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

Question Paper Code: 2143441

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Third Semester
Biotechnology
U20BT301 - CHEMICL PROCESS CALCULATIONS
(Regulation 2020)

Time: Three Hours | Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Convert the -40°C, 50°C to Kelvin and Fahrenheit $-40\,^{\circ}C = ?\,K = ?\,^{\circ}F$.

2. Iron metal weighs 500 lb and occupies a volume of 29.25 liters. Find the density in $\frac{kg}{m^3}$.

3. What is meant by Steady state and unsteady state processes?

4. Define Drying.

5. Define limiting reactants.

6. Differentiate between conversion and yield.

7. Differentiate heat of formation and heat of combustion.

8. Write the difference between endothermic and exothermic reactions.

9. Define combustion.

10. Differentiate gross heating and net heating value.

PART – B (5 x 16 = 80 Marks)

11. (a) If air contains 21% oxygen and 79% nitrogen by volume. Estimate its composition by weight % and its average molecular weight. (16)

Column No.->	1	2	3	4	5	6	7
S. No.	Component	Volume %	Mole %	No.of moles	MWT	Weigh t,	Weight (%)
-	-	%	%	kmol	kg/k mol	kg	%
1	O_2	21	21	21	32	672	23.30
2	N_2	79	79	79	28	2212	76.70
3	Total	100	100	100	-	2884	100

(OR)

(b) Chimney gas has the following composition: CO2 – 9.5%: CO-0.2%: O_2-9.6% and N_2 80.7%. Using ideal gas law, calculate, (16)

i. Its weight percentage
ii. Volume occupied by 0.5kg of gas at 30°C and 760 mmHg
iii. Density of the gas in kg/m^3 at condition of (ii)
iv. Specific gravity of the gas mixture

(Density of air may be taken as $1.3x10^{-3}$ g/cc)

12. (a) The feed to a fractionating column analyses by weight 28% benzene and 72% toluene. The analyses of the distillate shows 52 weight % benzene and 2% benzene in bottom product. Calculate the amount of distillate and bottom product per 1000 kg of feed per hour. Also calculate the percent recovery of benzene. (16)

(OR)

(b) A crystallizer is fed with 15 000kg/hr of a solution containing 10% NaCl, 15% NaOH and rest water. In the operation, water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator contains 45% NaOH, 2% NaCl and rest water. Calculate (i) Kg/hr water evaporatored (ii) Kg/hr salt precipitate. (iii)Kg/hr thick liquor. (16)

13. (a) Air at a temperature of 23 ^oC and pressure of 750mmHg has relative humidity of 83% Calculate: (a) molal humidity of air, (b) molal humidity of air if its temperature is reduced to (12^oC) and the pressure is increased to 261.32Kpa condensing out some of the water, (c) Calculate the weight of water condensed from 29.51 m^3 of original wet air in cooling to12^oC and compressing to 261.32kPa (d) calculate the final volume of the wet air of the part (b). (16)

(OR)

(b) Air at a temperature of 20 °C and pressure of 750mmHg has relative humidity of 80% Calculate: (a) molal humidity of air, (b) molal humidity of air if its temperature is reduced to (10°C) and the pressure is increased to 2000 mmHg condensing out some of the water, (c) Calculate the weight of water condensed from 1000 litre of original wet air in cooling to12°C and compressing to 261.32kPa (d) calculate the final volume of the wet air of the part (b). (16)

14. (a) Calculate the standard heat of reaction of the following reaction

$C_2H_{6(g)} \rightarrow C_2H_{4(g)} + H_{2(g)}$

Data: Component ΔH°C(kJ/mole)

a. C_2H_6(g) -1561

b. C_2H_4(g) -1411

c. H_2(g) -286

(16)

(OR)

(b) Calculate the standard heat of reaction of the following reaction at ∇H_R^{298} for the reaction

$$2FeS_2 + \frac{11}{2}O_2 \rightarrow Fe_2O_3 + 4SO_2$$

The standard heat of formation of the compounds as

Data: Component ΔH^{298}_f (kJ/mole)

a. FeS(g) -178.03

b. O_2(g) 0

c. Fe_2O_3 -822.75

d. SO_2 -297.11

(16)

15. (a) Write a brief note on determination of compositions by or sat analysis of product of combustion of solid. (16)

(OR)

(b) Write brief note on application of process simulators in energy and material balance problems.

(16)

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