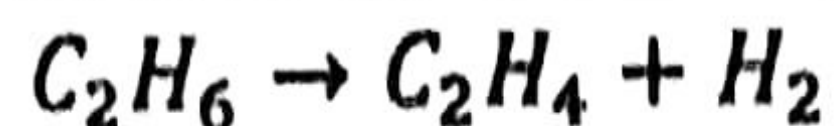


- N.B**
1. Question number one is compulsory.
  2. Attempt any three of the remaining questions.
  3. Each question carries equal marks.
  4. Figures to the right indicate marks.
  5. Make suitable assumptions when required.

- 1
  - (a) What you mean by a process. Differentiate unit process and unit operation. 05
  - (b) 20 grams of caustic soda is dissolved in water to prepare 500 ml of solution. Find normality and molarity of solution. 05
  - (c) Crude oil is analysed to contain 87% carbon, 12.5% hydrogen and 0.5% sulphur (w/w). Calculate the net calorific value of the oil at 298K. Given that the gross calorific value of the oil at 298K is 45071 kJ/kg oil and the latent heat of vaporization of water at 298K is 2442.5 kJ/kg. 05
  - (d) Explain concept of the adiabatic saturation temperature. 05
- 2
  - (a) A chemist is interested in preparing 500 ml of 1 normal, 1 molar and 1 molal solution of  $H_2SO_4$ . Assuming the density of  $H_2SO_4$  solution to be 1.075 g/cc, Calculate the quantities of  $H_2SO_4$  to be taken to prepare these solution. 05
  - (b) Certain chemical is found to contain 40ppm impurity. Convert this impurity into mass%. What is the condition for the following to be true: -mg/l = ppm 05
  - (c) The strength of aqueous hydrogen peroxide solution having a density 1.075 kg/l is specified as 60 volumes. Calculate the weight percentage of  $H_2O_2$  in solution. 10
- 3
  - (a) An evaporator system concentrating a weak liquor from 5% to 50% solid handles 100kg of solids per hour. If the same system is to concentrate a weak liquor from 4% to 35%, find the capacity of the system in terms of solids that can be handled per hour assuming water evaporation capacity to be same in both the cases. 10
  - (b) It is desired to have a mixed acid containing 40 per cent  $HNO_3$ , 43 percent  $H_2SO_4$  and 17 percent  $H_2O$  by weight. Sulphuric acid of 98 per cent by weight is available. Calculate (a) Strength of nitric acid (b) Weight ratio of sulphuric to nitric acid. 10
- 4
  - (a) The analysis of gas entering the converter in a sulphuric acid plant is 5%  $SO_2$ , 12%  $O_2$  and rest  $N_2$  by volume. The gas leaving the converter contains 0.5%  $SO_2$  on  $SO_3$  free basis. Give the actual analysis of the product gas stream. 10
  - (b) Gaseous benzene reacts with hydrogen in presence of nickel catalyst as per the reaction  $C_6H_6(g) + 3 H_2(g) \rightarrow C_6H_{12}(g)$ . 30 per cent excess hydrogen is used above that required by equation. Conversion is 50 per cent and yield is 90 per cent. Calculate the requirement of benzene and hydrogen gas for 100 moles of cyclohexane produced. 10
- 5
  - (a) Calculate the std. heat of reaction at 800 C for the complete combustion of pentane gas. The mean heat capacities of  $C_5H_{12}$ , oxygen, carbon dioxide and  $H_2O$  are 247, 33.62, 52.32, 38.49 j/mol.k respectively. The molar std heat of combustion at 298 K is - 3271.71 kJ/mol 10



- (b) Calculate the heat of reaction at 298K for the following reaction: 10



Data:

Component	$\Delta H_c^\circ$ kJ/mol
C <sub>2</sub> H <sub>6</sub>	-1560.69
C <sub>2</sub> H <sub>4</sub>	-1411.2
H <sub>2</sub>	-285.83

- 6 (a) Explain purging operation. 05

- (b) Ethylchloride can be prepared by the following reaction:- 15

$2C_2H_6 + Cl_2 \rightarrow 2C_2H_5Cl + H_2$ . Fresh ethane and chlorine gas along with recycled ethane are combined and fed in to the reactor. Test shows that if 100% excess Cl<sub>2</sub> is mixed with ethane a single pass conversion of 60% results & of the ethane that reacts all is converted to products & none goes as undesired product. Calculate the mole ratio of C<sub>2</sub>H<sub>5</sub>Cl in the product to C<sub>2</sub>H<sub>6</sub> in the fresh feed and the recycle ratio.