Fluid Pressures and Pressure Measurement

Problems on measuring pressure

Q1. Convert the pressure of 20 N/cm^2 to the height of water column. *(Ans: h = 20.38 m of water)*

Q2. Convert 30 cm of oil column in N/cm^2. Take specific gravity of oil as 1.2 *(Ans: 0.353 N/cm^2)*

Q3. Convert 3.5 bar pressure into equivalent mercury column. *(Ans: h = 2.62 m of mercury)*

Q4. Convert 15 cm mercury column equivalent to water column. *(Ans: h = 2.04 m of water)*

Q5. Barometric reading at a place is 75 cm of Hg. Express the pressure intensity of 10 N/cm^2 in

a) m of water *(Ans: 10.19m)*
b) mm of mercury *(Ans: 744mm)*
c) kN/m^2 Abs *(Ans: 200.06 kN/m^2)*

Q6. For the water column of height 6m, calculate

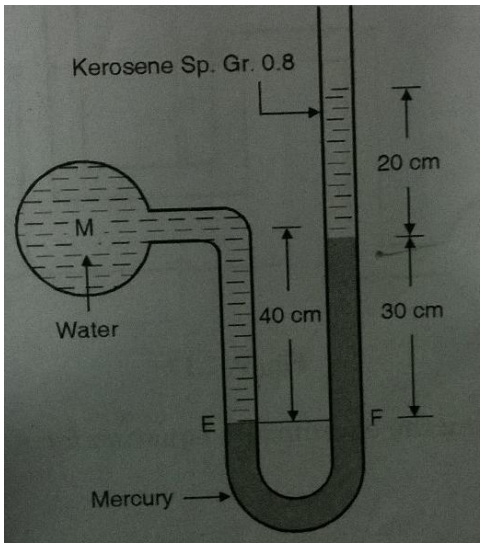
a) intensity of pressure in KPa *(Ans: 58.86 KPa)*
b) mm of mercury *(Ans: 441mm of Hg)*
c) m of water *(Ans: 6m of water)*
d) N/m^2 absolute *(Ans: 158.86 x 10^3 N/m^2)*

Q7. Convert 25 bar into MPa *(Ans: 2.5 MPa)*

Q8. Convert vacuum gauge reading 20 cm of Hg into absolute pressure in N/cm^2. *(Ans: P = 7.47 N/cm^2)*

Problems on manometers

Q9. Find the pressure in the pipe in terms of pressure head of water. *(Ans: h = 3.84 m)*

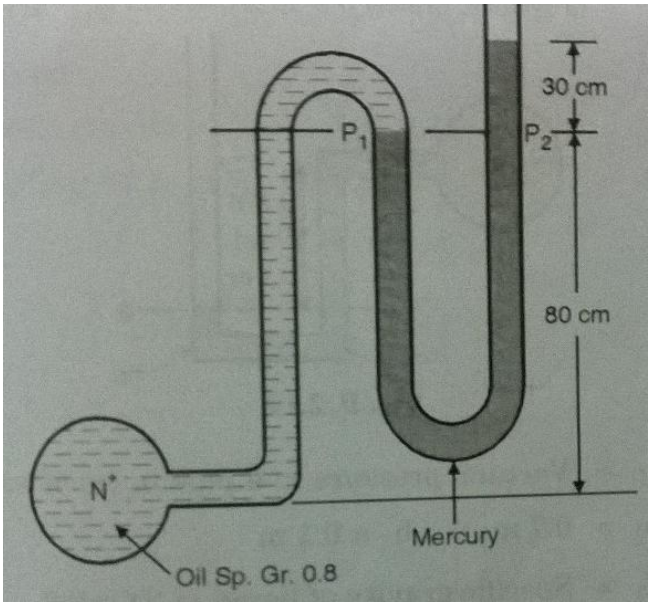


Q10. A tube containing mercury has its right limb open to atmosphere. The left limb is connected to a pipe containing water under pressure. If the mercury level in the right side is higher by 50 mm. find the pressure in pipe. The center of pipe is 30 mm above the right limb mercury level. *(Ans: P = 5.886 kN/m^2)*

Q11. A simple U-tube manometer shows mercury level 90 mm above center of pipe in the open limb and 60 mm below the center of pipe in the left limb connected to pipe. The pipe is horizontal and carries an oil of Sp. Gr 0.8. Calculate the absolute in the pipe. *(Ans: P = 120.87 kN/m^2)*

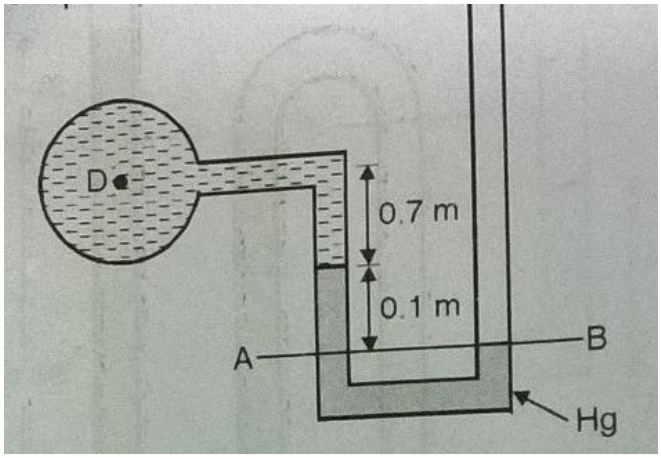
Q12. A tube you manometer is used to measure the pressure of oil having specific gravity 0.85 flowing in a pipe line. Its left end is connected to pipe and right limb is open to atmosphere. The center of pipe is 100 mm below the level of mercury in right limb. If difference in mercury level, in two limbs is 160mm. find absolute pressure in kPa. *(Ans: P = 119.08 kN/m^2)*

Q13. Find the absolute velocity in the pipe at point N. *(Ans: P_{abs} = 147.65 kN/m^2)*

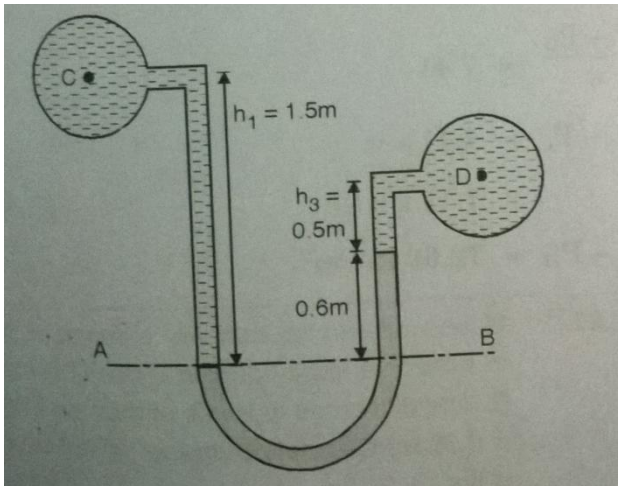


Q14. A simple U-tube manometer containing Hg is connected to a pipe in which a fluid of specific gravity 0.8 and ***having vacuum pressure*** is flowing the other end of the manometer which is open to the atmosphere. Find the vacuum pressure in pipe, if the difference in Hg level in the two limbs is 40 cm and the height of fluid in the left from the center of pipe is 15 cm below. . *(Ans: $P = -54543.6\ N/m^2$)*

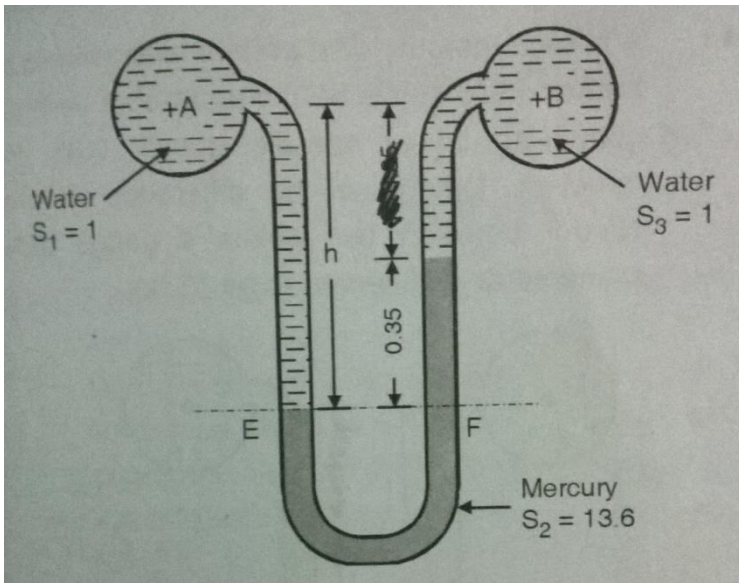
Q15. Find the vacuum pressure in the pipe containing a liquid of specific gravity 0.9 as shown the figure. *(Ans: $P_{vacuum} = -19.52\ kN/m^2$)*



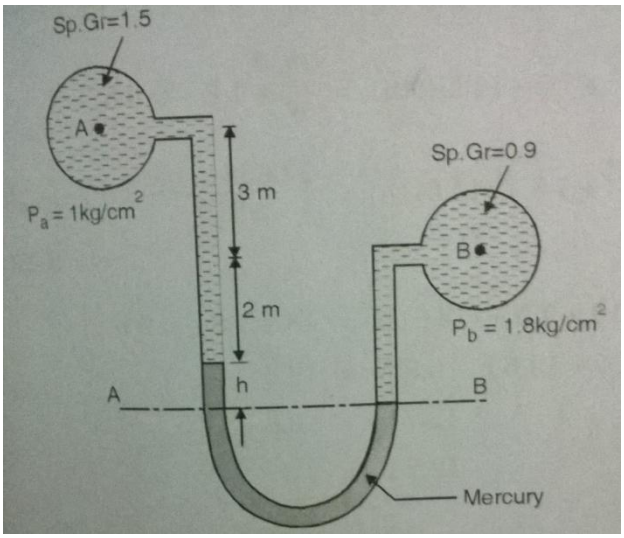
Q16. U-tube differential manometer containing Hg is used to measure the difference in pressure for two pipes C and D as shown in the figure. Pipe C contains carbon tetrachloride of specific gravity 0.8. Pipe D contains oil of specific gravity 0.9. Find the difference of pressure in two pipes. *(Ans: $P_C - P_D = 72.69\ kN/m^2$)*



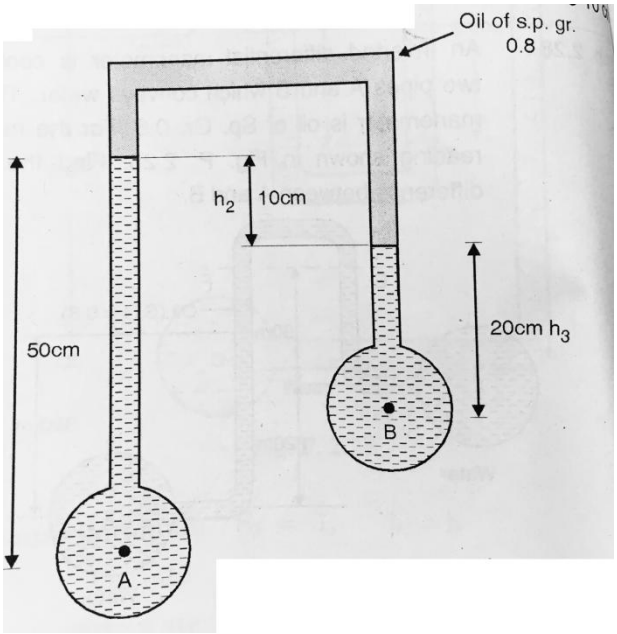
Q17. U-tube differential mercury manometer is connected to horizontal pipe carrying water at two points A and B. the difference in mercury level in the two limbs is 0.35 m. calculate the pressure difference at A and B in KPa. *(Ans: $P_A - P_B = 43.26\ kN/m^2$)*



Q18. A differential manometer is connected at two points A and B of two different pipes as shown in figure. The pipe A contains a liquid of specific gravity 1.5 while pipe B contains a liquid of specific gravity of 0.9. The pressure at A and B are 1 Kg/cm2 and 1.8 Kg/cm2 respectively. Find the difference in mercury level. . *(Ans: h = 0.18 m)*



Q19. An inverted U tube was used to determine the difference of pressures in two pipes carrying water as shown in the figure. Find the difference of pressure in the two pipes in terms of head of water and kN/m^2, if the manometric fluid is oil having specific gravity 0.8. *(Ans: $P_A - P_B = 2.156\ kN/m^2$)*



Type II (Hydrostatic Pressure on immersed body)

Q1. A circular plate 1.2 m diameter is placed vertically in water so that the center of the plate is 2 m below the free surface. Determine the depth of center of pressure. (h = 2.045 m)

Q2. Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the center of plate is 3 m below the free surface of water. Find the position of center of pressure. (P = 52007.1 N, h = 3.045 m)

Q3. Consider a 4 x 4 square plate is immersed in water with one of its diagonals vertical. Its centroid lies at a depth of 8m from the free water surface. Calculate the total pressure on the plate and locate the position of center of pressure with respect to the plate centroid. *(P = 1255.6 kN, h = 8.163 m)*

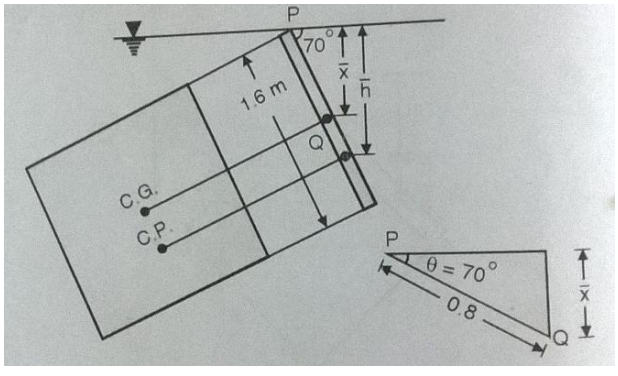
Q4. An isosceles triangle plate of 3m base and 3 m height is immersed vertically in water such that its base is immersed vertically in water such that its base is at a depth of 4.5m from free surface. The apex of plate is below the base of plate. Determine the total pressure and position of center of pressure. *(P = 242.793 kN, h =5.59 m)*

Q5. A rectangular sluice gate is situated on the vertical wall. The vertical side of the sluice is D m in length and depth of centroid of area is (P) m below the water surface. Prove that the depth of pressure is equal to $h = P + d^2/(12P)$

Q6. A square plate of sides 1.6m is held in water such that two sides are horizontal and the plane makes an angle of 70^0 with the horizontal. If the upper horizontal side is at water surface, calculate

a. Total pressure on the plate
b. The position of center of pressure.

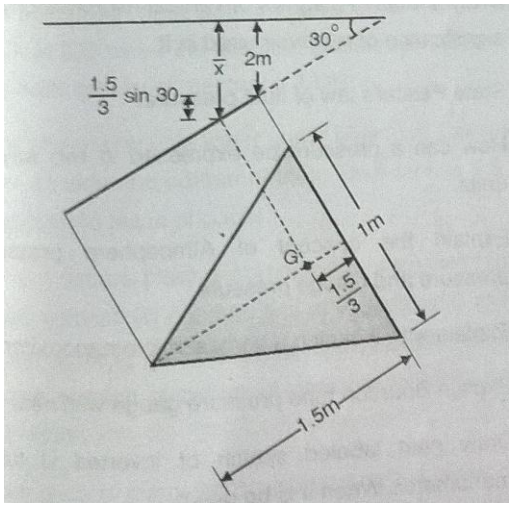
(P = 18.83 kN, h = 1.002 m)



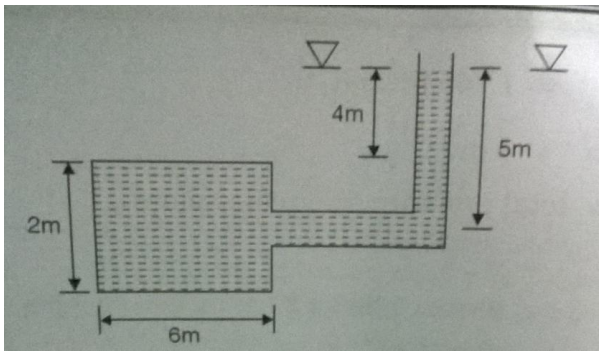
Q7. A circular plate 3 m in diameter is immersed in water such that the greatest and least depth below free surface of water is 4.5 m and 2 m respectively. Determine total hydrostatic pressure on disc. *(P = 225.93 kN)*

Q8. A circular plate of 6m diameter is held in water in such a way that its maximum and minimum depth from the surface of water is 3m and 9m. Determine the total pressure on the plate and the position of center of pressure. *(P = 1.66 kN, h = 6.33 m)*

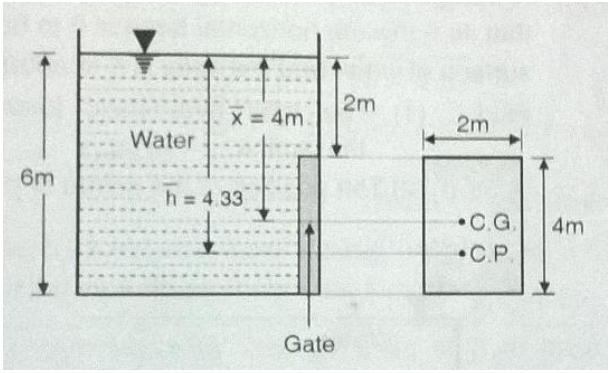
Q9. A triangular plate 1m base and 1.5 m altitude is immersed in water. The plane of the plate is inclined at 30^0 with the free surface and the base is parallel to and at a depth of 2m from water surface. Find the total pressure on the plate and the position of the center of pressure. *(P = 16.554 kN, h = 2.233 m)*



Q10. The tank shown contains water under pressure. Calculate total pressure on side and bottom of tank. Take tank is 2.5 m wide and perpendicular to the plane of paper. (F = 882.9 kN)



Q11. A rectangular gate having 2m width height, 4m height fitted in one of the vertical side of a tank. The depth of the water in tank is 6m. The gate is installed at bottom of tank. Calculate total hydrostatic pressure and center of pressure on gate. *(P = 313.93 kN, h = 4.33 m)*



Type III Pressure Distribution diagram (For Civil Only)

Q1. A vertical tank square in plan has side 3m. It contains oil of specific gravity 0.4 upto the depth of 2.5m. Calculate the total pressure at the bottom and on the side of the tank. *(Ans: On bottom P = 88.29 kN, on side P = 36.79 kN)*

Q2. A tank 3 X 5 m is filled with water upto the depth of 2m. Calculate the total pressure on 5m side of tank and at the bottom of the tank. *(Ans: On bottom P = 294.3 kN, on side P = 98.1 kN)*

Q3. A cylindrical tank 10m in diameter and 15 m high is filled with water. Find

i) Intensity of water on bottom of tank.
ii) Total force on bottom
iii) Total force on side *(Ans: On bottom P = 11557.13 kN, on side P = 11036.25 kN)*

Q4. Determine the total pressure acting on one side and bottom of tank containing water upto depth 2m, length 3m and width 3m. *(Ans: On bottom P = 176.68 kN, on side P = 58.86 kN)*

Q5. Find the intensity of pressure at bottom and centre of gate containing sea water 10m above the bottom. The gate is placed vertically and specific gravity of sea water is 1.04. *(Ans: on bottom P = 102.024 KN, on centre of gate P =51.01 kN)*

Q6. A container having each side equal to 1m contains an oil of specific gravity0.8 to a depth of 90 cm. calculate the magnitude of the force acting on any one of the vertical sides and also the position of the point at which this force acts. Draw the pressure diagram for the vertical side. *(Ans: On side P = 3.17 kN)*

Q7. A square tank 1 X 1 m in plan and 2m deep contains oil of specific gravity 0.85. The free liquid surface of oil is 50 cm below the top of tank. Find the total pressure and position of the centre of pressure on side and bottom of tank. *(Ans: On side P = 9.37 kN)*

Q8. A bulk head 3m long divides a storage tank. On one side there is petrol of specific gravity 0.75 stored to depth of 2m while on other side there is oil of specific gravity 0.8 stored to a depth of 0.9m. Determine the resultant pressure on the bulk head and position at which it acts. *(Ans: Resultant Total pressure = 34.617 kN, h = 0.72m from base)*

Q9. Upstream side of a dam is vertical. It supports a 10m layer of water placed above 2m layer of liquid mud having specific gravity 1.2. Determine the total pressure acting on the dam per meter run. *(Ans: Resultant Total pressure = 710.24 kN, h =3.98m from base)*