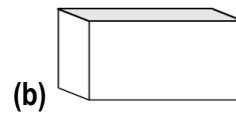
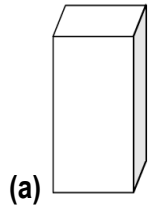


PRESSURE AND ATMOSPHERIC PRESSURE

- Pressure $P = \frac{\text{Force}}{\text{Area}}$ aka $\frac{\text{N}}{\text{m}^2}$ (Pa)).

EXAMPLE 1: Two identical wood blocks (800 kg/m^3 , and $0.2 \text{ m} \times 0.2 \text{ m} \times 1.0 \text{ m}$) are placed on outdoors, horizontal surfaces as shown. Calculate the pressure of each block on the surfaces they each sit on.



- Just like how the objects above push down against the floor, the AIR above the objects pushes down against them.
 - This is called atmospheric pressure, and it has a standard value at SEA LEVEL:
 $\rightarrow P_{\text{AIR}} = 1.01 \times 10^5 \text{ Pa} = 1 \text{ atm} = 14.7 \text{ lb/in}^2 = 760 \text{ mmHg}$ (assume this, unless otherwise stated)

EXAMPLE 2: For the blocks above, calculate the force applied by the air above them to their top surfaces.

(a)

(b)

PRACTICE: WEIGHT AND PRESSURE OF AIR

PRACTICE: A large warehouse is 100 m wide, 100 m deep, 10 m high:

- (a) What is the total weight of the air inside the warehouse?
- (b) How much pressure does the weight of the air apply on the floor?

PRESSURE IN AIR AND IN LIQUIDS (INTRO)

- If you are out in the open, as you go UP in height, there is LESS air above you, so:

(1) Air Pressure P_{AIR} _____ (less weight pushing down)

(2) Air Density ρ_{AIR} _____ (molecules more spread out)

- Because the density of AIR is low, both changes are only significant over LARGE distances.

EXAMPLE 1: Which of the following is the best approximation for the atmospheric pressure at 100 m above sea level?

(a) $0.50 \times 10^5 \text{ Pa}$

(b) $1.00 \times 10^5 \text{ Pa}$

(c) $2.00 \times 10^5 \text{ Pa}$

- If under any LIQUID, as you go DOWN in height/depth (go deeper), there is MORE liquid above you, so:

(1) Water Pressure _____ (more weight pushing down)

- Changes are significant even for small distances

(2) Water Density does NOT change much (assume constant)

- Changes are insignificant even for large distances

- The Pressure in a liquid changes with depth according to this equation:

$$\begin{array}{ccccc} \rightarrow P_{\text{BOT}} & = & P_{\text{TOP}} & + & \rho g h \\ \text{Absolute Pressure} & & \text{Relative Pressure} & & \text{Gauge Pressure} \end{array}$$

EXAMPLE 2: Suppose you are 1.8 m tall, your heart is located 1.4 m from your feet, and the blood pressure near your heart is $1.3 \times 10^4 \text{ Pa}$. Calculate the blood ($1,060 \text{ kg/m}^3$) pressure: **(a)** at the top of your head; **(b)** at the bottom of your feet.

- This equation also works for air pressure, but we usually ignore changes in air pressure since they require long distances.

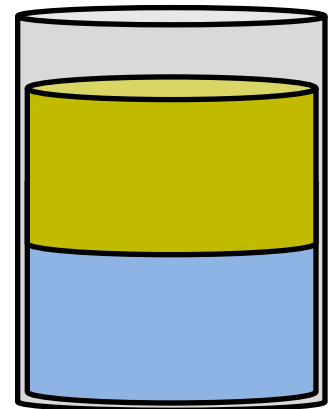
CALCULATING PRESSURES IN LIQUIDS

- Remember that pressure in a liquid changes with *depth* $\rightarrow P_{BOT} = P_{TOP} + \rho gh$
 - h is NOT height from bottom, but _____ measured from _____.
- The point / boundary where two materials “touch” is called an _____
 - At these points, the pressure of both materials is the _____.
 - Therefore, everywhere a liquid “touches” air $\rightarrow P_{LIQUID} = P_{AIR}$
- GAUGE PRESSURE** = _____ between *bottom* (abs.) pressure and *atmospheric* pressure (1.01×10^5 Pa)
 - If $P_{TOP} = P_{AIR}$, then gauge pressure is just the _____ term(s) in the pressure EQ.



EXAMPLE: You pour a 6 cm column of $1,200 \text{ kg/m}^3$ blue liquid, and a 4 cm column of 800 kg/m^3 yellow liquid, on a 12 cm-tall beaker, as shown. The liquids do not mix. Calculate:

- The absolute pressure at the blue/yellow interface
- The gauge pressure at the blue/yellow interface
- The absolute pressure at the bottom of the blue liquid



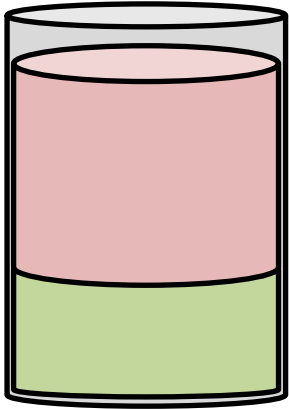
PRACTICE: PRESSURE / MARIANA TRENCH

PRACTICE: The deepest known point on Earth is called the Challenger Deep, within the Mariana Trench, at a depth of ~11,000 m (~36,000 ft). If the surface area of the average human ear is 20 cm^2 , how much average force would be exerted on your ear at that depth?



PRACTICE: PRESSURE / TWO-LIQUID BEAKER

PRACTICE: A tall cylindrical beaker 10 cm in radius is placed on a picnic table outside. You pour 5 L of an $8,000 \text{ kg/m}^3$ liquid and 10 L of a $6,000 \text{ kg/m}^3$ liquid into it. Calculate the total pressure at the bottom of the beaker.



PRACTICE: PRESSURE / FORCES UNDERWATER

PRACTICE: A wooden cube, 1 m on all sides and having density 800 kg/m^3 , is held under water in a large container by a string, as shown below. The top of the cube is exactly 2 m below the water line. Calculate the difference between the force applied by water to the top and to the bottom faces of the cube (Hint: calculate the two forces, then subtract).

