

**M.Sc. 1st Semester Examination, 2010**

**CHEMISTRY**

( *Industrial Chemistry* )

PAPER—CEM-104

*Full Marks : 40*

*Time : 2 hours*

Answer any **four** questions

*The figures in the right-hand margin indicate marks*

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

*Illustrate the answers wherever necessary*

1. (a) Explain the terms (i) Dynamic viscosity and (ii) Kinematic viscosity. Give their dimensions.
- (b) Define Newtonian and non-Newtonian fluids.
- (c) Define and explain Newton's law of viscosity.

- (d) A plate 0.025 mm distance from a fixed plate, moves at 60 cm/s and requires a force of  $2 \text{ N/m}^2$  to maintain this speed. Determine the fluid viscosity placed between the plates.

2 + 2 + 2 + 4

2. (a) Differentiate between (i) absolute and gauge pressure, (ii) simple manometer and differential manometer.

- (b) What is the difference between U-tube differential manometers and inverted U-tube differential manometers? Where are they used?

- (c) Determine the gauge and absolute pressure at a point which is 2.0 m below the surface of water. Take atmospheric pressure as  $10.1043 \text{ N/cm}^2$ .

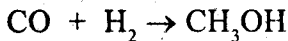
3 + 3 + 4

3. (a) Define equivalent length of a piping component.

- (b) Explain the principle of venturimeter with a neat sketch. Derive the expression for the rate of flow of fluid through it.

2 + 8

4. (a) Derive Euler's equation of motion along a stream line for an ideal fluid stating clearly the assumptions.
- (b) A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressures at the two ends are  $29.43 \text{ N/cm}^2$  and  $22.563 \text{ N/cm}^2$  respectively. The two ends are situated above the datum plane of 28 m and 30 m respectively. Calculate the loss of head between two ends. 5 + 5
5. (a) In production of  $\text{SO}_3$ , 100 kgmole of  $\text{SO}_2$  and 200 kgmole of  $\text{O}_2$  are fed to reactor. The product stream is found to contain 80 kgmole of  $\text{SO}_3$ . Find the % conversion of  $\text{SO}_2$ .
- (b) Methanol is produced by the reaction of CO with  $\text{H}_2$  as



Only 15% of CO entering the reactor is converted to methanol. The methanol formed is condensed and removed completely. The unconverted CO and  $\text{H}_2$  are recycled back to

the reactor. The fresh feed will contain  $H_2$  and CO in the molar ratio of 2 : 1. The 3200 kg/hr of methanol produced, calculate (i) kmole/kg of fresh feed, (ii) kmole/kg of recycle feed.

- (c) 1000 kg/hr of a thermic fluid to be used as a heat transfer medium, is being indirectly heated in a heater from 380 K to 550 K. Calculate the heat load on the heater in kW.

Given  $C_p = 1.436 + 0.00218T$ .

2 + 5 + 3

6. (a) Write down the basic relation for heat flow by conduction and explain the meaning of the terms involved.
- (b) For heat flow through a hollow cylinder arrive at the expression

$$q = \frac{k \bar{A}_L (T_i - T_0)}{r_0 - r_i}$$

where the notations have their usual meanings.

- (c) A layer of pulverised cork 6 in thick is used as a layer of thermal insulation in a flat wall. The temperature of the cold side of the cork is  $40^\circ\text{F}$  and that of the warm side is  $180^\circ\text{F}$ .

The thermal conductivity of the cork at  $32^{\circ}\text{F}$  is  $0.021$  Btu/ft.h.  $^{\circ}\text{F}$  and that at  $200^{\circ}\text{F}$  is  $0.032$ . The area of the wall is  $25\text{ ft}^2$ . What is the rate of heat flow through the wall in Btu per hour? 2 + 4 + 4

7. (a) Name four nitrating agents used for technical nitration and show how active nitrating species are formed in the reaction medium using the nitrating agents mentioned above.

(b) Define the terms D.V.S and nitric ratio.

(c) Glycerine containing 1 percent moisture is nitrated with a mixed acid having the following composition

Actual  $\text{H}_2\text{SO}_4$  .... 49.90%

Actual  $\text{HNO}_3$  .... 52.38%

$\text{H}_2\text{O}$  .... -2.40%

Assuming the value of nitric ratio to be 2.30 calculate the D.V.S. for this nitration.

(d) Explain how D.V.S controls the stability of nitrator charge. 1 + 1 + 5 + 3

8. Write short notes on any *two* of the following: 5 x 2

(i) Hydrogenation

(ii) Black body radiation

(iii) Dressing of ore

(iv) Beneficiation of ore.

