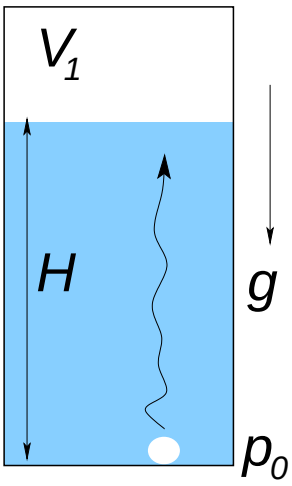
Bubble Up

An air tight container contains liquid (density ρ, height H), some air of volume V_1 above it, and a small air bubble of volume V_0 at the bottom. The pressure on the bottom thus created is p_0. What will be the pressure on the bottom when the bubble surfaces?



Treat gas as ideal, liquid incompressible; the process occurs at constant temperature, and gas does not dissolve into liquid.

If initially there is no air at the top ($V_1 = 0$), what would be the pressure on the bottom after the bubble has risen up?

Answer of problem **Bubble Up**

When the bubble is at the bottom pressure of gas above is:

$$p_1 = p_0 - \rho g H$$

After the bubble surfaces, pressure on top is found from adding quantities of the gas in the bubble and in the free space above liquid, and taking into account that the total volume available to the gas is the same as was originally, since liquid is incompressible,

$$\frac{p_1 V_1}{T} + \frac{p_0 V_0}{T} = \frac{p_1'(V_1 + V_0)}{T} \qquad \Rightarrow \qquad p_1' = p_0 - \rho g H \frac{V_1}{V_1 + V_0}$$

and the new pressure on the bottom is

$$p_0' = p_1' + \rho g H = p_0 + \rho g H \frac{V_0}{V_1 + V_0}$$

If there were no gas on top the pressure at the bottom would be

$$\boxed{p_0' = p_0 + \rho g H}$$