



Remarks: (Answer the following questions, and assume any missing data)

Question (1) [15Marks]

1-(a) What is meant by the following terms?

[5 Marks]

- Fluid – Non-Newtonian fluid – Incompressible fluid – Energy line –Steady flow

1- (b) Put (✓) or (x), and CORRECT the wrong one

[5 Marks]

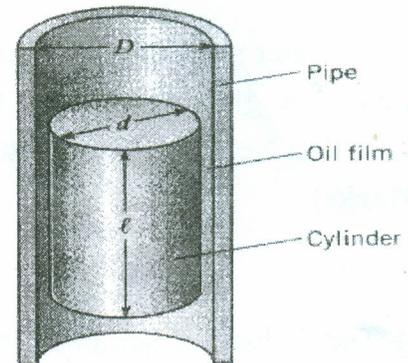
1. () Micro- manometer is used to measure high difference pressure.
2. () Newton's law of viscosity is applied on Newtonian and Non- Newtonian fluids
3. () In turbulent flow stream lines moves in a parallel lines.
4. () Continuity equation is deduced based on the law of energy conservation.
5. () The friction coefficient of laminar flow in pipes increases as the Reynolds number increases.

1-(c) Starting from Energy equation, deduce the relation that is used to calculate the volume flow rate of the venturi flow meter.

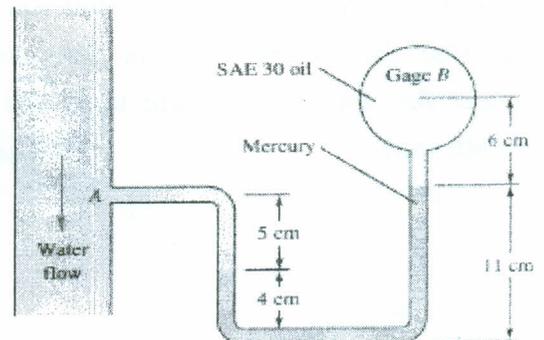
[5 Marks]

Question (2) [25 Marks]

2-(a) A solid circular cylinder has a diameter of 100 mm and length of 300 mm slides inside a vertical smooth pipe of 100.5 mm diameter. The space between the cylinder and the pipe is lubricated with an oil film has a dynamic viscosity of 0.15 N.m/s^2 . Assuming linear variations of velocity between the cylinder and pipe. Draw the velocity distribution and calculate the velocity of the cylinder if it has a weight of 50 N. [10 Marks]



2-(b) The arrangement system shown in figure is to measure the pressure at point A in a water flow. If the pressure at B is 87 kPa, estimate the pressure at A, in kPa. Take the specific weights of SEA oil and mercury are 0.87 and 13.6 respectively. [10 Marks]



2-(c) If the flow velocity is given by the following equations:

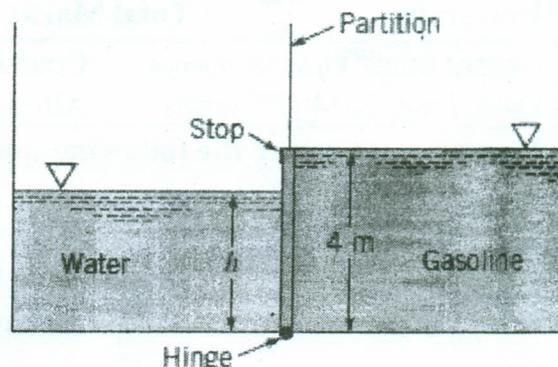
[5 Marks]

$$u = -ky \qquad v = kx \qquad (k \text{ is constant})$$

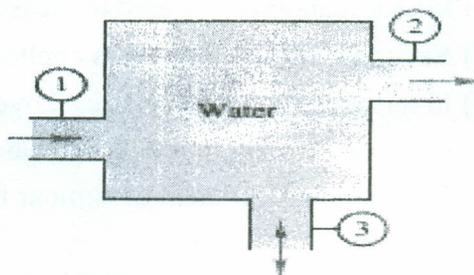
- a) Obtain the streamline equation for this flow.
- b) Is this flow (one or two dimensional flow, steady or unsteady flow, and rotational or irrotational flow)?

Question (3) [15 Marks]

3-(a) An open tank has a vertical partition and on one side contains gasoline with a density of 700 kg/m^3 at a depth of 4 m, as shown in figure. A rectangular gate that is 4 m high and 2 m wide and hinged at one end is located in the partition. Water is slowly added to the empty side of the tank. At what depth, h , will the gate start to open? [8 Marks]

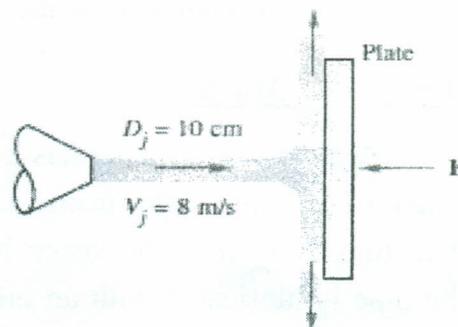


3-(b) Water flows steadily through a closed tank, as in Figure. At section 1, $D_1 = 6 \text{ cm}$ and the volume flow is $100 \text{ m}^3/\text{h}$. At section 2, $D_2 = 5 \text{ cm}$ and the average velocity is 8 m/s . If $D_3 = 4 \text{ cm}$, what is (a) Q_3 in m^3/h and (b) average V_3 in m/s ? [5 Marks]

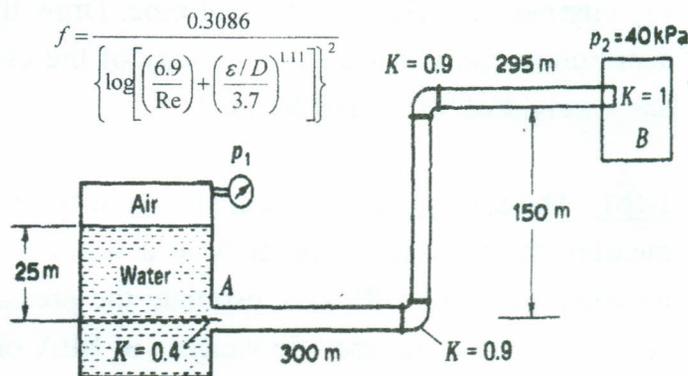


Question (4) [20 Marks]

4-(a) The water jet shown in Figure strikes normal to a fixed plate. Neglect gravity and friction, and compute the force F in Newtons required to hold the plate fixed. [10 Marks]



4-(b) The industrial scrubber B shown in figure consumes water ($\mu=10^{-3} \text{ Pa}\cdot\text{s}$) at a rate of $0.1 \text{ m}^3/\text{s}$ if the pipe is 150 mm diameter determine the necessary tank pressure p_1 . Neglect Air elevation in the tank and take $\epsilon=0.046 \text{ mm}$. [10 Marks]



$$f = \frac{0.3086}{\left\{ \log \left[\left(\frac{6.9}{Re} \right) + \left(\frac{\epsilon/D}{3.7} \right)^{1.11} \right] \right\}^2}$$

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