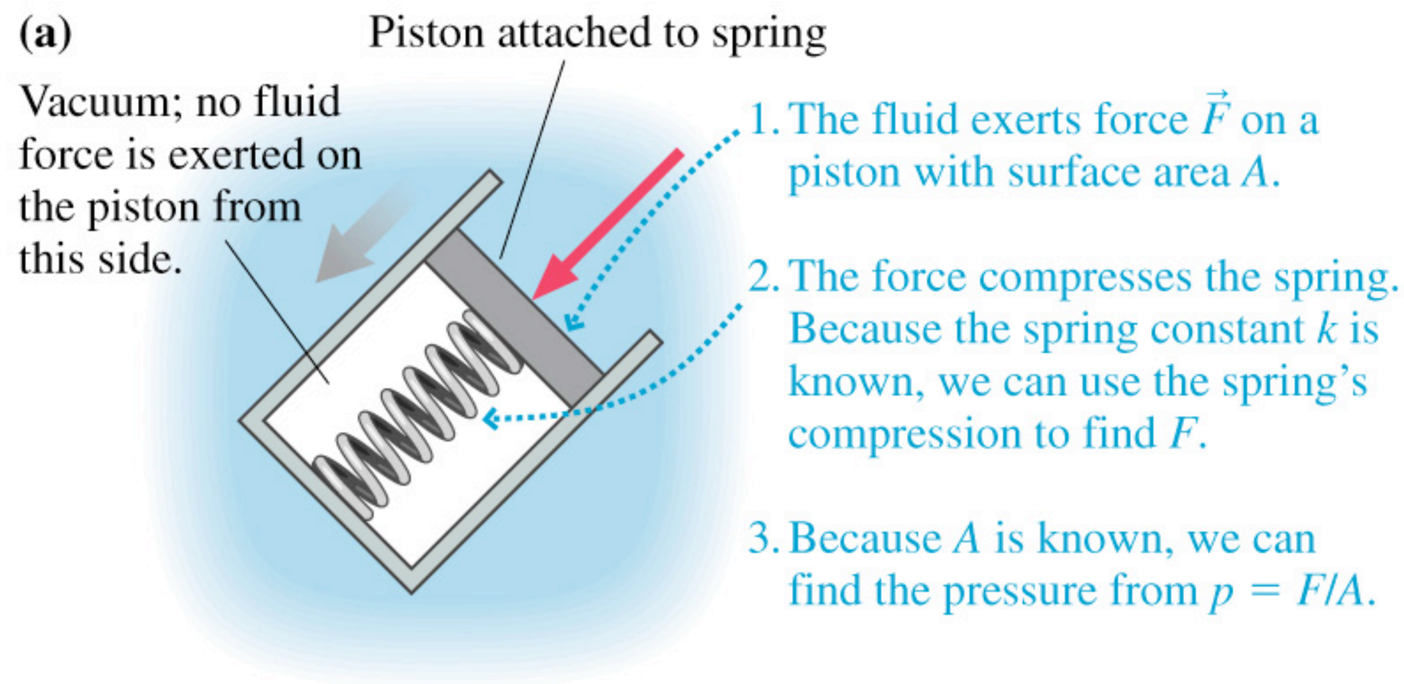
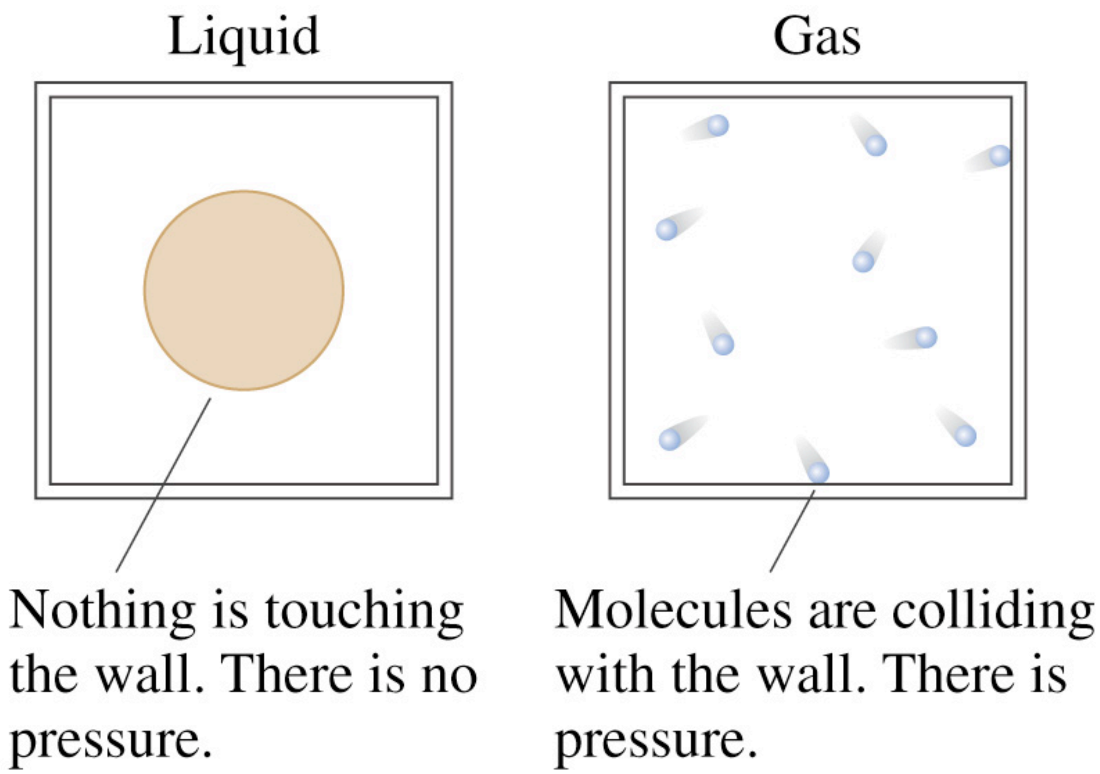
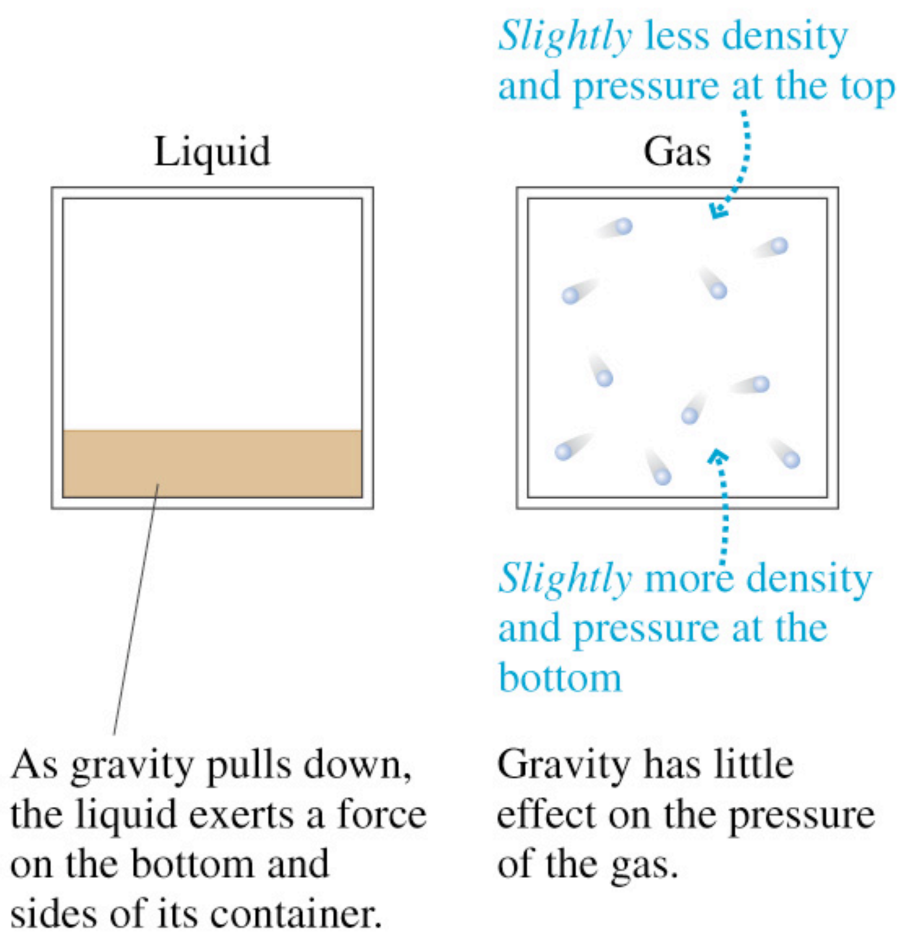
# Figures for lecture 5

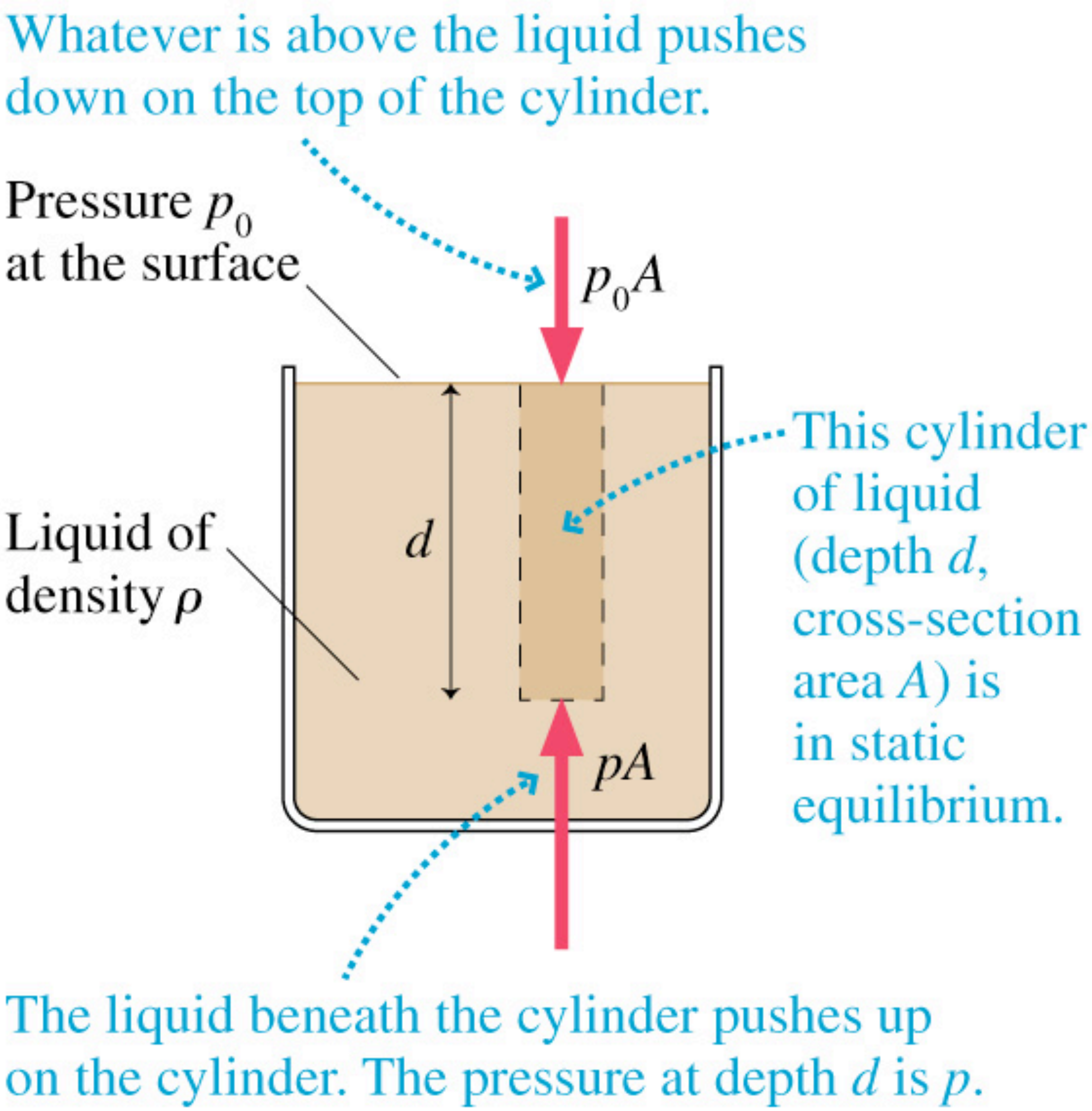




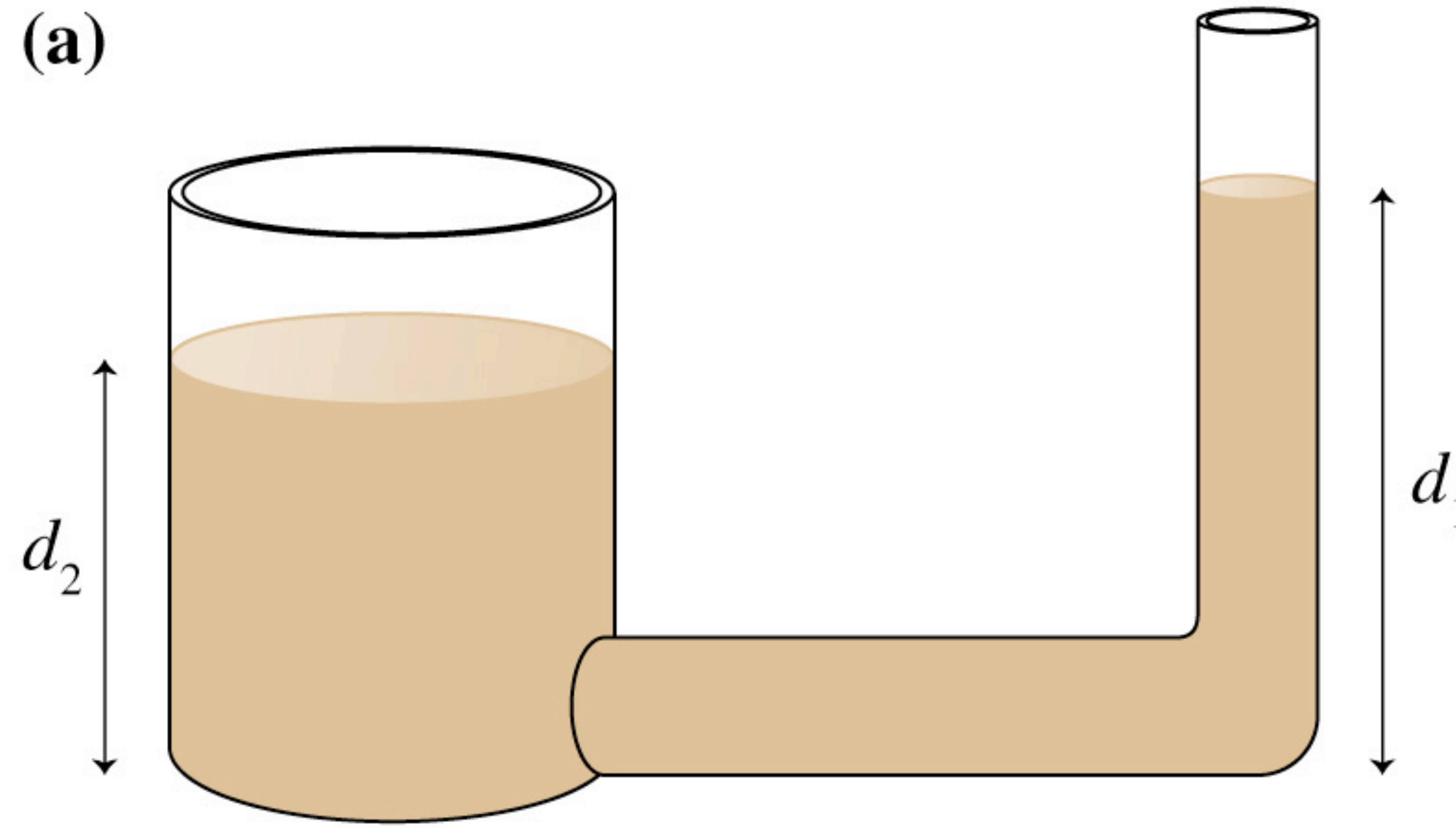





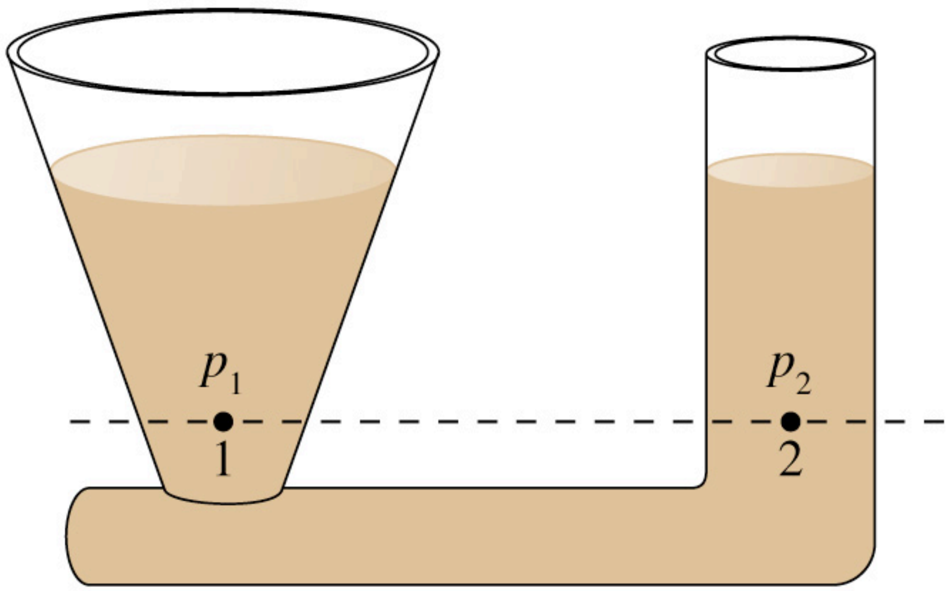




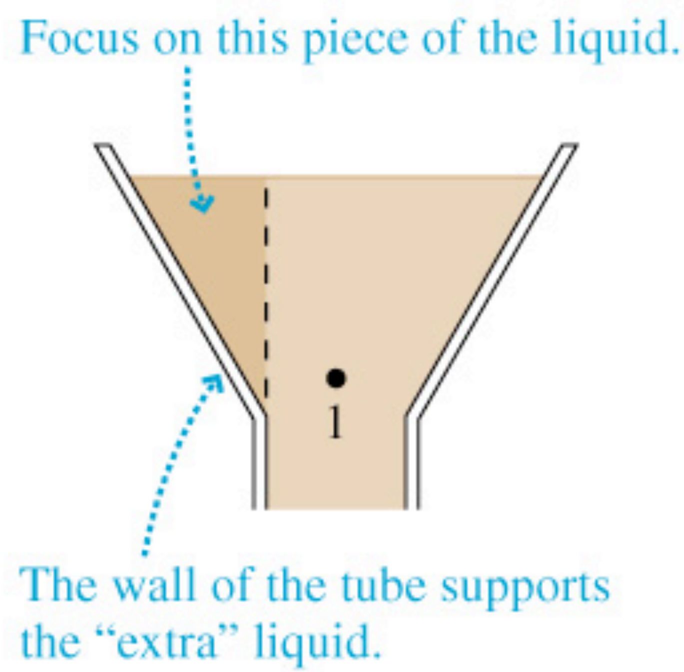

Is this possible?

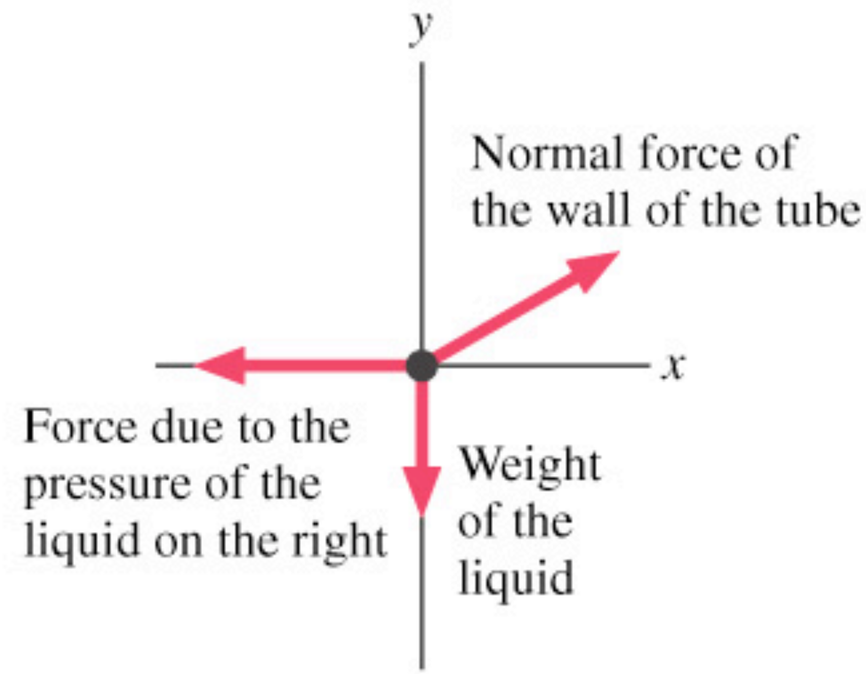
**(b)**

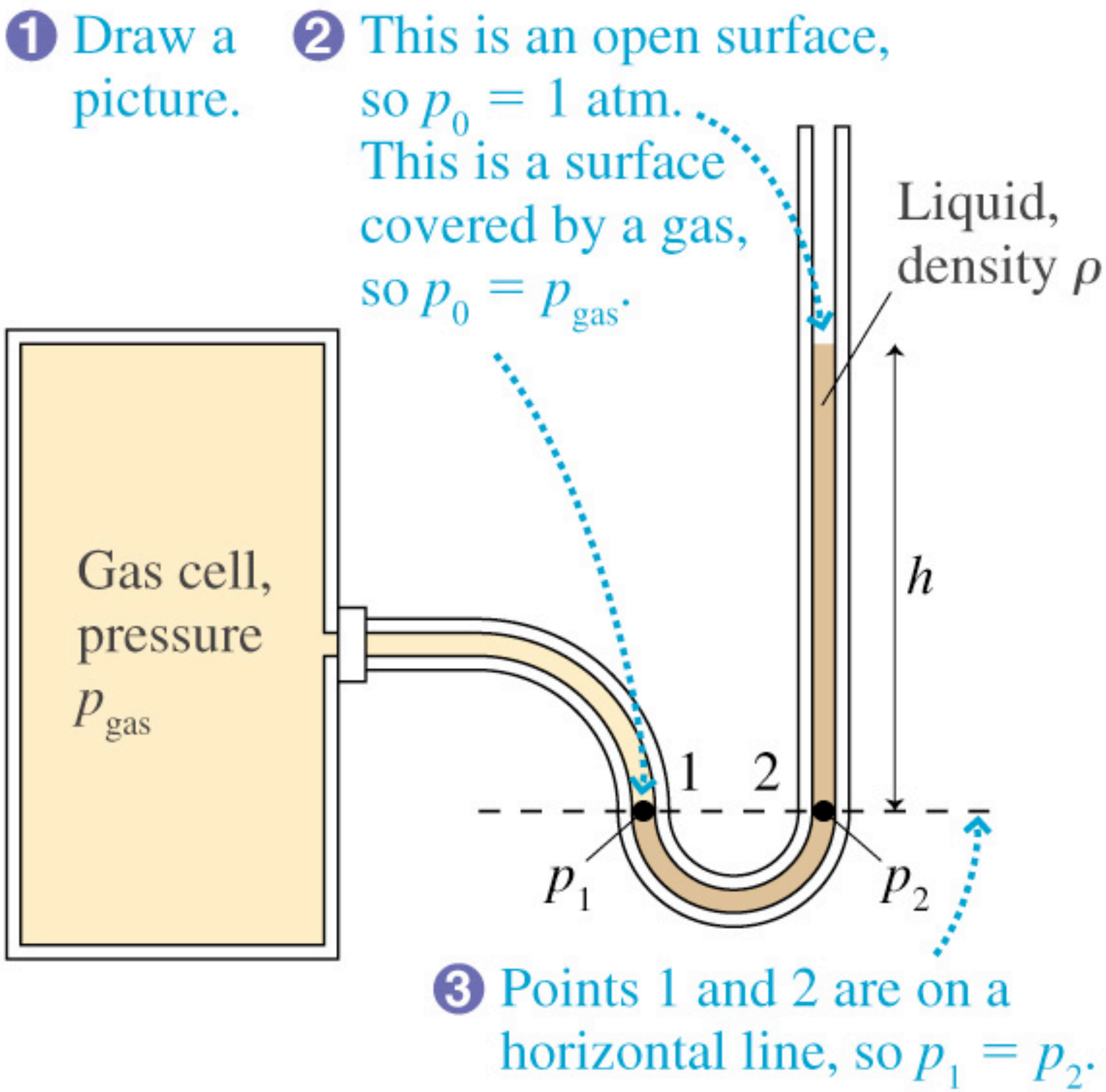

$p_1$
$p_2$
1
2

Is $p_1 > p_2$?



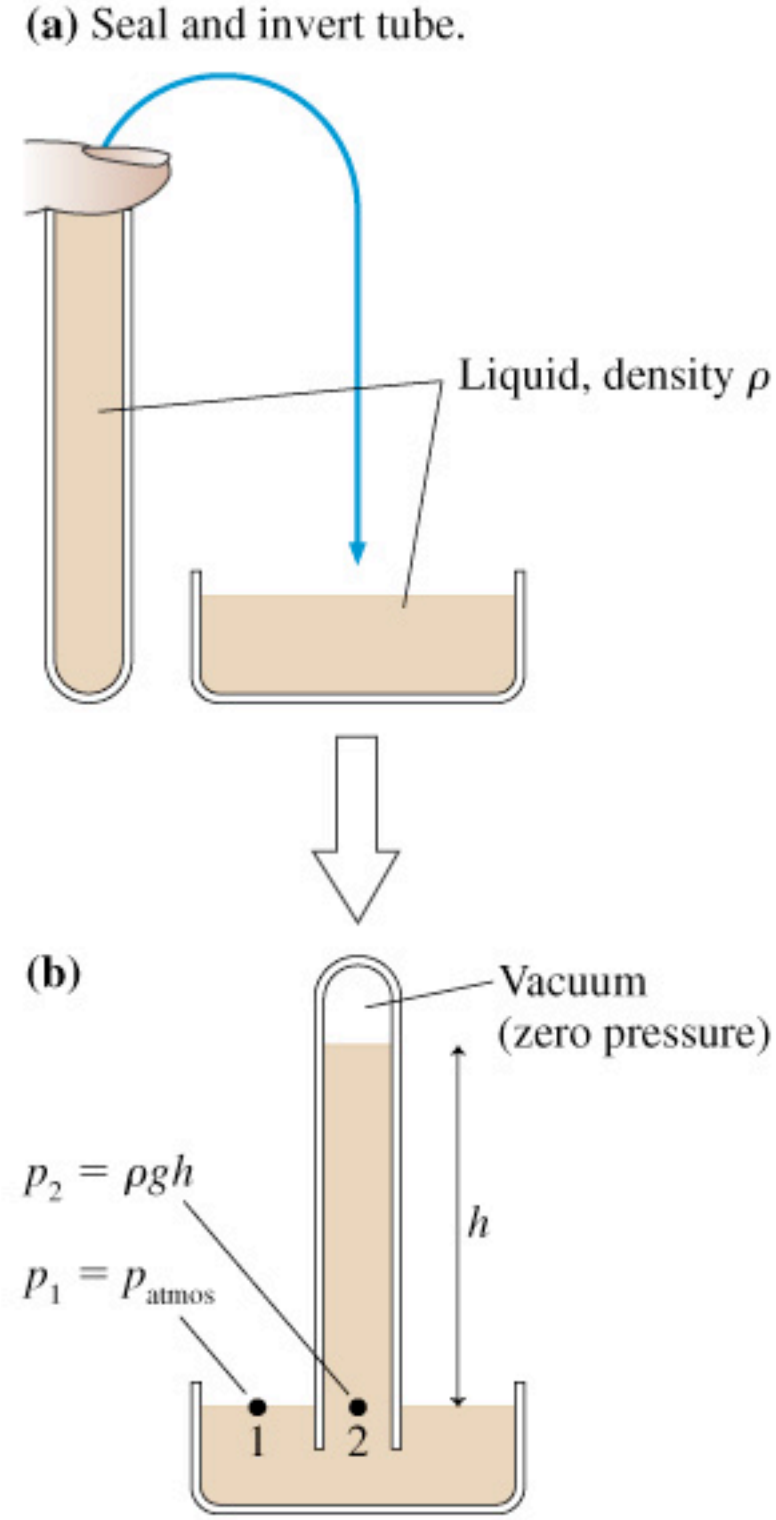

Focus on this piece of the liquid.
1
The wall of the tube supports the “extra” liquid.


y
x
Normal force of the wall of the tube
Force due to the pressure of the liquid on the right
Weight of the liquid

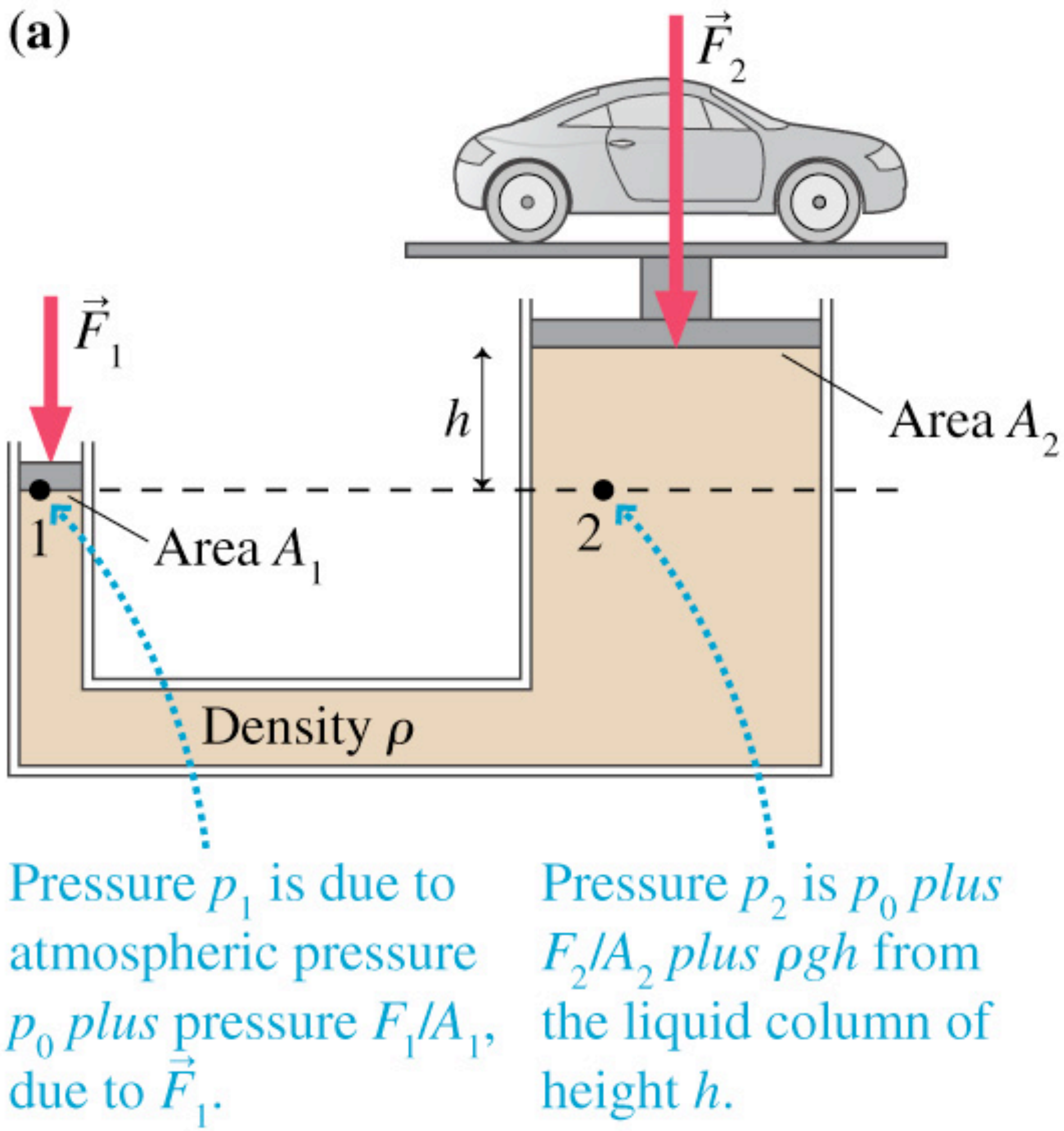


1 Draw a picture.
2 This is an open surface, so $p_0 = 1$ atm.
This is a surface covered by a gas, so $p_0 = p_{gas}$.
Liquid, density $\rho$
Gas cell, pressure $p_{gas}$
$h$
1 2
$p_1$
$p_2$
3 Points 1 and 2 are on a horizontal line, so $p_1 = p_2$.

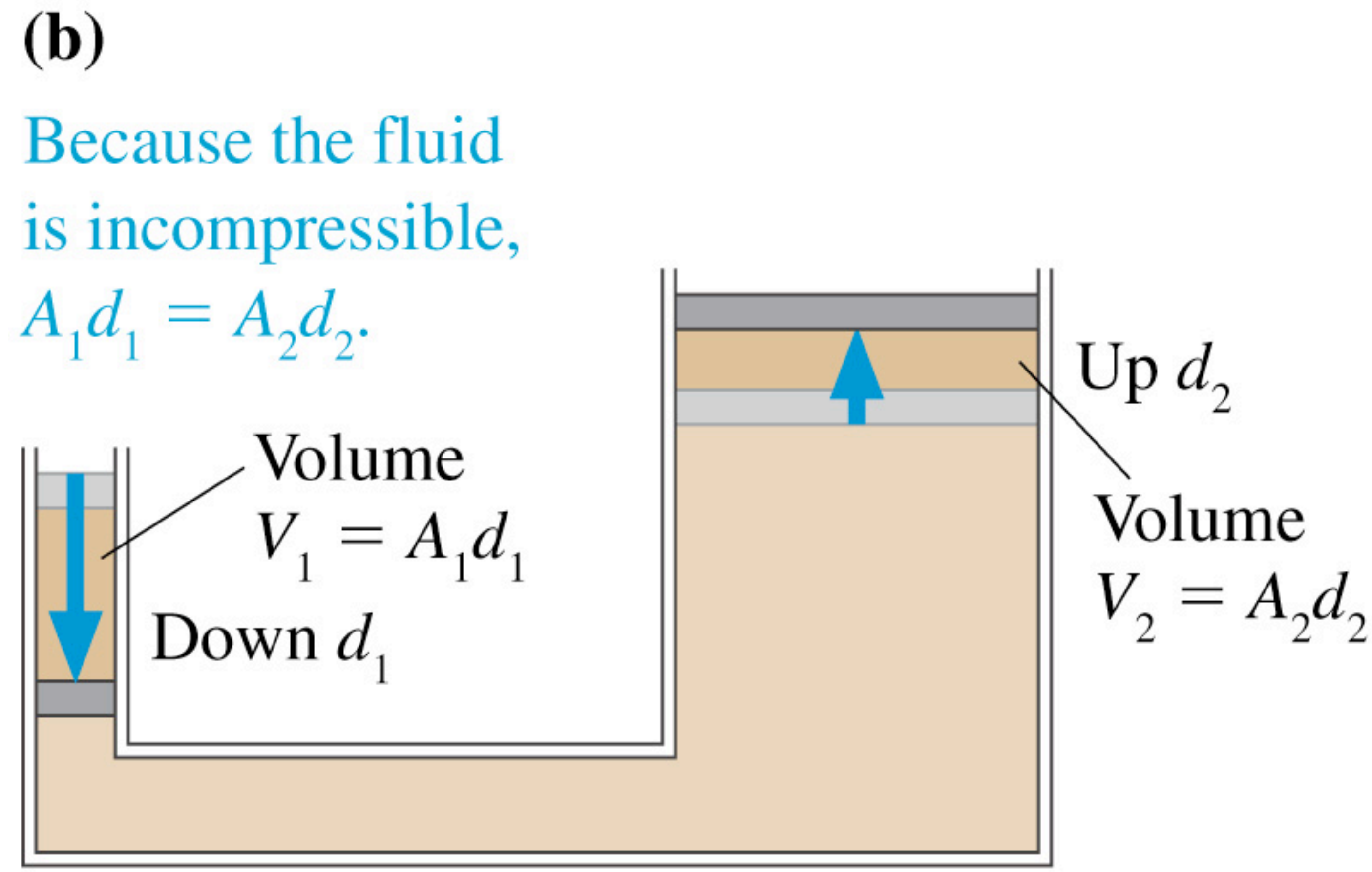


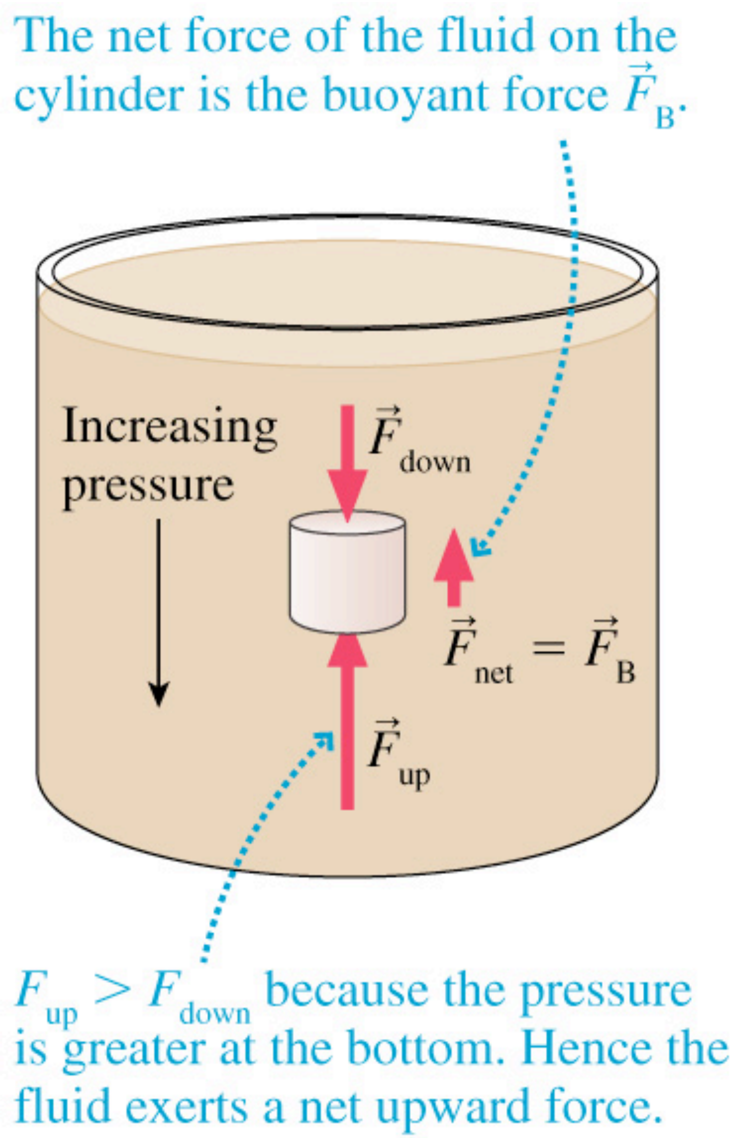



(a) Seal and invert tube.
Liquid, density $\rho$
(b)
Vacuum (zero pressure)
$p_2 = \rho g h$
$p_1 = p_{atmos}$
$h$
1 2


(a)
$\vec{F}_2$
$\vec{F}_1$
$h$
Area $A_2$
1
Area $A_1$
2
Density $\rho$
Pressure $p_1$ is due to atmospheric pressure $p_0$ *plus* pressure $F_1/A_1$, due to $\vec{F}_1$.
Pressure $p_2$ is $p_0$ *plus* $F_2/A_2$ *plus* $\rho gh$ from the liquid column of height $h$.



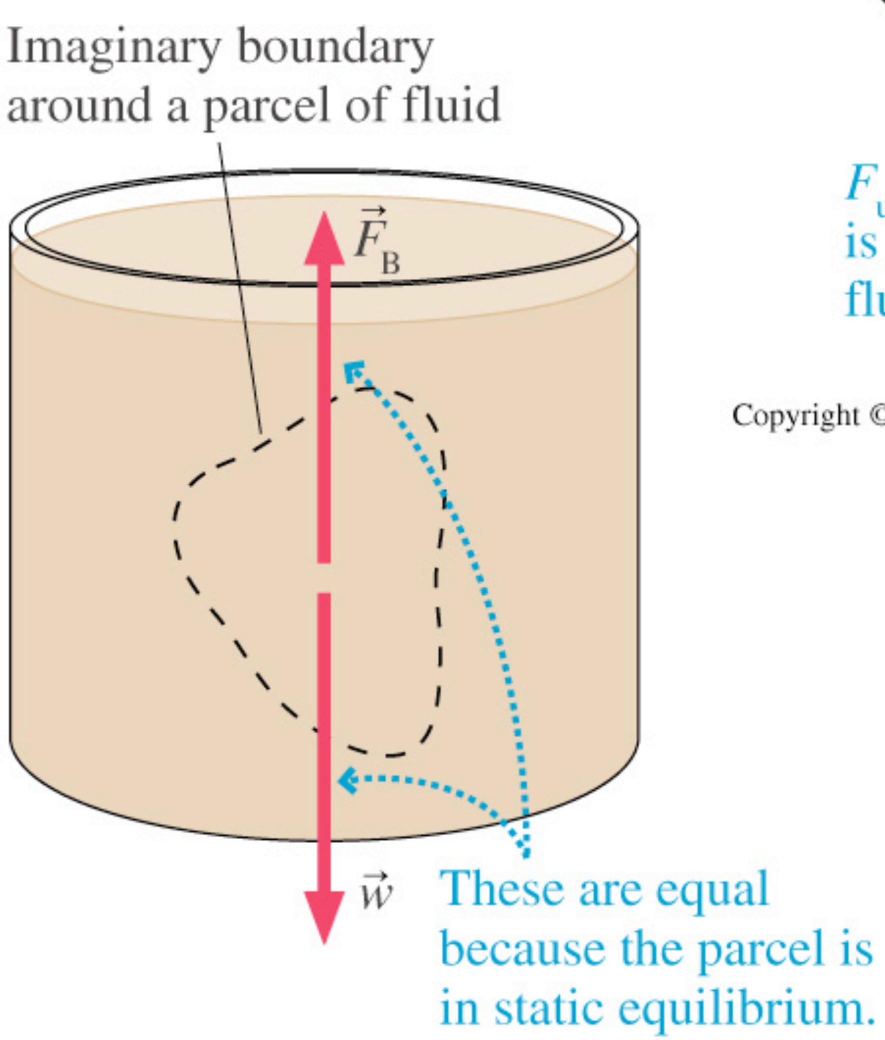

(b)
Because the fluid is incompressible, $A_1 d_1 = A_2 d_2$.
Volume $V_1 = A_1 d_1$
Down $d_1$
Up $d_2$
Volume $V_2 = A_2 d_2$



The net force of the fluid on the cylinder is the buoyant force $\vec{F}_B$.
Increasing pressure
$\vec{F}_{down}$
$\vec{F}_{net} = \vec{F}_B$
$\vec{F}_{up}$
$F_{up} > F_{down}$ because the pressure is greater at the bottom. Hence the fluid exerts a net upward force.

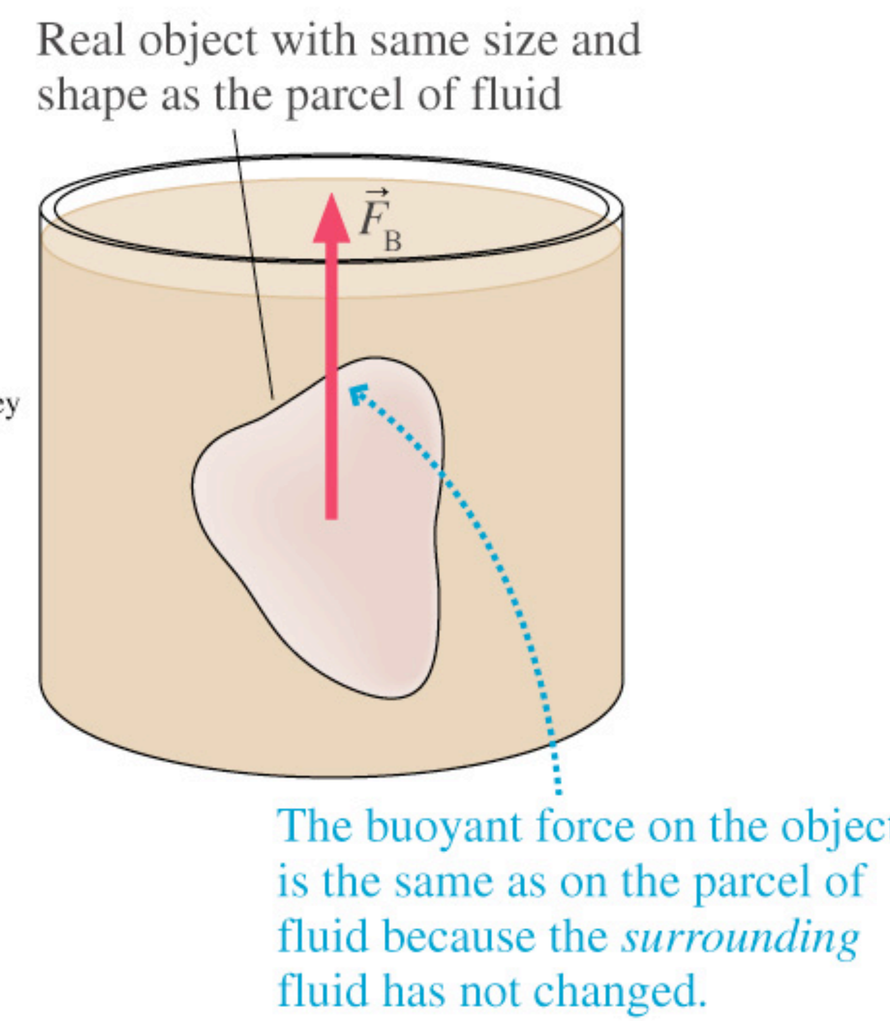



(a)

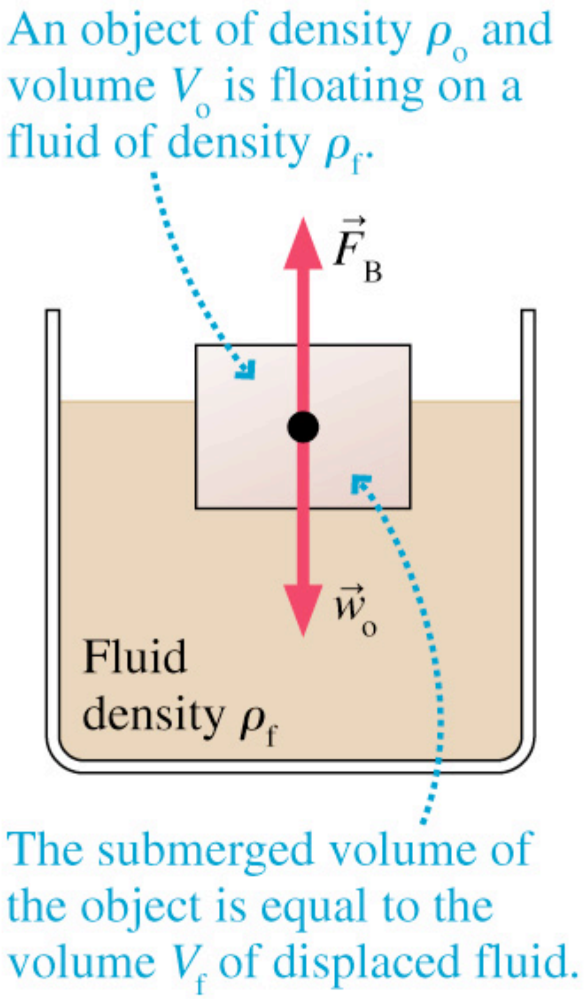


Imaginary boundary around a parcel of fluid
$\vec{F}_B$
$\vec{w}$
These are equal because the parcel is in static equilibrium.

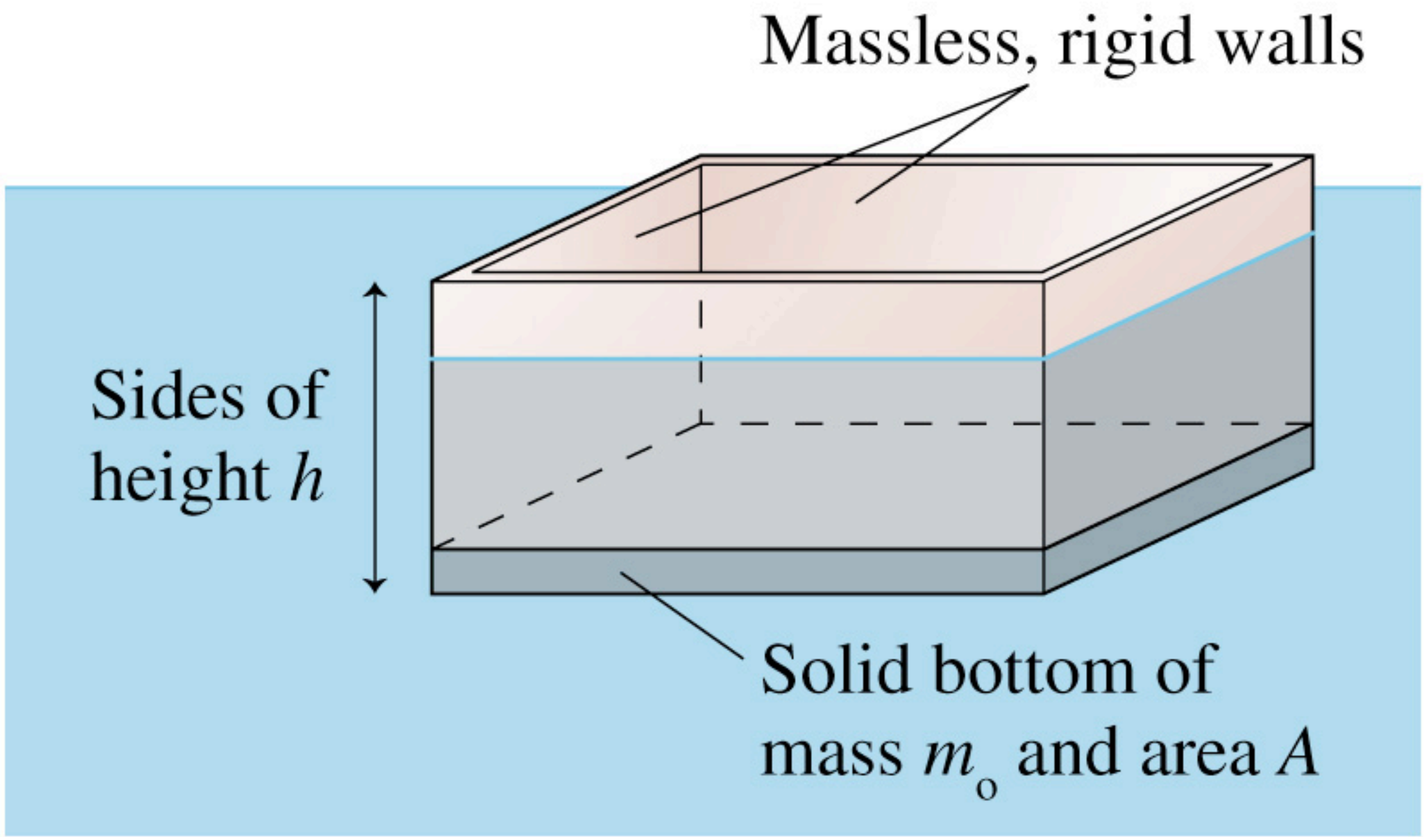

(b)



Real object with same size and shape as the parcel of fluid
$\vec{F}_B$
The buoyant force on the object is the same as on the parcel of fluid because the *surrounding* fluid has not changed.


An object of density $\rho_o$ and volume $V_o$ is floating on a fluid of density $\rho_f$.
$\vec{F}_B$
$\vec{w}_o$
Fluid density $\rho_f$
The submerged volume of the object is equal to the volume $V_f$ of displaced fluid.




Massless, rigid walls
Sides of height $h$
Solid bottom of mass $m_o$ and area $A$