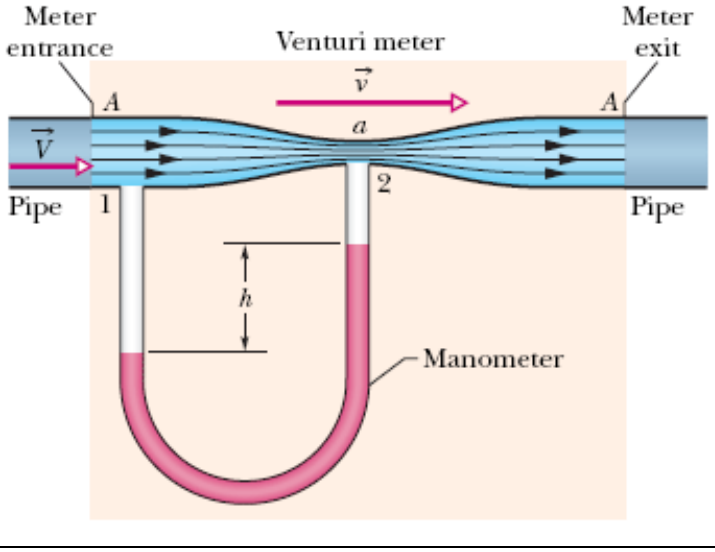
QUESTION No 1

A venturi meter is used to measure the flow speed of a fluid in a pipe, as shown



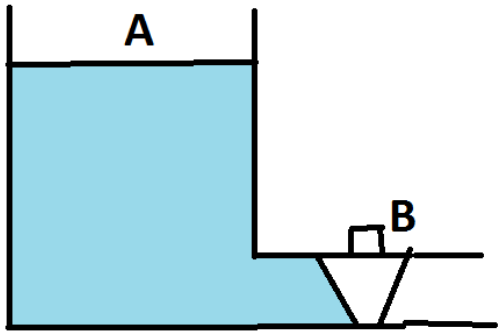
Venturimeter

The meter is connected between two sections of the pipe; the cross-sectional area A of the entrance and exit of the meter matches the pipe's cross-sectional area. Between the entrance and exit, the fluid flows from the pipe with speed V and then through a narrow "throat" of cross-sectional area a with speed v. A manometer connects the wider portion of the meter to the narrower portion. The change in the fluid's speed is accompanied by a change ΔP in the fluid's pressure, which causes a height difference 'h' of the liquid in the two arms of the manometer. (Here ΔP means pressure in the throat minus pressure in the pipe.) By applying Bernoulli's equation and the equation of continuity, show that,

$V = \text{sqrt}\,[2a^2\Delta P/\rho\,(a^2-A^2)]$

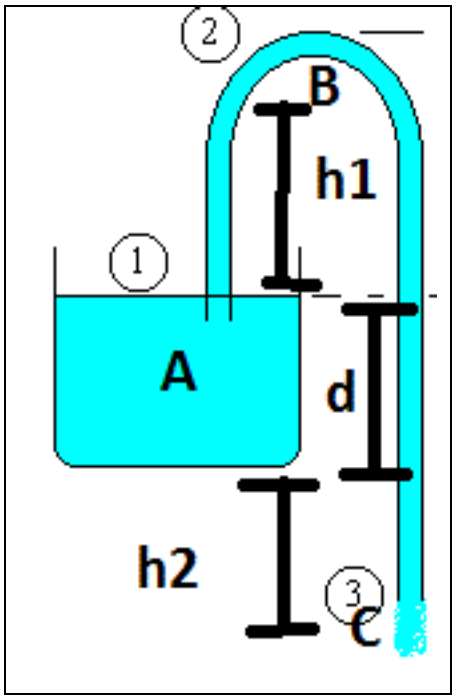
QUESTION No 2

The area of cross section of a large tank is 0.6 m^2. It has an opening near the bottom having area of cross section 1 cm^2. A load of 25 kg is applied on the water at the top. Find the velocity of the water coming out of the opening at the time when the height of water level is 40 cm above the bottom. Take g = 10 ms-2



QUESTION No 3

Figure below shows a siphon, which is a device for removing liquid from a container.



Tube ABC must initially be filled, but once this has been done, liquid will flow through the tube until the liquid surface in the container is level with the tube opening at A. The liquid has density 1000 kg/m^3 and negligible viscosity. The distances shown are h_1 = 30 cm, d = 15 cm, and h_2 = 45 cm.

(a) With what speed does the liquid emerge from the tube at C?

(b) If the atmospheric pressure is 1.01 X 10^5 Pa, what is the pressure in the liquid at the topmost point B?

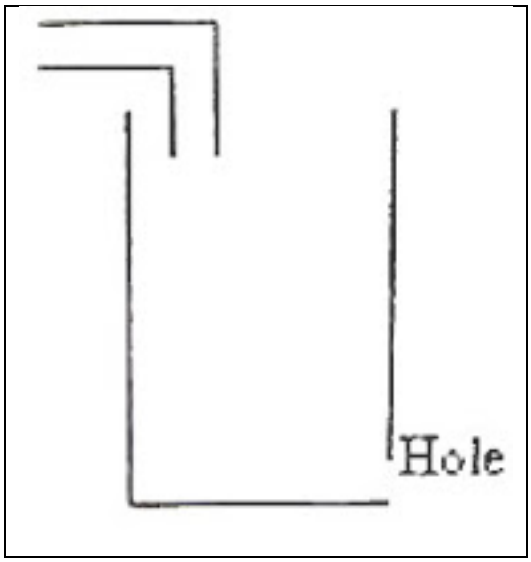
(c) Theoretically, what is the greatest possible height h_1 that a siphon can lift water? Take g = 10 m

QUESTION No 4

Water is flowing steadily out through the end of a vertical pipe (fig) with a velocity of 4 ms^{-1}. At what distance from the end of the pipe will the area of cross section of the stream of water be (2/3)A where A is the area of cross section of the pipe? Take g=10 m/s^2

QUESTION No 5

In the figure shown below, a tall cylindrical empty tank with a small side hole of square shape near its bottom.

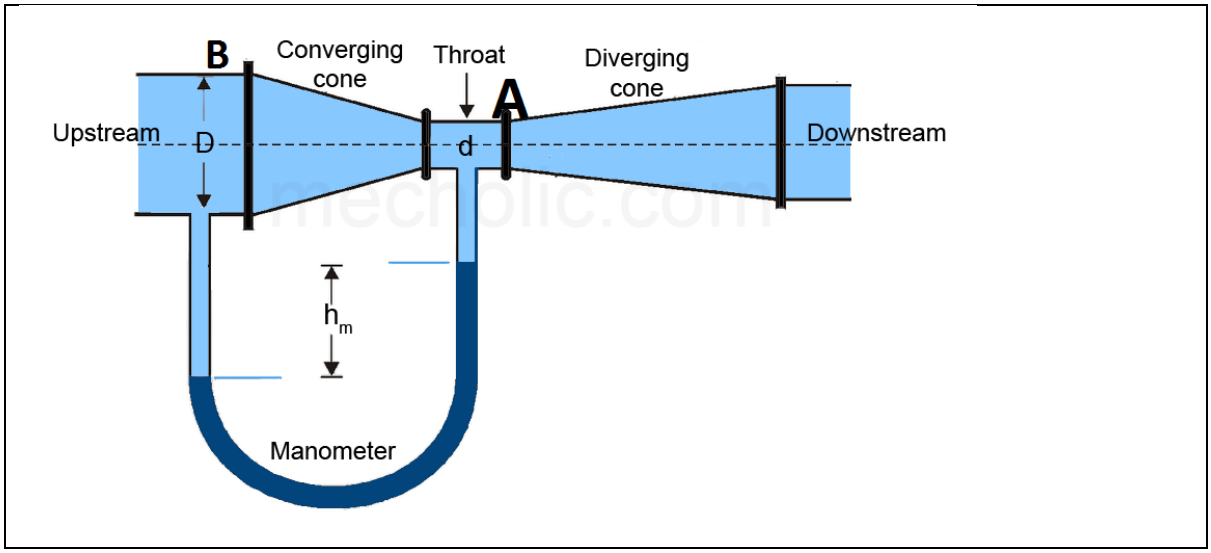


The area of the hole is A. Water flowing with a velocity ‘v’ through a pipe of circular cross section having the same area A (as that of the hole) starts falling vertically down in to the tank.

Prove that the height of water column in the tank will increase initially and will remain steady at $v^2/2g$

QUESTION No 6

Water flows through the tube shown in figure.



The areas of cross-section of the wide and the narrow portions of the tube are 6 cm^2 and 2.5 cm^2 respectively. The rate of flow of water through the tube is 450 cm^3s^{-1}. Find the difference of mercury (specific gravity=13.6) levels in the U-tube. Take g = 10 ms^{-2}.