

(3 Hours)

[Total marks: 80]

N.B: (1) Question No. 1 is compulsory

(2) Attempt any three of remaining five questions

(3) Assume suitable data wherever necessary

1. (a) Define the following (Any four) (10)
- Molarity
  - Stoichiometry
  - Stoichiometric ratio
  - Limiting reagent
  - Percentage excess
- (b) Prove for an ideal gas: Pressure% = Mole% = Volume % (10)
2. (a) Write an outline of procedure for material balance calculations (12)
- (b) How many moles of  $H_2SO_4$  will contain 64 kg of S? (04)
- (c) Convert 294 g/L  $H_2SO_4$  to normality (04)
3. (a) 1000 kg/h of a mixture containing equal parts by mass of benzene and toluene are distilled to get overhead product containing 95% benzene (weight basis). The flow rate of bottom stream being 512 kg/h. (12)
- Calculate:
- The percentage of toluene in the bottom product (weight basis)
  - Flow rate of overhead product and its molar composition
  - Molar percentage of benzene in the feed
- Molecular weight of benzene: 78  
Molecular weight of Toluene: 92
- (b) 98 grams of sulphuric acid ( $H_2SO_4$ ) are dissolved in water to prepare one liter of solution. Find normality and molarity of the solution. (05)
- (c) Find out grams of HCl needed to prepare 2 L 2N HCl solution. (03)

(P. T. O.)

11/6/15

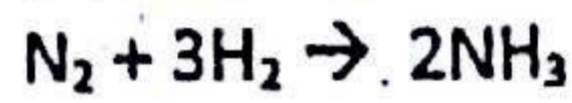
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QP Code : 4953

4. (a) A coke is known to contain 90% carbon and 10% non-combustible ash (by weight): (12)
- I. How many moles of oxygen are theoretically required to burn 100 kg of coke completely?
  - II. If 50% excess air is supplied, calculate the analysis of gases at the end of combustion?

(b) Ammonia is produced by the following reaction: (08)

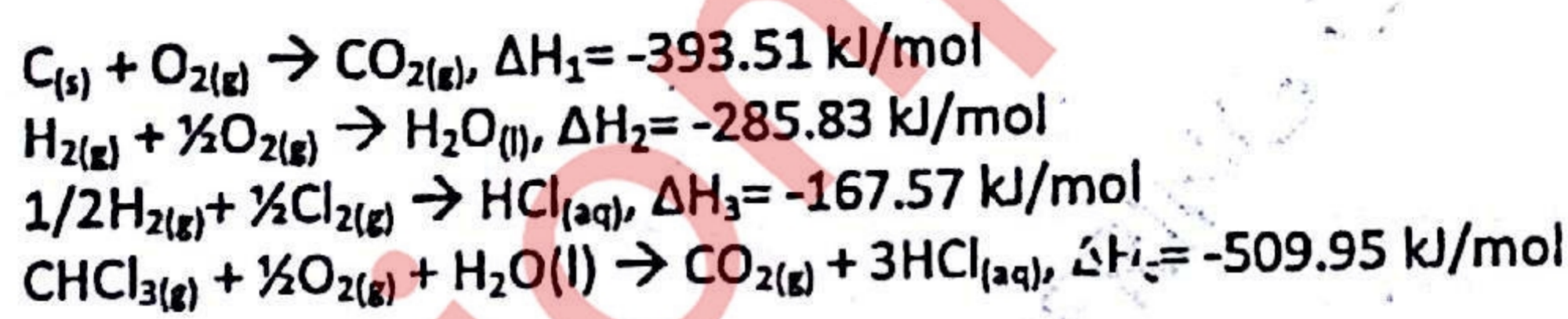


Calculate:

- I. The molal flow rate of hydrogen corresponding to N<sub>2</sub> feed rate of 25 kmol/h if they are fed in the stoichiometric proportion
  - II. The kg of ammonia produced per hour if percent conversion is 25 and nitrogen feed rate is 25 kmol/h
5. (a) A natural gas has the following composition on mole basis: (12)  
 CH<sub>4</sub> = 84%, C<sub>2</sub>H<sub>6</sub> = 13%, N<sub>2</sub> = 3%. Calculate the heat to be added to 10 kmol of natural gas from 298 to 523 K using the heat capacity data given below.  
 $C_p^0 = a + bT + cT^2 + dT^3$  kJ/(kmol.k)

Gas	a	b*10 <sup>3</sup>	c*10 <sup>6</sup>	d*10 <sup>9</sup>
CH <sub>4</sub>	19.2494	52.1135	11.973	-11.3173
C <sub>2</sub> H <sub>6</sub>	5.4129	178.0872	-67.3749	8.7147
N <sub>2</sub>	29.5909	-5.141	13.1822	-4.968

(b) Calculate the standard heat of formation of chloroform gas from its elements using Hess's law (08)



6. Write short notes on any four (20)

- (a) Liquid-Liquid extraction
- (b) Drying
- (c) Distillation
- (d) Evaporation
- (e) Ideal gas law