M.Tech. Chemical 2011 Sem-I

URMODI – I (CBCS 2011 COURSE) : WINTER- 2016
SUBJECT : ADVANCED TRANSPORT PHENOMENA

Day : Thursday
Date : 15-12-2016

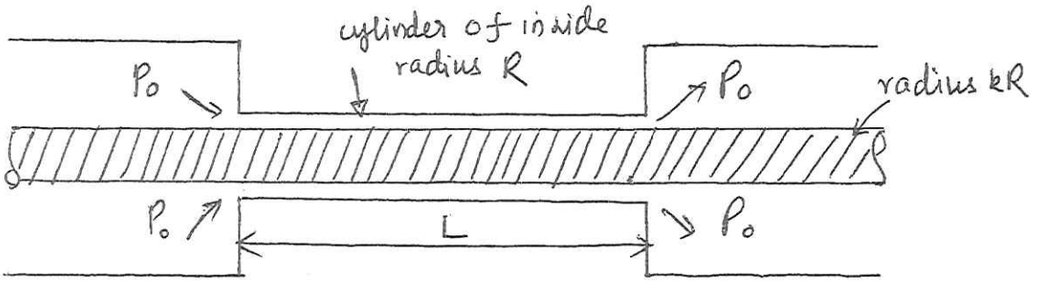
Time : 11:00AM TO 2:00P.M.
Max. Marks : 60

N.B.

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in **SEPARATE** answer book.

SECTION – I

Q.1 A cylindrical rod of diameter kR moves axially with velocity V_0 along the axis of a cylindrical cavity of radius R as seen in figure. The pressure at both ends of the cavity is same, so that the fluid moves through the annular region solely because of rod motion. **(10)**

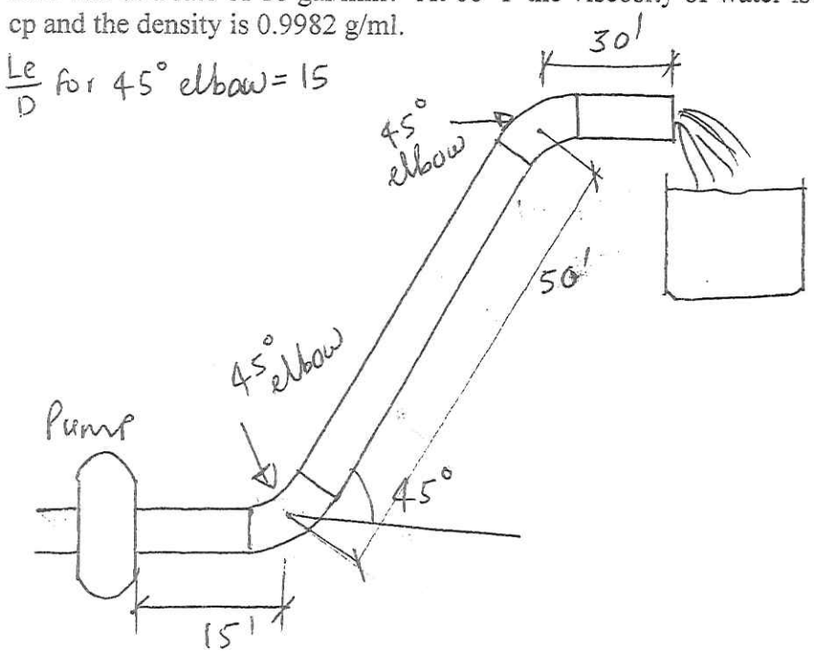


Find the velocity distribution in the narrow annular region.

OR

What is the science of Rheology? Discuss in detail about various rheological models for Non-Newtonian fluids.

Q.2 Water at 68 ^{0}F is to be pumped through the 95 ft of standard 3 inch pipe (internal diameter 3.068 inch) into an overhead reservoir. What pressure is required at the outlet of the pump to supply water to the overhead reservoir at a rate of 18 gal/min? At 68 ^{0}F the viscosity of water is 1.002 cp and the density is 0.9982 g/ml. **(10)**



P.T.O.

OR

Discuss in detail about the friction factors for packed columns and obtain the expressions for pressure drop for the following type of flow :

i) Laminar flow
ii) Highly turbulent flow
iii) Transition flow

Q.3 Develop a formula for the overall heat transfer coefficient for the cuboid shaped composite wall. **(10)**

OR

For heat conduction in a cooling fin, derive an expression for temperature distribution and prove that,

$$\theta = \frac{Cosh\, N(1-\tau)}{Cosh\, N}.$$

SECTION – II

Q.4 A solid material occupying the space from y = 0 to y = ∞ is initially at temperature T_0. At time t = 0, the surface at y = 0 is suddenly raised to temperature T_1 and maintained at that temperature for t > 0. Find the time dependent temperature profit T (y, t). **(10)**

OR

Discuss in detail about the heat transfer coefficients for forced convection in tubes.

Q.5 Define Fick's law of diffusion. Consider a diffusion system in which liquid is evaporating into gas B. Derive an expression for concentration profile for the case of diffusion through a stagnant film and prove that **(10)**

$$\left(\frac{1-x_A}{1-x_{A1}}\right) = \left(\frac{1-x_{A2}}{1-x_{A1}}\right)^{\frac{z-z_1}{z_2-z_1}}$$

OR

For diffusion and chemical reaction inside a porous catalyst, obtain an expression for concentration profile and prove that

$$\frac{C_A}{C_{AR}} = \left(\frac{R}{r}\right)\frac{\sinh\sqrt{k_a'' / D_A}\, r}{\sinh\sqrt{k_a'' / D_A}\, R}$$

Q.6 Discus in detail about enhancement of mass transfer by first order reaction in turbulent flow. **(10)**

OR

Discuss in detail about combined heat and mass transfer by free convection.

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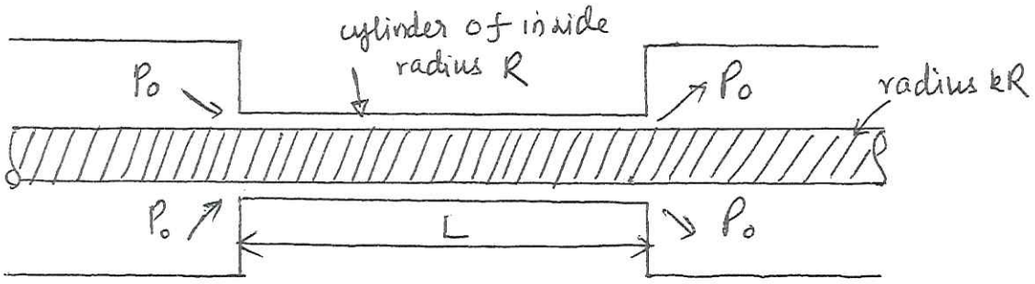

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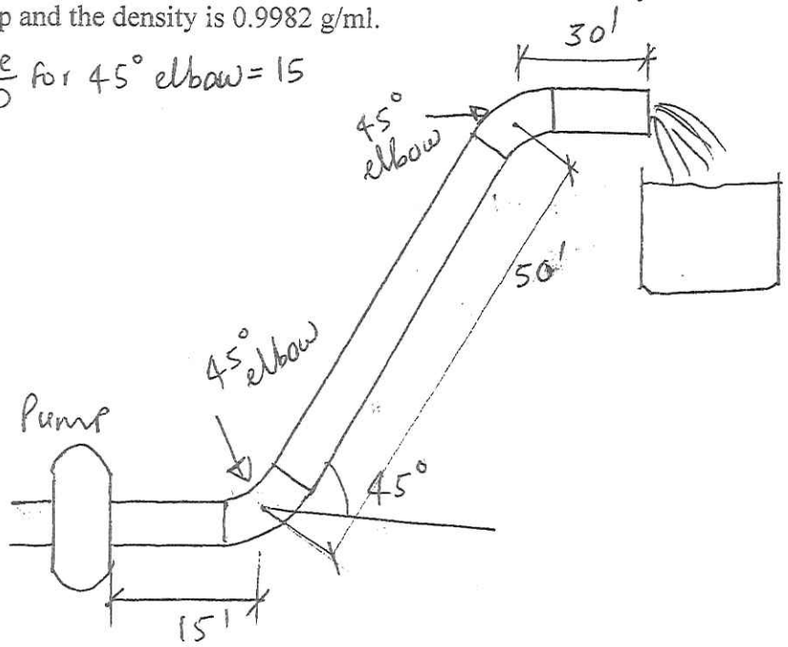
$\frac{Le}{D}$ for 45° elbow = 15



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