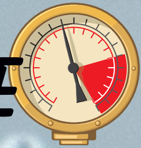
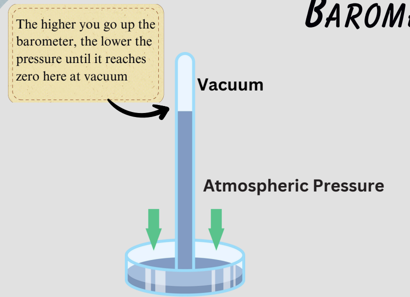
Pressure



The amount of force exerted per unit area

$$P = \frac{F}{A} \qquad P = \rho \times h \times g$$

Barometer



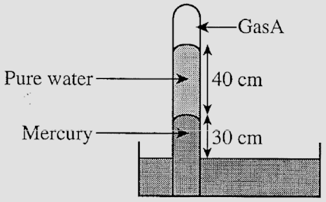


Diagram 1

Given that the atmospheric pressure is 76 cmHg, calculate the pressure of the gas A in the diagram 1.

Solution: Think of a push-of-war game. Atmospheric pressure is pushing (downwards) against Gas A + pressure of pure water column + pressure of mercury column .

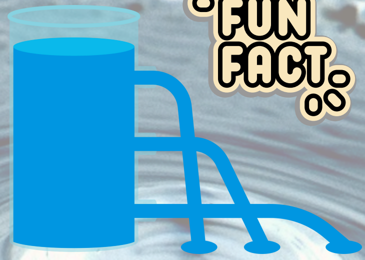
Atmospheric Pressure = hρg (water) + hρg (mercury) + Pressure of gas A

76cm Hg = 0.4(1000)(10) + 0.3(13600)(10) + Pressure of gas A

(0.76)(13600)(10) = 0.4(1000)(10) + 0.3(13600)(10) + Pressure of gas A

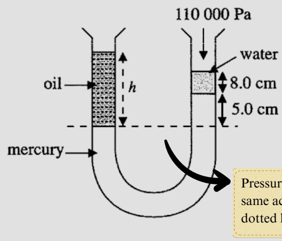
Pressure of gas A = 22,560 Pa

Fun Fact



The lower stream spurts further since the pressure at these holes given by hρg is higher when we descend lower. If we needed to patch the hole up, it will be wise to calculate the force at the holes using pressure x area of hole = force. Just make sure the tape used can withstand this force before safely sealing the holes.

Manometer



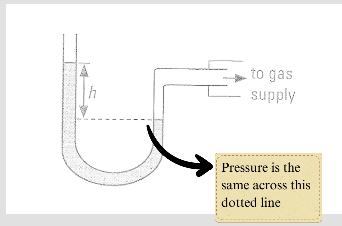
A manometer is filled with mercury, water and oil as shown below. Given that the right side of the tube is connected to an air pressure of 110,000 Pa and the density of mercury, water and oil are 13,600 kg/m3, 1000 kg/m3 and 800 kg/m3 respectively, calculate the height h. (atmospheric pressure = 100,000 Pa)

Solution: Think of a push-of-war game. Oil column is pushing (downwards) against water column + mercury column. Since atmospheric pressure acts on both the ends of test tube, they cancel out in the equation below.

~~Atmospheric Pressure~~ + hρg (Oil) = ~~Atmospheric Pressure~~ + hρg (water) + hρg (mercury)

h(800)(10) = 0.08(1000)(10) + 0.05(13600)(10)

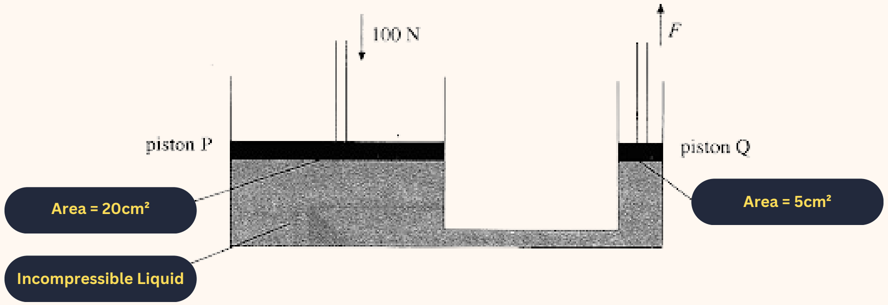
h = 2.20m



Since gas supply is sealed, there is no atmospheric pressure here. Imagine the same push-of-war between atmospheric pressure and liquid column h against gas supply.

Atmospheric Pressure +hρg (liquid) = Pressure of gas

Hydraulic Press



In an incompressible liquid, pressure is same throughout the liquid.

Area P = 20cm² = (20/100²)m² = 0.002m²

Area Q = 5cm² = (5/100²)m² = 0.0005m²

Pressure at P = Pressure at Q

100N / 0.002 = F / 0.0005

F = 25N

$$V = \pi r^2 h$$

In an incompressible liquid, volume displaced at P = Volume displaced at Q. If Piston P moves down by 10cm, what is the distance Piston Q move up by?

Volume displaced at P = 0.002m² x 0.1m = Volume displaced at Q

0.002m² x 0.1m = 0.0005m² x height which Piston Q moves up

Height = 0.4m

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