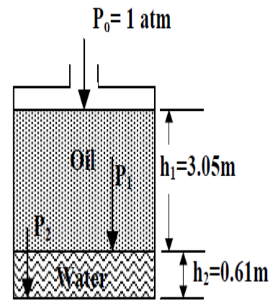
**Example -2.1-**

A large storage tank contains oil having a density of 917 kg/m$^3$. The tank is 3.66 m tall and vented (open) to the atmosphere of 1 atm at the top. The tank is filled with oil to a depth of 3.05 m (10 ft) and also contains 0.61 m (2 ft) of water in the bottom of the tank. Calculate the pressure in Pa and psia at 3.05 m from the top of the tank and at the bottom. And calculate the gauge pressure at the bottom of the tank.




**Example -2.2-**

Convert the pressure of [ 1atm =101.325 kPa] to

a- head of water in (m) at 4°C

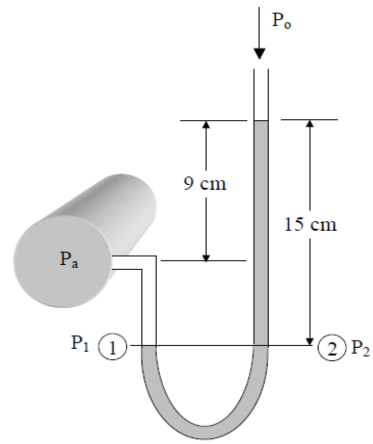
b- head of Hg in (m) at 0°C

**Example -2.3**

Find the static head of a liquid of sp.gr. 0.8,pressure equivalent to 5 x 10$^4$ Pa.

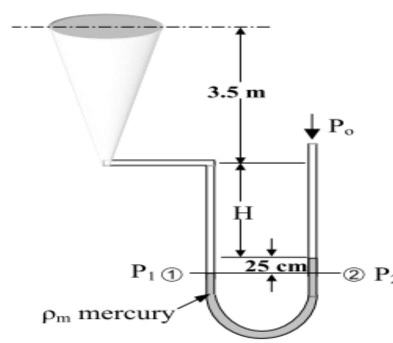
**Example -2.4-**

A simple manometer is used to measure the pressure of oil sp.gr. 0.8 flowing in a pipeline. Its right limb is open to atmosphere and the left limb is connected to the pipe. The center of the pipe is 9.0 cm below the level of the mercury in the right limb. If the difference of the mercury level in the two limbs is 15 cm, determine the absolute and the gauge pressures of the oil in the pipe.




**Example -2.5-**

A conical vessel is connected to a U-tube having mercury and water as shown in the Figure. When the vessel is empty the manometer reads 0.25 m. find the reading in manometer, when the vessel is full of water.




**Example -2.6-**

A differential manometer is connected to two pipes as shown in Figure. The pipe A is containing carbon tetrachloride sp.gr. = 1.594 and the pipe B is contain an oil of sp.gr. = 0.8. Find the difference of mercury level if the pressure difference in the two pipes be 0.8 kg/cm2

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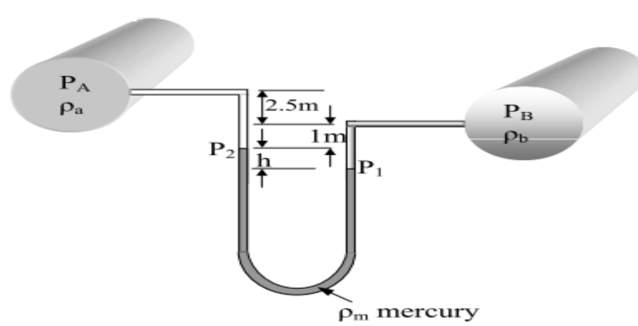
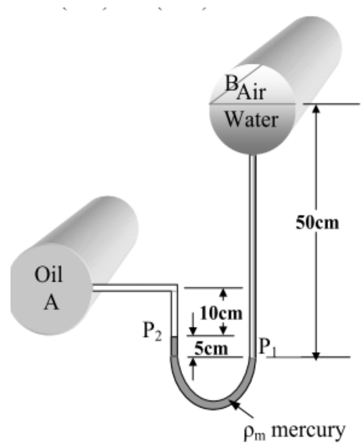


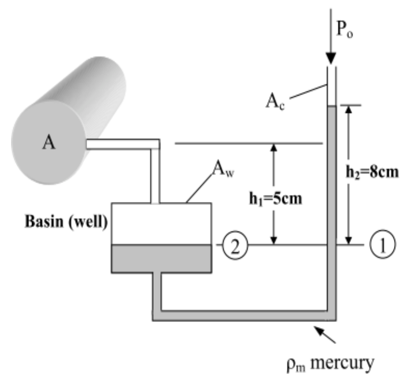
**Example -2.7-**

A differential manometer is connected to two pipes as shown in Figure. At B the air pressure is 1.0 $kg/cm^2$ (abs), find the absolute pressure at A.



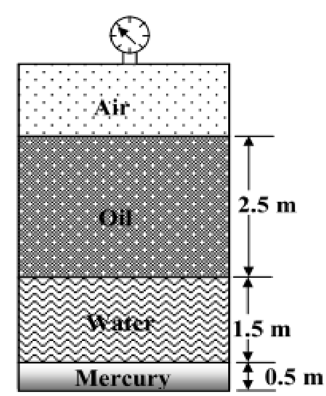

**Example -2.8 -**

A Micromanometer, having ratio of basin to limb areas as 40, was used to determine the pressure in a pipe containing water. Determine the pressure in the pipe for the manometerreading shown in Figure.



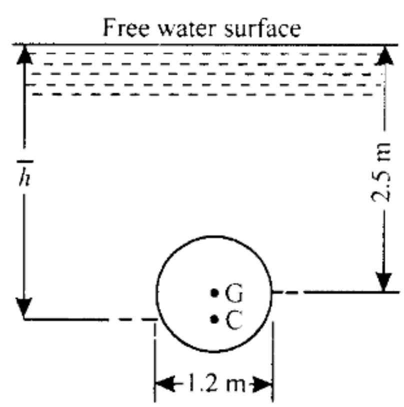

**Example -2.9-**

A closed tank contains 0.5 m of mercury, 1.5 m of water, 2.5 m of oil of sp.gr. = 0.8 and air space above the oil. If the pressure at the bottom of the tank is 2.943 bar gauge, what should be the reading of mechanical gauge at the top of the tank.



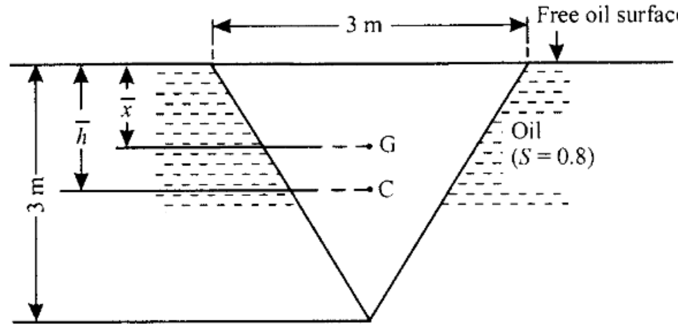

**Example 2.10** .

the figure. shows a circular plate of diameter 1.2 m placed vertically in water in such a way that the centre of the place is 2.5 m below the free surface of water. Determine: (i) Total pressure on the plate, (ii) Position of centre of pressure.



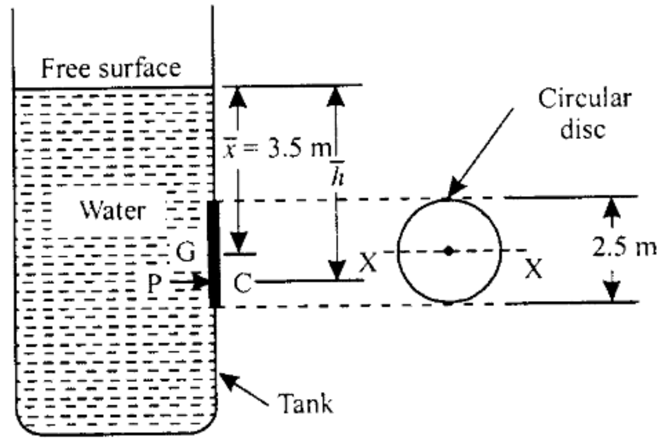
**Example 2.11.**

An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free surface of oil Determine: (i) Total pressure on the plate (ii) Centre of pressure.



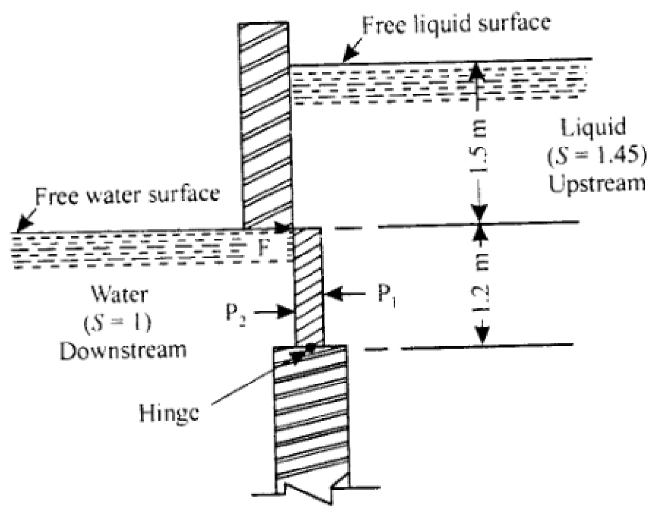

**Example 2.12.**

A circular opening, 2.5 m diameter, in a vertical side of tank is closed by a disc of 2.5m diameter which can rotate about a horizontal diameter Determine: (i) The force on the disc (ii) The torque required to maintain the disc in equilibrium in vertical position when the head of water above horizontal diameter is 3.5 m.



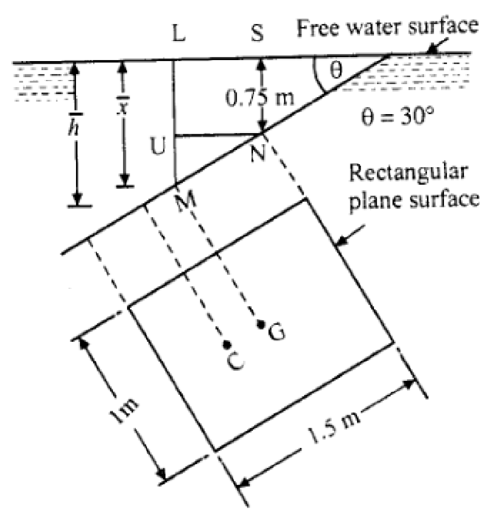

**Example 2.13.**

An opening in a dam is covered by the use of a vertical sluice gate. The opening is 2 m wide and 1.2 m high. On the upstream of the gate the liquid of specific gravity 1.45, lies up to a height of 1.5 m above the top of the gate, whereas on The downstream side the water is available up to a height touching the top of the gate Find:1- The resultant force acting on the gate and position of centre of pressure: 2- The force acting horizontally at the top of the gate which is capable of opening it. assume that the gate is hinged at the bottom.

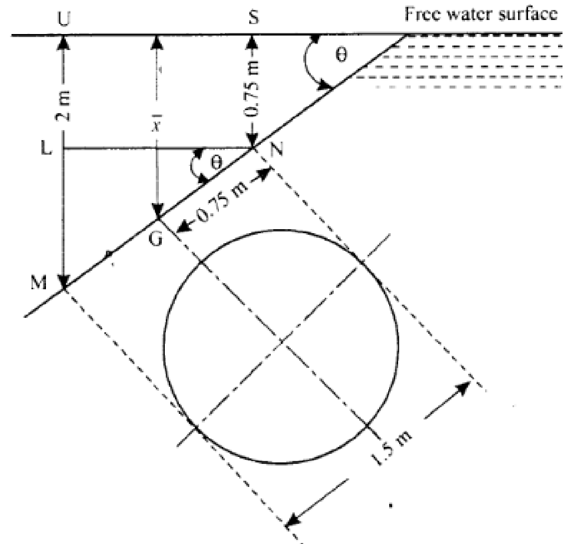



**Example 2.14.**

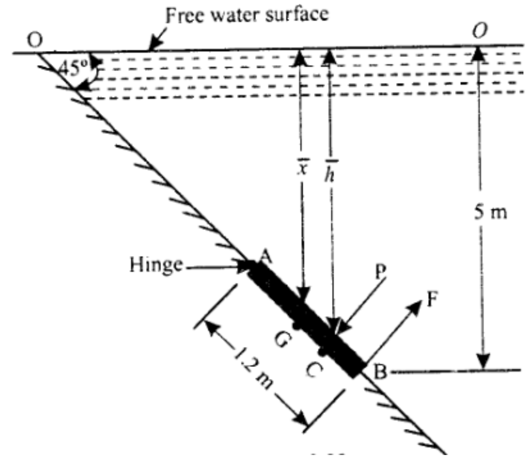
A 1m wide and 1.5 m deep rectangular plane surface lies in water in such a way that its plane makes an angle of $30^{o}$C with the free water surface. Determine the total pressure and position of centre of pressure when the upper edge is 0.75 m below the free water surface.



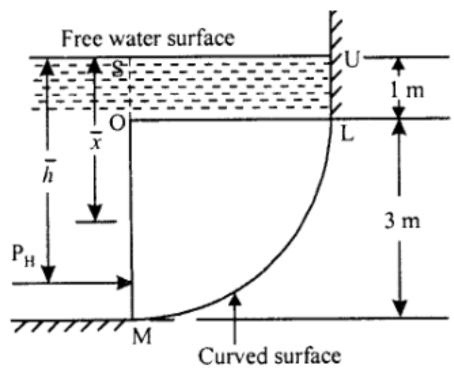
**Example 2.15.**
A circular plate 1.5 m diameter is submerged in water, with its greatest and least depths below the surface being 2 m and 0.75 m respectively. Determine:
(i) The total pressure on one face of the plate
(ii) The position of the centre of pressure.



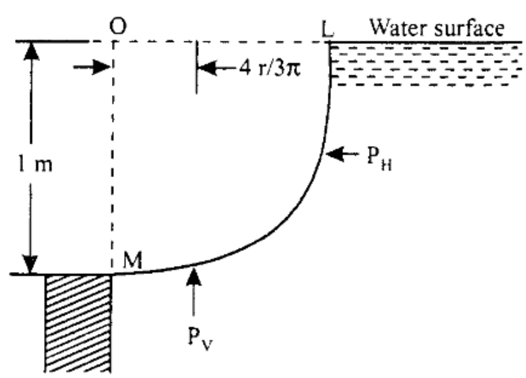

**Example 2.16**
An inclined rectangular sluice gate AB 1.2 m by 5 m size as shown in the figure is installed to control the discharge of water. The end A is hinged. Determine the force normal to the gate applied at B to open it.




**Example 2.17.** The figure. shows a curved surface LM, which is in the form of a quadrant of a circle of radius 3 m, immersed in the water. If the width of the gate is unity, calculate the horizontal and vertical components of the total force acting on the curved surface.




**Example 2.18**. The figure shows a gate having a quadrant shape of radius of 1m subjected to water pressure. Find the resultant force and its inclination with the horizontal Take the length of the gate as 2 m.



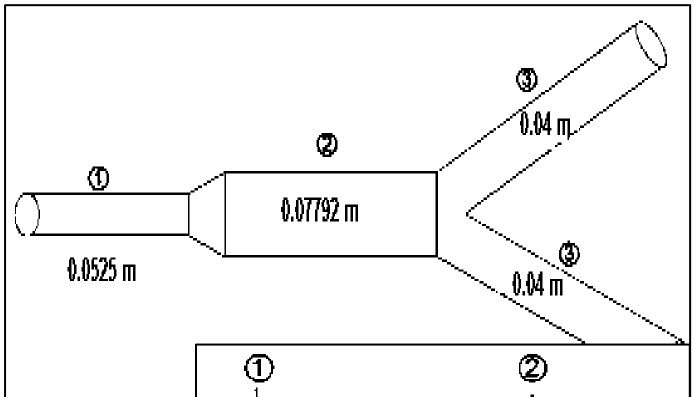

**Example1:** Water at 303 K is flowing at the rate of 0.2917 m/s

in a pipe having an inside diameter I.D. of 0.0525 m. Calculate the Reynolds number.

**Example2:** A petroleum crude oil having a density of 892 $kg/m^3$ is flowing, through the piping arrangement shown in the below Figure, at total rate of 1.388 x $10^{-3}$ $m^3/s$ entering pipe ❶ The flow divides equally in each of pipes ❸

Calculate the following:

1. The total mass flow rate in pipe ❶ and pipes ❸.
2. The average velocity in pipe ❶ and pipes ❸.
3. The mass velocity in pipe ❶.




**Example3:** A pipe, through which water is flowing, is having diameters, 20 cm and 10 cm at the cross-sections 1 and 2 respectively. The velocity of water at section 1 is given 4.0 m/s. Find the velocity head at section 1 and 2 and also rate of discharge.

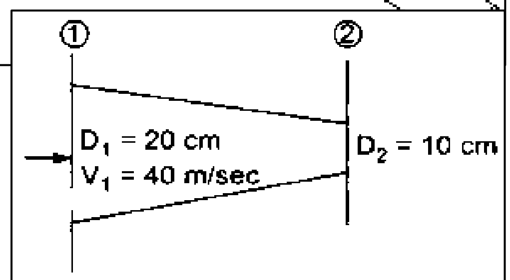
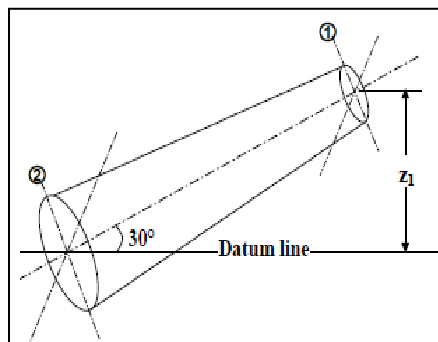
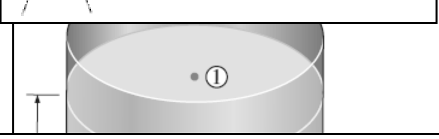



Fig.

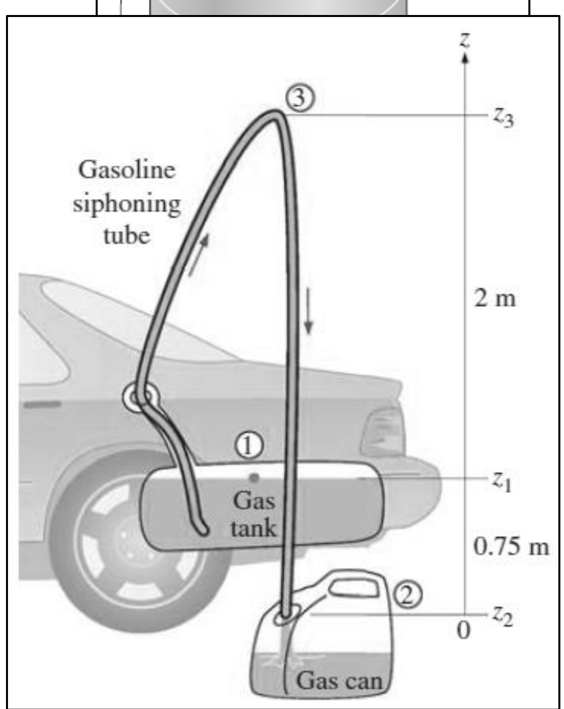
**Example4:** A conical tube of 4 m length is fixed at an inclined angle of 30° with the horizontal-line and its small diameter upwards. The velocity at smaller end is ($u_1$ = 5 m/s), while ($u_2$ = 2 m/s) at other end. The head loss in the tube is [0.35 $(u_1-u2)^2/2g$]. Determine the pressure head at lower end if the flow takes place in down direction and the pressure head at smaller end is 2 m of liquid.




**Example5**: A large tank open to the atmosphere is filled with water to a height of 5 m from the outlet tap (Fig.). A tap near the bottom of the tank is now opened, and water flows out from the smooth and rounded outlet. Determine the maximum water velocity at the outlet.

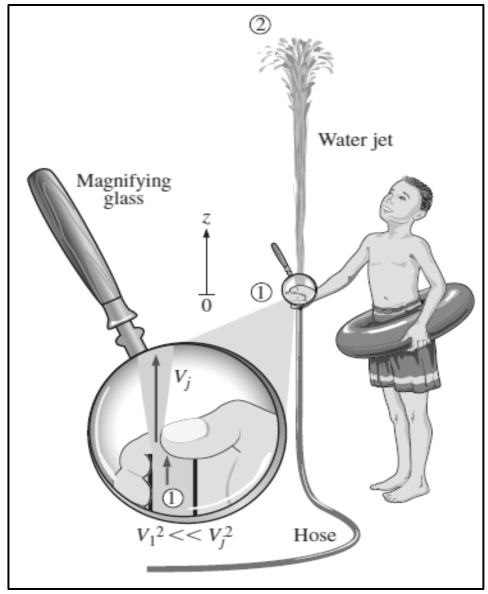



**Example6**: During a trip to the beach a car runs out of gasoline, and it becomes necessary to siphon gas out of the car of a Good Samaritan (Fig.). The siphon is a small-diameter hose, and to start the siphon it is necessary to insert one siphon end in the full gas tank, fill the hose with gasoline via suction, and then place the other end in a gas can below the level of the gas tank. The difference in pressure between point 1 (at the free surface of the gasoline in the tank) and point 2 (at the outlet of

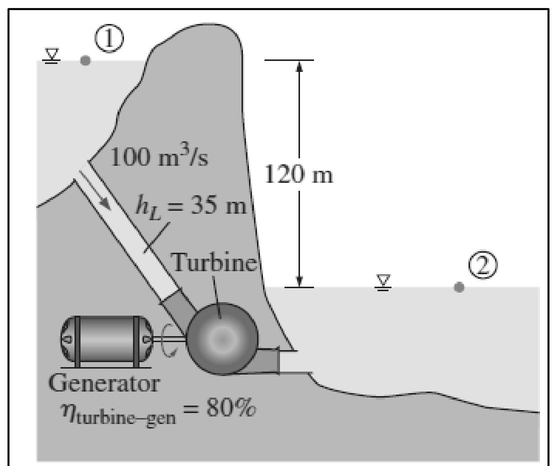


the tube) causes the liquid to flow from the higher to the lower elevation. Point 2 is located 0.75 m below point 1 in this case, and point 3 is located 2 m above point 1. The siphon diameter is 5 mm, and frictional losses in the siphon are to be disregarded. Determine (*a*) the minimum time to withdraw 4 L of gasoline from the tank to the can and (*b*) the pressure at point 3. The density of gasoline is 750 kg/m$^3$.

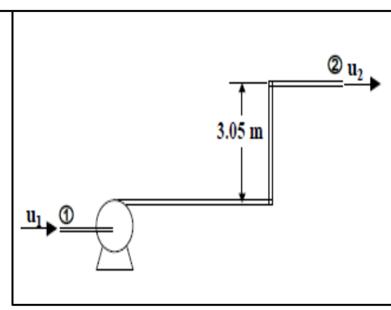
**Example7**: Water is flowing from a garden hose (see the Fig.). A child places his thumb to cover most of the hose outlet, causing a thin jet of high-speed water to emerge. The pressure in the hose just upstream of his thumb is $400 kPa$. If the hose is held upward, what is the maximum height that the jet could achieve?



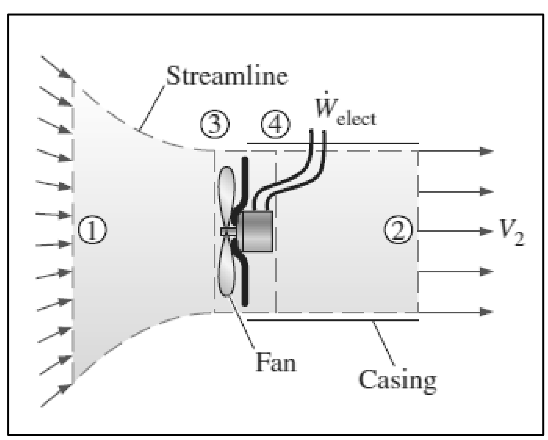

**Example8**: In a hydroelectric power plant, $100\ m^3/s$ of water flows from an elevation of 120 m to a turbine, where electric power is generated (Fig). The total irreversible head loss in the piping system from point 1 to point 2 (excluding the turbine unit) is determined to be 35 m. If the overall efficiency of the turbine–generator is 80 percent, estimate the electric power output.




**Example9:** Water with density ρ = 998 kg/m3, is flowing at steady mass flow rate through a uniform-diameter pipe. The entrance pressure of the fluid is 68.9 kPa in the pipe, which connects to a pump, which actually supplies 155.4 J/kg of fluid flowing in the pipe. The exit pipe from the pump is the same diameter as the inlet pipe. The exit section of the pipe is 3.05 m higher than the entrance, and the exit pressure is 137.8 kPa. Calculate the frictional loss (F) in the pipe system.




**Example10**: A fan is to be selected to cool a computer case whose dimensions are $12\ cm \times 40\ cm \times 40\ cm$ (Fig). Half of the volume in the case is expected to be filled with components and the other half to be air space. A 5-cm-diameter hole is available at the back of the case for the installation of the fan that is to replace the air in the void spaces of the case once every second. Small low-power fan–motor combined units are



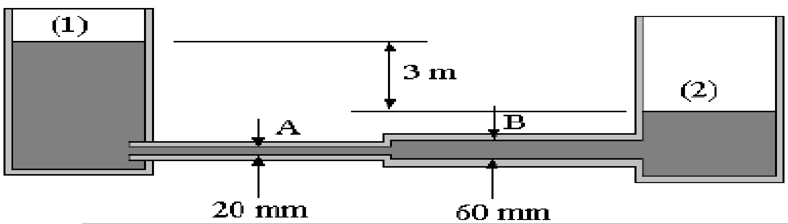
available in the market and their efficiency is estimated to be 30 percent. Determine the wattage of the fan–motor unit to be purchased. Take the air density to be 1.20 kg/m$^3$.

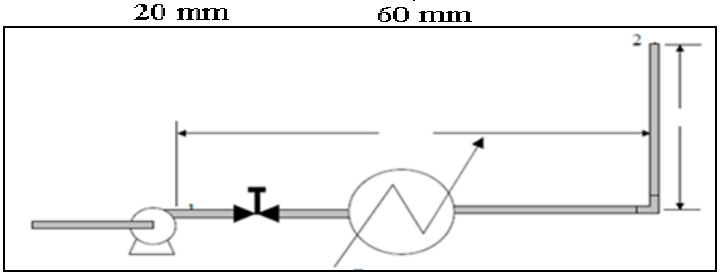
**Example11.** Oil, with $\rho$ = 900kg/m$^3$ and kinematic coefficient of viscosity $\upsilon$ = 0,00001m$^2$/s, flows at Q = 0.2m$^3$/s through 500 m of 200-mm diameter cast-iron pipe. Determine (a) the head loss and (b) the pressure drop if the pipe slopes down at 10 in the flow direction.

**Example12.** Oil, with $\rho$ = 950 kg/m$^3$, flows through a 30 cm-diameter pipe 100 m long with a head loss of 8 m. The roughness ratio is $\varepsilon$ /d = 0.0002. Find the average velocity and flow rate.

**Example 13:** A tank of water empties by gravity through a horizontal pipe into another tank. There is a sudden enlargement in the pipe as shown. At a certain time, the difference in levels is 3 m. Each pipe is 2 m long and has a friction coefficient $f$ = 0.02. The inlet loss constant is K = 0.3. Calculate the volume flow rate.

**Example 14:** 630 cm$^3$/s water at 320 K is pumped in a 40 mm I.D. pipe through a length of 150 m in horizontal



direction and up through a vertical height of 10 m. In the pipe there is a control valve which may be taken as equivalent to 8 m pipe length and also other fittings equivalent to 2.4 m pipe length. Also in the line there is a heat exchanger across which there is a loss in head of 1.5 m $H_2$o. If the main pipe has a roughness of 0.0002 m, what power must supplied to the pump if $\eta = 60\%,\ \ \mu = 0.65\ mPa.s.$

**Example 15:** A circular tank of diameter 4 m contains water up to a height of 5 m. The tank is provided with an orifice of diameter 0.5 m at the bottom. Find the time taken by water (i) to fall from 5 m to 2 m (ii) for completely emptying the tank. Take Cd = 0.6.

**Example 16:** An open circular cylinder of 15 cm diameter and 100 cm long contains water up to a height of 80 cm. Find the maximum speed at which the cylinder is to be rotated about its vertical axis so that no water spills.

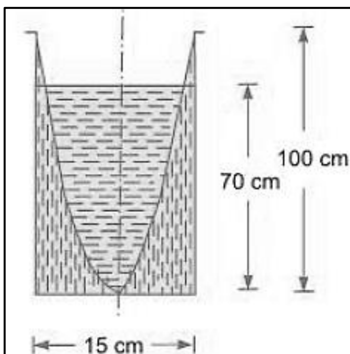


Fig.

**Example 17:** An open circular cylinder of 15 cm diameter and 100 cm long contains water up to a height of 70 cm. Find the speed at which the cylinder is to be rotated about its vertical axis, so that the axial depth becomes zero.

**Example 18:** A closed cylindrical vessel of diameter 30 cm and height 100 cm contains water up to a depth of 80 cm. The air above the water surface is at a pressure of 5.886 N/cm$^2$. The vessel is rotated at a speed of 250 r.p.m. about its vertical axis. Find the pressure head at the bottom of the vessel: (a) at the centre, and (b) at the edge.

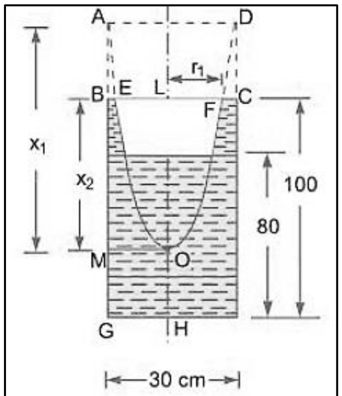


Fig.