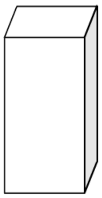
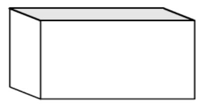
PRESSURE AND ATMOSPHERIC PRESSURE

● Pressure P = ______________ (____/____ aka ____________ (____)).

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

(a) 

(b) 

● Just like how the objects above push down against the floor, the AIR above the objects pushes down against them.

- This is called ___________________________________, and it has a standard value at SEA LEVEL:

→ **P_{AIR} = 1.01 x 10^5 Pa = 1 atm = 14.7 lb/in^2 = 760 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 $\mathbf{P_{,AIR}}$ ________________ (less weight pushing down)

(2) Air Density $\boldsymbol{\rho_{,AIR}}$ ________________ (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) 0.50×10^5 Pa (b) 1.00×10^5 Pa (c) 2.00×10^5 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:

→ $\mathbf{P_{BOT}}$	=	$\mathbf{P_{TOP}}$	+	$\boldsymbol{\rho g h}$
Absolute Pressure		Relative Pressure		Gauge Pressure

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 1.3×10^4 Pa. Calculate the blood (1,060 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* → $P_{BOT} = P_{TOP} + \rho g h$

- 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 _________.

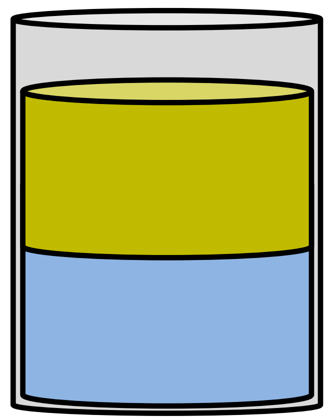
- Therefore, everywhere a liquid "touches" air → $P_{LIQUID} = P_{AIR}$

● **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.

<u>EXAMPLE</u>: You pour a 6 cm column of 1,200 kg/m³ blue liquid, and a 4 cm column of 800 kg/m³ yellow liquid, on a 12 cm-tall beaker, as shown. The liquids do not mix. Calculate:

a) The absolute pressure at the blue/yellow interface
b) The gauge pressure at the blue/yellow interface
c) The absolute pressure at the bottom of the blue liquid

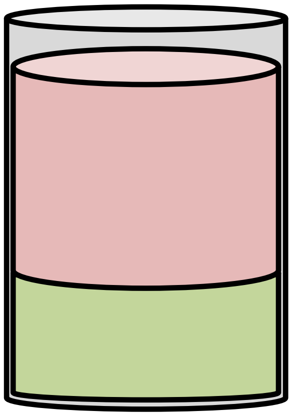


PRACTICE: PRESSURE / MARIANA TRENCH

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 kg/m^3 liquid and 10 L of a 6,000 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**).**