO_2 at 20°C and 640 mm Hg. What will be the volume of the CO_2 if the pressure is increased to 800 mm Hg?	3	AP
7.	Write the overall and individual material balance equation for extraction?	4	U
8.	Differentiate percentage saturation and relative saturation.	4	AP
9.	Differentiate sensible heat and latent heat.	5	AP
10.	Define specific heat.	5	U

PART B - (5 X16 = 80 Marks)

11. (a) (i) What is the weight of iron and water required for the production of 100 Kg of hydrogen? **(10)** **1** **AP**

$3Fe + 4\,H_2O \rightarrow Fe_3O_4 + 4H_2$

Data: Mol.wt of Iron: 55.85 g/mol.

(ii) Express the given composition in mole% **(6)** **1** **AP**

Data:

Compound	Weight (%)
C_2H_4	25
C_2H_6	39.2
CH_4	16.3
O_2	12
N_2	7.5

(OR)

	(b)	It is required to prepare 500 ml of 1 Normal, 1 Molar and 1 Molal solution of Sulphuric acid. Calculate the quantity of H_2SO_4 to be taken to prepare these solutions if the density is 1.075 g/cm^3.	**(16)**	**1**	**AP**
12.	(a)	The waste acid from a nitrating process contains 23% HNO_3, 57% H_2SO_4, 20% water. This acid is to be concentrated to 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 amount in kg of waste and concentrated acids that must be combined to obtain 1000 kg of desired mixture.	**(16)**	**2**	**AP**
		(OR)			
	(b)	10,000 kg/h of solution containing 20% methanol is continuously fed to a distillation column. Distillate (product) is found to contain 98% methanol and waste solution from the column carries 1% methanol. All percentages are by weight. Calculate a) the mass flow rates of distillate and bottom product and b) the percent loss of methyl alcohol.	**(16)**	**2**	**AP**
13.	(a)	Estimate the density of chlorine gas at temperature of 503 K and 15.2 MPa pressure by using (i) Ideal gas equation and (ii) Vander waals equation. Take a = 0.6354 $(m^3)^2$ Mpa/$(Kmol)^2$; b = 0.0543 m^3/kmol.	**(16)**	**3**	**AP**
		(OR)			
	(b)	A gas mixture contains 0.274 kmol of Hcl, 0.337 kmol of N_2 and 0.089 Kmol of O_2. Calculate a) Avg. Molecular weight b) Volume occupied by the mixture c) partial pressure of each component at 405.3 kPa and 303K d) density of the gas mixture.	**(16)**	**3**	**AP**
14.	(a)	(i) Explain in detail the importance and applications of the humidification process.	**(8)**	**4**	**AP**
		(ii) Define dry bulb temperature, wet bulb temperature, humid volume and absolute humidity.	**(8)**	**4**	**U**
		(OR)			
	(b)	The crystallizer is fed with a saturated solution of $MgSO_4$ at 353 K. The mass is cooled to 303 K to obtain $MgSO_4.7H_2O$ crystals. During	**(16)**	**4**	**AP**

cooling, 4% solution is lost by evaporation of water. Estimate the quantity of saturated solution that should be fed to the crystallizer in order to obtain 1000 kg of $MgSO_4.7H_2O$ crystals.

15. (a) Using the data of heats of combustion in cal/g.mole. Calculate the following **(16)** **5** **AP**

Heat of combustion of benzene to water

Heat of vaporization of benzene

Data:

C_6H_6 (l) to CO_2 (g) and H_2O (l)	7,80,980
C_6H_6 (g) to CO_2 (g) and H_2O (l)	7,59,520
H_2 (g) to H_2O (l)	68,317
H_2 (g) to H_2O (g)	59,798
Graphite to CO_2 (g)	94,052

(OR)

(b) (i) A stream of carbon dioxide flowing at a rate of 100 kmol/min is heated from 298 K to 283 K. Calculate the heat that must be transferred using Cp data. $Cp = 21.3655 + 64.2841 \times 10^{-3}\ T - 41.0506 \times 10^{-6}\ T^2 + 9.7999 \times 10^{-9}$. **(8)** **5** **AP**

(ii) On the basis of the data and the chemical reaction given below. Find the heat of formation of $ZnSO_4$ from elements: **(8)** **5** **AP**

Reaction	ΔH (kcal/mol)
$Zn + S$ (Rhombus) → ZnS	-44
$2ZnS + 3O_2 \rightarrow 2\ ZnO + 2\ SO_2$	-221.88
$2SO_2 + O_2 \rightarrow 2SO_3$	-46.88
$ZnO + SO_3 \rightarrow ZnSO_4$	-55.10