J00T.2

The container is adiabatic thus dU=dW and so:

$$C_V dT = -pdv \tag{1}$$

Using the ideal gas law (pV=nRT) and that V=Ah, where A is the cross sectional area, we attain:
$C_V lnT = -nRlnh + const$

$$p = \frac{A}{nR} h^{-\frac{nR}{C_V}-1} * Const \tag{2}$$

Now $p = \frac{Mg}{A} + p_0$ where p_0 is the pressure of the air surrounding the container. Thus we attain:

$$M(h) + \frac{p_0 A}{g} = \frac{A}{nR} h^{-\frac{nR}{C_V}-1} * Const \tag{3}$$

Now at room temperature C_V for N_2 is just $\frac{5nR}{2}$. This value comes either from statistical mechanics or more simply from equipartition (at room temperature the rotational modes of the molecule are activated but no the vibrational modes, so there is 5 degrees of freedom and hence $C_V = \frac{5nR}{2}$). So we have:

$$M(h) + \frac{p_0 A}{g} = \frac{A}{nR} h^{-\frac{7}{5}} * Const \tag{4}$$

One thought on "J00T.2"

December 15, 2013 at 9:54 pm

Good, I have no comments on this solution.