M.Sc. 1st Semester Examination, 2014

CHEMISTRY

PAPER – CEM-104

Full Marks : 40

Time : 2 hours

Answer any **four** questions of the following

The figures in the right-hand margin indicate marks

1. (*a*) A gas mixture has the following composition by volume SO_2 - 8·5%; O_2 - 10% and N_2 - 81·5%. Find (*a*) density at 200 °C and 2 atmg and (*b*) composition by weight.

   (*b*) In the manufacture of HCl gas containing 22% HCl and 78% air by volume enters a absorption tower at a temperature of 50 °C and a pressure of 745 mmHg. 98% of the HCl is absorbed in water and remaining

gas leaves the tower at a temperature of 25 °C and a pressure of 735 mmHg. Calculate (i) the weight of HCl remove per m³ of gas entering the system ; (ii) the volume of gas leaving per m³ of gas entering the system.

(c) Methane oxidation reactions are

$$CH_4 + O_2 \dashrightarrow HCHO + H_2O$$
$$CH_4 + 2O_2 \dashrightarrow CO_2 + 2H_2O$$
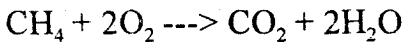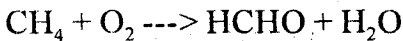
100 kmol of methane are charged, if product stream found to contain 10 kmol CO_2 and 40 kmol HCHO. Calculate (a) % conversion of methane (b) yield of HCHO.   3 + 4 + 3

2. (a) Draw a rheogram and explain the types of fluids with example.

(b) Explain why pseudoplastic liquid is also known shear thinning liquid ?

(c) An inverted U-tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance

between the axes of these pipes is 30 cm. When an oil of density 800 kg/m^3 is used as a manometric fluid, the vertical heights of water columns in the two limbs of the inverted manometer (when measured from the respective centre lines of the pipes) are 35 cm. Determine the difference of the pressure between the pipes. $4 + 2 + 4$

3. (a) State and explain the Bernoulli's equation.

   (b) Write the assumptions necessary for the derivation of Bernoulli's equation.

   (c) Derive an expression to determine the discharge from an orifice meter with neat sketch. $3 + 2 + 5$

4. (a) State and explain Fourier's law and Stefan -Boltzman law.

   (b) Define emissivity and black body.

   (c) Derive an expression for the conduction heat transfer in Cartesian co-ordinate system. $3 + 2 + 5$

5. (a) Derive an expression for the flow of conductive heat for cylindrical body.

(b) A refrigerant at $-50\,^\circ$C flows in a copper pipe of inside diameter 1 cm and wall thickness 2 mm. To reduce losses a 5 cm thick shell of thermocol type of material is put around the pipe. Calculate heat leakage to the refrigerant per metre length of pipe. Assume the internal and external heat transfer coefficients to be 500 and 13 W/m^{2}K respectively. The ambient air temperature is 40 $^\circ$C.

Given,

$k_{thermocol} = 0.020$ W/mK; $k_{copper} = 401$ W/mK　　10

6. With respect of nitration reaction answer the following : 　　10

(i) purpose

(ii) reagent used

(iii) aromatic nitration reactions

(iv) gas phase nitration reactions for paraffinic hydrocarbon.

7. (a) Write the condition required for the removal of acetylene in the purification ethylene manufacturing process.

   (b) Write the purpose and reactions involved in the dehydrosulflurization process.

   (c) Write a note on hydrogenation of fats. 3 + 3 + 4

8. (a) Define ore and mineral.

   (b) Write a note on the physical methods used for the concentration of ore.

   (c) Write the principle of froth flotation process used for ore dressing.   3 + 3 + 4

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