ws Oct 09-1 190 Sem V / Mech / Fluid Machanics / Dec-09

Con. 5742–09. **(REVISED COURSE)** **SP–8492**

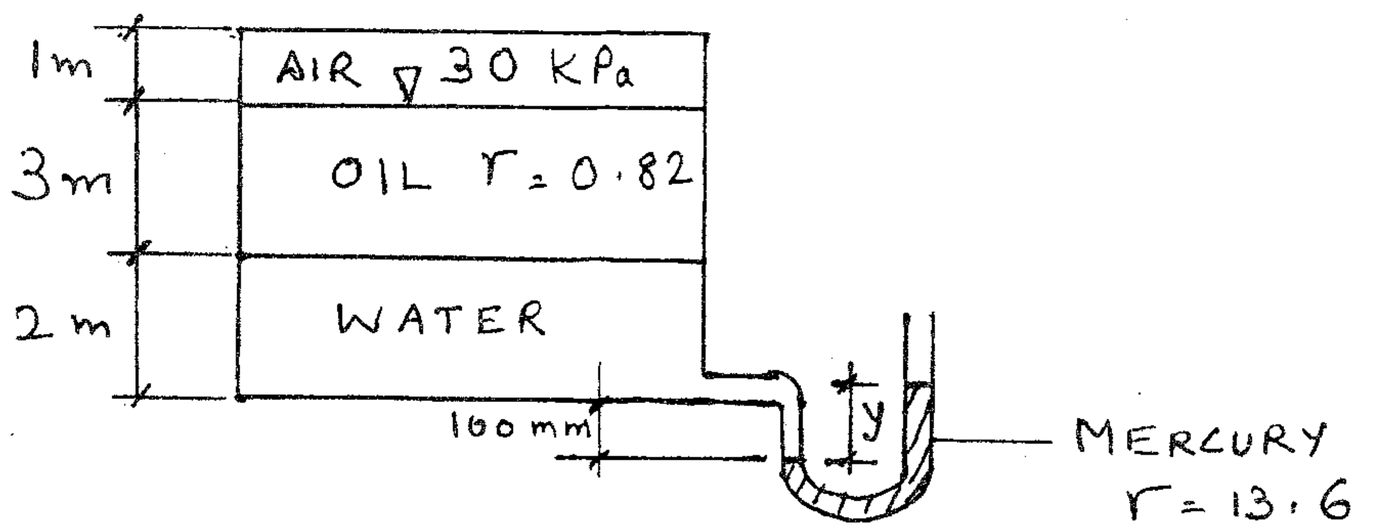
(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** of the remaining questions.
(3) Assume **suitable** data,if **necessary**.

Q.No.1

1. Develop a formula for capillary rise of water between two concentric glass tubes of radii Ro and Ri and contact angle θ. The surface tension coefficient at the interfaces is σ. 5

2. A manometer is attached to a tank containing 3 different fluids as shown below. What will be the deflection of the mercury column 'y' for the given configuration? 5

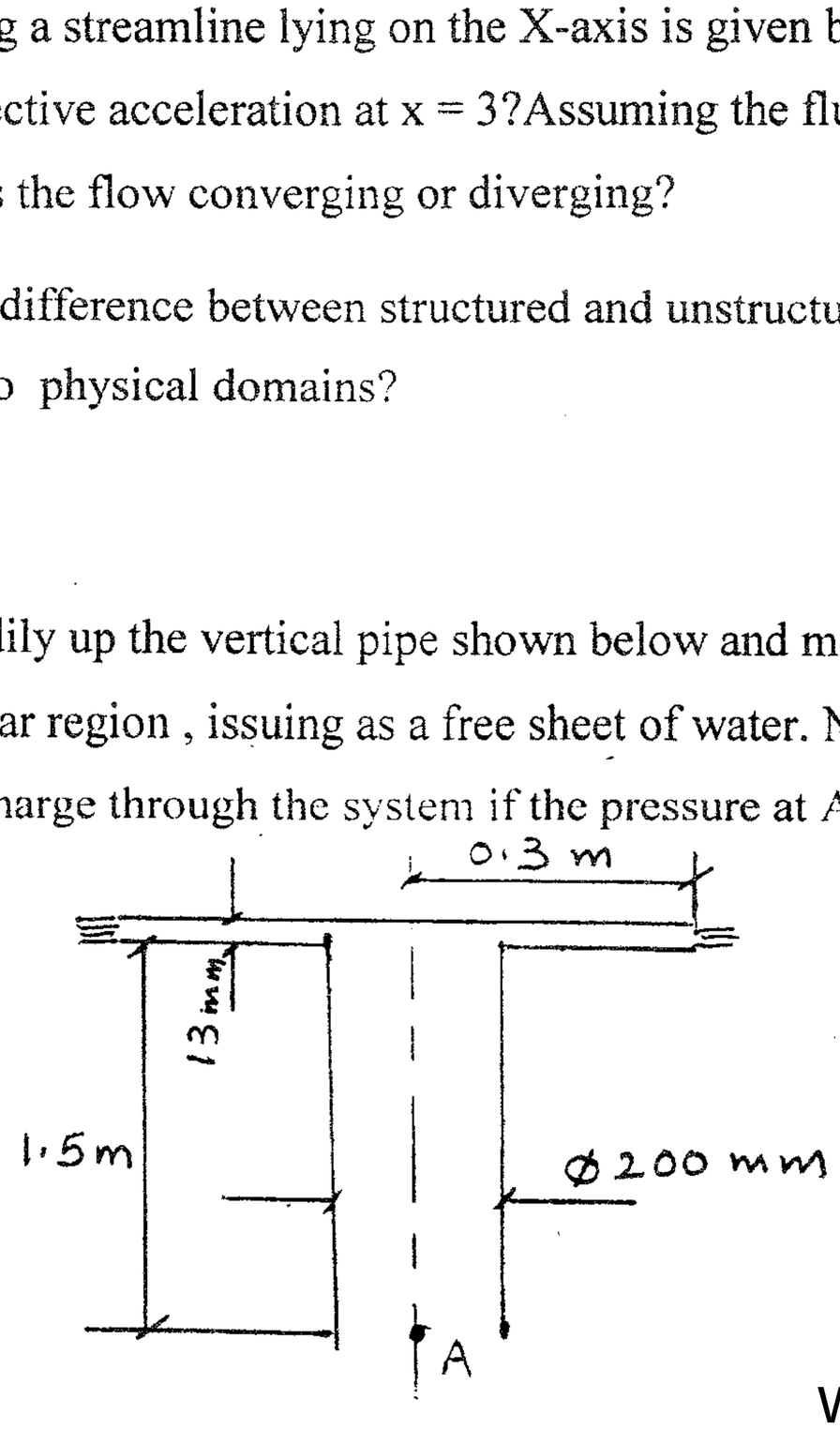


3. The velocity along a streamline lying on the X-axis is given by $u = 10 + x^{0.5}$. What is the convective acceleration at x = 3?Assuming the fluid is incompressible, is the flow converging or diverging? 5

4. What is the main difference between structured and unstructured mesh and when are they applied to physical domains? 5

Q.No.2

1. Water flows steadily up the vertical pipe shown below and moves out radially through the annular region , issuing as a free sheet of water. Neglecting friction calculate the discharge through the system if the pressure at A is 80 KPa (gauge)? 8



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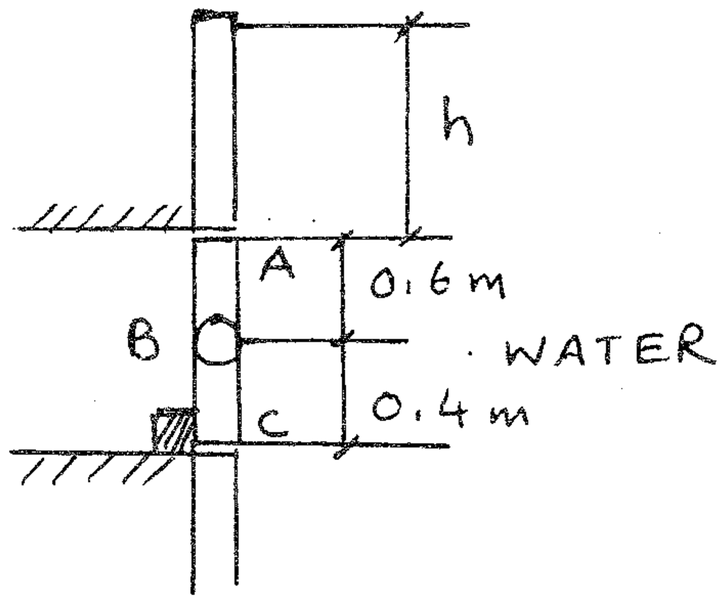
2. Gate ABC is 1m square and hinged at B. It will open automatically when water depth 'h' becomes high enough. Determine the minimum value of h at which the gate will open 12



Q.No.3

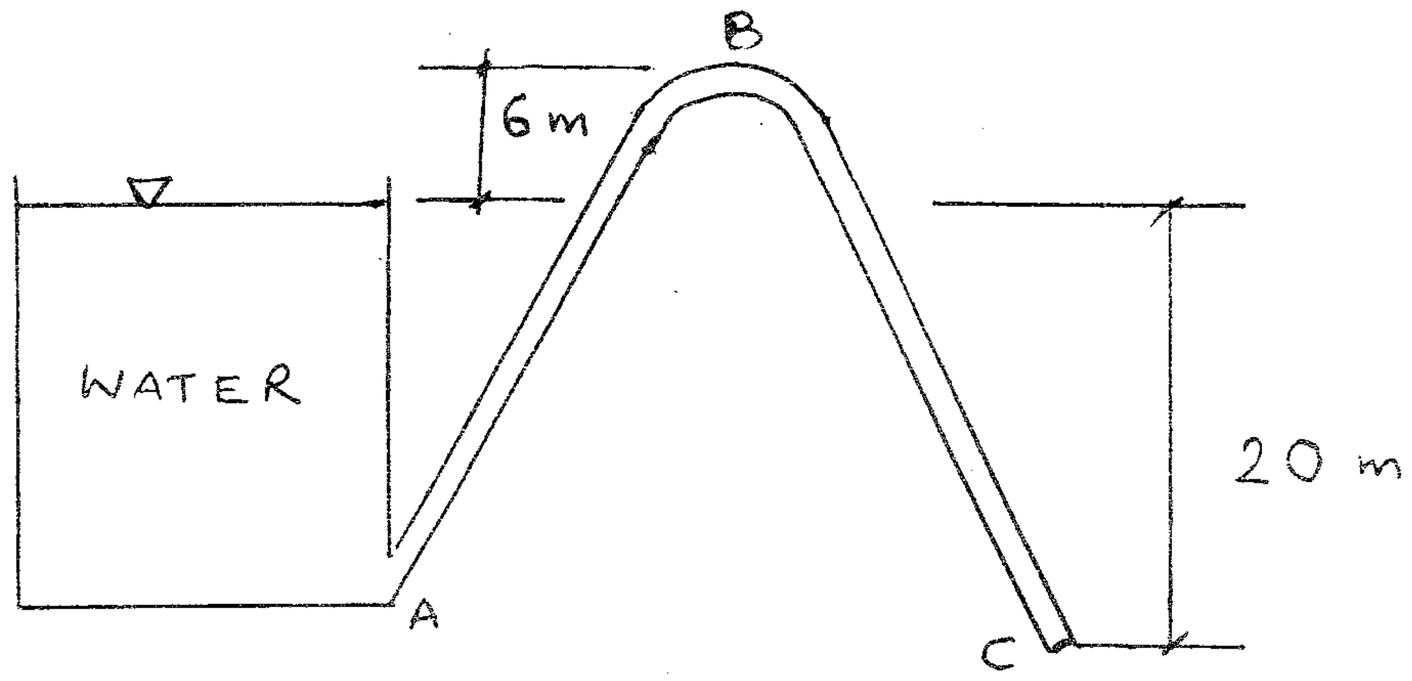
1. For the pipeline shown below determine the maximum length of pipe that can be laid between A and B so that there is no disruption of flow due to vaporisation.

   The following data is given:

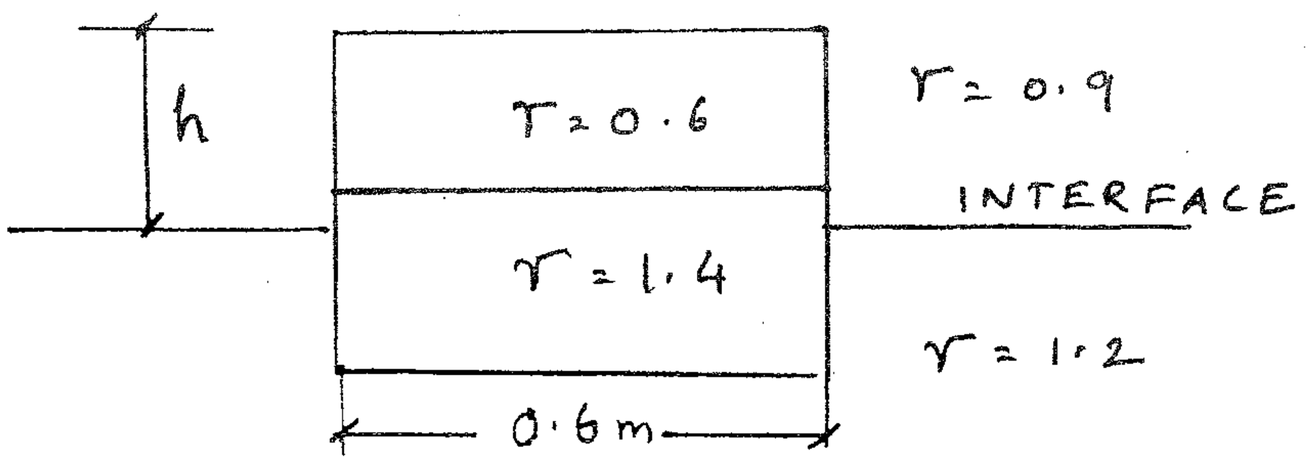
   Length of pipe A-B-C = 1000m , Diameter of pipe = 60 mm

   Vapour pressure head of water = 0.08 kgf / cm^2 (absolute)

   Ambient pressure = 0.98 kgf / cm^2, Friction factor for the pipe = 0.03 10



2. A cube of 0.6 m side has its lower half of specific gravity 1.4 and upper half of specific gravity 0.6. It is submerged in a two layered fluid, the lower has a specific gravity of 1.2 and the upper has a specific gravity of 0.9. Determine 'h', the height of the top of the cube above the interface. 10



Q.No.4

1. A sink of strength 100 m^2/s located at the origin of the coordinates is combined with a horizontal rectilinear flow (from left to right) having a velocity of 10 m/s. Determine the stream function of the combined flow field. Locate any stagnation points. Derive the equation of the streamline passing through the stagnation point. 10

2. Determine the ratio of the momentum thickness to the boundary layer thickness 'δ' when the velocity profile within the boundary layer is given by

$$U / U\alpha = (y / \delta)^{1/2}$$

Where U is the velocity at a height 'y' above the surface and the free stream velocity is Uα. 10

Q.No.5

1. Consider a two dimensional viscous incompressible flow of a Newtonian fluid between 2 parallel planes , both of which are stationary and separated by a distance 'c'. Obtain the governing equations from the general continuity and the Navier- Stokes equations. Specify the boundary condition for a CFD solution. By showing a computation domain which is discretized into 6 (horizontal) by 3 (vertical) cells, develop a set of discretized algebraic equations for the velocity. 17

2. Convert the following:

(-300) mm of Hg into N/m^2 (absolute) 03

Q.No.6

1. In a circular pipe of diameter 'd', the velocity profile is linear. If U_{max} is the centerline velocity and U is the velocity at any radius 'r', determine the following:

(a) the average velocity

(b) The kinetic energy correction factor 10

2. Derive the Euler's equations of motion for a three dimensional flow. State clearly all the assumptions made in arriving at the equations 10

Q.No.7

1. A branched pipe is placed in a horizontal plane as shown in the diagram. The data is as follows:

Pa = 1.5 kgf / cm^2 = P_c Pb = 1.4 kgf / cm^2

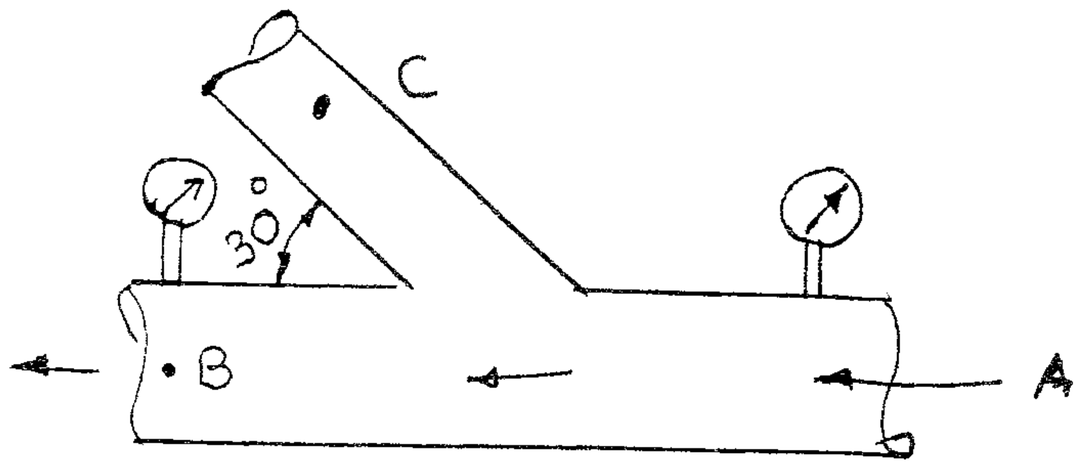
Diameter d_a = 100 mm and diameter d_b= 100mm

Flow rate at A is 2000 litres per minute. Determine the following:

(a) Flow rate at B and flowrate at C

(b) diameter d_c

(c) Net force on the branch due to momentum change 14



2. Define lift and drag coefficient for an aerofoil? How does it vary with the angle of attack? 06