

M.Sc. 1st Semester Examination, 2011

CHEMISTRY

PAPER—CEM-104

Full Marks : 40

Time : 2 hours

Answer any four questions

The figures in the right-hand margin indicate marks

1. (a) Explain the terms 'emissivity', 'monochromatic emissivity' and 'gray body'. State the Stefan-Boltzmann law for blackbody radiation.
- (b) Derive an expression for heat flux through compound resistances in series. 1 + 1 + 1 + 2 + 5
2. (a) Discuss about the factors that affect technical nitrations.
- (b) Define the terms 'D. V. S.' and nitric ratio.

(c) Deduce an expression for the rate constant of a self-catalysed polyesterification reaction.

4 + (1 + 1) + 4

3. (a) Define ideal and real fluid.

(b) Explain why pseudoplastic fluid is called shear thinning fluid.

(c) Write examples of Bingham plastic fluid.

(d) What do you mean by single column manometers? How are they used for the measurement of pressure?

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

2 + 2 + 2 + 2 + 2

4. (a) State and explain the Bernoulli's theorem for steady flow of an incompressible fluid.

(b) What is a venturimeter? Derive an expression for the discharge through a venturimeter. 3 + 7

5. A flat plate fuel element for a nuclear reactor is 7 mm thick and is clad on each face with aluminium 2 mm thick. The rate of heat generation is uniform within

the element and has a magnitude of 3×10^4 W/kg of uranium. Determine the temperatures at the free surface of the aluminium, the aluminium/uranium interface, and at the centre of the fuel element. The coolant temperature is 413 K. 10

Additional data :

Density of uranium = 18.9×10^3 kg/m³

Thermal conductivity of uranium = 24.3 W/mK

Thermal conductivity of aluminium = 2.1×10^2 W/mK

The heat transfer coefficient at the aluminium/coolant interface = 2.84×10^4 W/m²K.

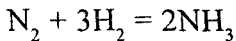
6. (a) 2000 kg of wet solids containing 70% solids by weight are fed to tray drier where it is dried by hot air. The product finally obtained is found to contain 1% moisture by weight. Calculate

(i) kg of water removed from the wet solids

(ii) kg of product obtained.

- (b) For carrying out nitration reaction, it is desired to have a mixed acid containing 39% HNO_3 , 42% H_2SO_4 and 19% H_2O (by weight). Nitric acid of 68.3% (by weight) is readily available. Calculate (i) required strength of H_2SO_4 to obtain the above mixed acid, (ii) the weight ratio of HNO_3 to H_2SO_4 to be mixed. 4 + 6

7. (a) NH_3 is produced by following reaction :



Calculate (i) the molal flow rate of H_2 corresponding to N_2 feed rate of 25 kgmole/hr if they are in stoichiometric proportion, (ii) the kg of NH_3 produced if % conversion is 25 and N_2 feed rate is 25 kgmol/hr.

- (b) 1000 kg/hr of a fluid is to be indirectly heated in a heater from 300 K to 550 K. Calculate the heat load on the heater in kW. The heat capacity of the fluid

$$C_p = 1.436 + 0.00218 T$$

Where C_p is in kJ/kgK and T is in K. 5 + 5

8. (a) Write a note on the concentration of ore using physical methods.
- (b) Write the principles of froth flotation. 5 + 5
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