RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

SECOND YEAR

B.A./B.Sc. FOURTH SEMESTER (January – June) 2015

Mid-Semester Examination, March 2015

Date : 18/03/2015 **INDUSTRIAL CHEMISTRY (Honours)**

Time : 11 am – 1 pm Paper : IV Full Marks : 50

[Use a separate answer book for each group]

Group – A

Answer Question No. 1 and any three from the rest :

1. Choose the correct alternatives for **any five** of the following questions : [5×1]

   a) A manometer is used to measure
   i) Positive pressure ii) Negative pressure iii) atmospheric pressure iv) both (i) and (ii)

   b) The principle of continuity is based on
   i) Law of conservation of energy ii) Law of conservation of matter
   iii) Law of conservation of momentum iv) All of these

   c) Dimension of kinematic viscosity is
   i) MLT^{-1} ii) L^2T^{-1} iii) L^2T iv) L^2T^{-2}

   d) For a laminer flow through a closed conduit
   i) $V_{max} = 2V_{av}$ ii) $V_{max} = V_{av}$ iii) $V_{max} = 1{\cdot}5\ V_{av}$ iv) $V_{av} = 2V_{max}$

   e) The dimension of power in FLT system is
   i) FL^2T ii) FLT^{-1} iii) FL^{-2} iv) $FL^{-1}T^{-2}$

   f) One stoke is equal to
   i) 1 m^2/s ii) $0{\cdot}1\ m^2/s$ iii) $1\times10^{-2} m^2/s$ iv) $1\times10^{-4}\ m^2/s$

   g) According to Bernoulli's equations
   i) Z+P+V = C ii) $Z+\frac{P}{w}+\frac{V}{g}=C$ iii) $Z+\frac{P}{w}+\frac{V^2}{g}=C$ iv) $Z+\frac{P}{w}+\frac{V^2}{2g}=C$
   [C = constant]

   h) An ideal fluid is
   i) frictionless ii) One which obeys Newton's law of viscosity
   iii) highly viscous incompressible iv) None of these

2. a) What is the difference between differential balance and integral balance. [2]

   b) Explain the following terms :
   i) yield and conversions ii) Limiting reactant and excess reactant [2]

   c) Check the dimension homogeneity of the following expression
   i) $H_f = 4f\ell v^2 / 2gd$ where v = velocity, g = acceleration due to gravity, d = diameter, f = constant [2]
   ii) $q = C\sqrt{(mi)}$, where m = hydraulic mean depth, i = longitudinal slope of the channel, v = velocity [2]
   iii) Show that Reynold's number is a dimensionless number. [2]

3. a) Limestone is a mixture of Calcium and Magnesium carbonates and inert material. Lime is made by calcining the carbonates i.e heating them until CO_2 is driven off by the reaction
   $CaCO_3 \rightarrow CaO + CO_2$; $MgCO_3 \rightarrow MgO + CO_2$

when 100 kg of limestone is calcined, 44 kg of CO_2 is liberated. If the limestone contains 10% inerts, calculate complex analysis. [4]

b) Dry Methane is burnt with dry air and both are initially at 25°C. The flame temperature is 1297°C. If complete combustion is assumed, how much excess air is to be used? [6]

[Data : Heat of Reaction, $\Delta H_R = -0{\cdot}2 \times 10^6$ cal, C_P for CO_2 = 12·37 cal/mol °C, C_P for water = 9·60 cal/mol °C, C_P for N_2 = 7·68 cal/mol °C, C_P for air = 7·74 cal/mol °C]

4. a) Define Newton's law of viscosity. Explain graphically the relationship between shear stress and rate of shear strain of the following fluids.
i) Newtonian ii) Non Newtonian iii) ideal plastic fluid iv) pseudo-plastic [2+4]

b) An oil of mean weight of 8·8 KN/m^3 flows under a head of 5 metres through a 3000 metres long pipe of 300 mm dia. Due to cooling the viscosity changes along the length and may be taken as 0·166 poise over the first 1500 metres and 0·332 poise over the second 1500 metres. Determine the flow of oil through the pipe in litres/sec. [4]

5. a) Derive and explain the significance of Hagen-Poiseullie law for Laminar flow in pipes. [5]

b) Estimate the consumption of 96% NaCl and 93% H_2SO_4 for the production of 500 Kg HCl, if the conversion is 90%. Also calculate the amount of Na_2SO_4 produced during the process. HCl is produced by the following reaction. $2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl$. [5]

Group – B

Answer <u>any three</u> questions :

6. 56 g ethylene was polymerised using Ziegler catalyst. Degree of Polymerisation (DP) after 15 minutes on reaction was 500.
Calculate the number of Polyethelene molecules formed and number of molecules of ethylene not undergone Polymerisation reaction.
Deduce Carother's equation in terms of extent of reaction 'p' average Functionality 'f' and average degree of Polymerisation '$\bar{X}_n$'. [2+3]

7. Compare between Addition (chain growth) and condensation (step growth) Processes of Polymerisation highlighting with at least five important features. [5]

8. What is CoPolymerisation? Explain with example M_1 and M_2 are two co-monomers —Show qualitatively how can you predict structure of the copolymer on the basis of speed constants of the reaction of the two free radical species $M_1^{\bullet}$ and $M_2^{\bullet}$.
Pentaerythritol reacts with maleic anhydride in stoichiometric equivalent quantity to produce polyester resin. Calculate the extent of reaction when $DP \to \infty$. [3+2]

9. Discuss in brief the technique of suspension and emulsion Polymerisation Processes giving examples of commercial polymers manufactured by these two processes. [2·5+2·5]

10. Compare between Novolac and Resol in respect of their chemistry & processes of manufacture of moulding granules.
Mention various uses of Phenoplasts in Trade and industry. [4+1]

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