2009

M.Sc.

2nd Semester Examination

CHEMISTRY (CHEMICAL TECHNOLOGY)

PAPER—CH-1204

Full Marks : 40

Time : 2 Hours

The questions are of equal value.

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Answer any *four* questions.

1. (a) Define molecular diffusion.

   (b) State and explain Fick's law of diffusion.

   (c) From the first principle derive an equation to determine the molar flux. Apply this equation to determine molar flux in the following cases, (i) the steady state diffusion of gas A through a stagnant gas B, (ii) Equimolar counter diffusion of gas A and B. 2+2+6

2. (a) A vertical glass tube of diameter 0.3 cm is filled with benzene at 30°C to a depth of 2 cm from the top end. Estimate the diffusivity of benzene into air if the air above the liquid surface in the tube is stagnant. The vapour pressure and density of benzene at 30°C are 60 mm Hg and 800 kg/m^3 respectively.

(b) Ammonia diffuse through nitrogen gas under equimolar counter diffusion at a total pressure of $1{\cdot}013 \times 10^5$ Pa and at a temperature of 298 K. The diffusion path is 0.15 m. The partial pressure of ammonia at one point is $1{\cdot}5 \times 10^4$ Pa and at the other point is 5×10^3 Pa. Diffusivity under the given condition is $2{\cdot}3 \times 10^{-5}$ m^2/s. Calculate the flux of ammonia. 5+5

3. (a) Define molecularity and the order of reaction.

(b) For a gas reaction at 400 K the rate is as follows,

$$-\frac{dp_A}{dt} = 2.5p_A^2 \text{ atm/hr}$$

Estimate the rate constant, if the reaction is expressed as

$$-r_A = kC_A^2 \text{ mole/lit.sec.}$$

(c) For a 1st order gas phase reaction A → R, 50% of A is converted to R in 15 min. Determine the time required for 60% conversion of A to R. 2+4+4

4. (a) Make a comparative study of the advantages and disadvantages of solid, liquid and gaseous fuels. 5

(b) Write a short note on proximate and ultimate analysis of coal. 5

5. (a) Define manufactured fuel with suitable example.

(b) Explain : (any *two*)

(i) Carbonisation of Coal ;

(ii) Net calorific value ;

(iii) Octane number ;

(iv) Significances of volatile matter in coal.

(c) Mention two important applications of charcoal. 2

(d) Differentiate between fixed carbon and total carbon present in coal. 2

6. (a) Describe the single stage atmospheric distillation of crude petroleum with a neat flow diagram. 6

(b) Describe the Fischer-Tropsch process for the manufacture of synthetic liquid fuel. 4

7. (a) Classify refractories on the basis of (i) chemical nature ; (ii) refractoriness. 2+2

(b) Discuss the following properties of refractories :

(i) porosity and slag permeability ;

(ii) spalling ;

(iii) slag resistance.

8. (a) Define refractories. 2

(b) What are the basic raw materials used to manufacture a common refractory? 3

(c) Discuss the pretreatment process for the manufacture of a common refractory. 3

(d) Name some binding materials used in the refractories. 2