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Roll No .....

CM-304 (GS)

B.E. III Semester Examination, June 2020

Grading System (GS)

Material and Energy Balance

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.

1. The nitrogen content of NH_4NO_3 sample is 34.5% by weight. Find actual content of ammonium nitrate in sample.

2. A gas has the following composition in mole basis CO_2 = 10.5%; CO = 0.2%; O_2 = 8.6% and N_2 = 80.7%. Calculate its weight percentage; volume occupied by 0.5 kg gas at 30°C and 760 mm Hg; density of gas kg/m^3 and specific gravity of the gas mixture.

3. Define dimensionless number and write their significance:
   i) Renolds Number
   ii) Prandtl Number

4. A mixture contains:
   10.0 mole% ethyl alcohol (C_2H_5OH) 75.0 mole % ethyl acetate ($C_4H_8O_2$) 15.0 mole% acetic acid (CH_3COOH)
   i) Calculate the mass fractions of each component in the mixture.
   ii) What is the average molecular weight of the mixture?

5. The heat capacity of sulfuric acid has the units of J/(gmol)(ºC) and is given by the relation
   $Cp=139.1+(1.56\times10^{-1})T(^oC)$
   where T is expressed in ºC. Modify the formula so that the heat capacity has a unit of Btu/(lbmol)(ºR) and T is in ºR.

6. a) Explain Hess's Law of constant heat summation.
   b) Calculate the heat that must be added to 3 kg mole air to heat it from 25°C to 200°C. [Data - Mean molal heat capacity of air Cpm° (between 200 and 25°C) = 7.021 kcal/ kg mole °K]

   OR

   The specific gravity of gasoline is approximately 0.70. Determine the mass (kg) of 50.0 liters of gasoline.

7. Explain relative and percentage humidity.

OR

Find the value of gas constant in $\frac{cm^3 \cdot mmHg}{mol \cdot K}$.

8. Answer any two of the following:
   a) Technical grade hydrochloric acid has a strength of 28% w/w. Express this as a mole fraction.
   b) Define the molal humidity, absolute humidity and percentage humidity.
   c) Define bypass and Purging.
   d) Write the Effect of Pressure on Heats of Reaction.
   e) Write two standard measures of performance of evaporator.
   f) How crystallization process is useful in process industries?

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