# Reminders 02-23 -10:

-POW 5 Due Tuesday March 2 by 5PM.

-Quiz 5 Thursday Ch.5 and 6 in Lecture.

-Homework 6 Due Tuesday the 23rd.

-Exam 2 March 2 Ch 5,6, and 14.

# Objectives:

-Fluids, Density, Pressure

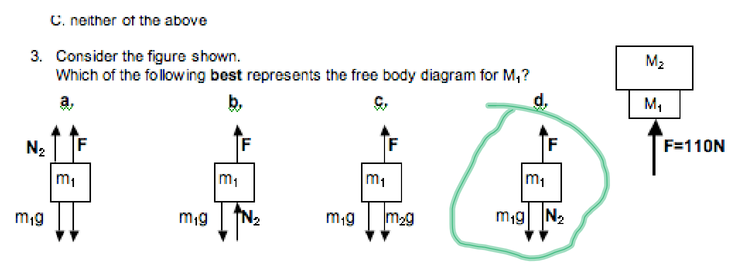
-Pascal's Principle

-Archimedes' Principle

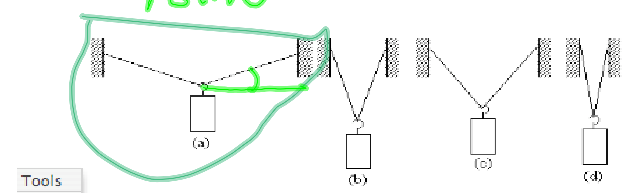
1. A train consisting of 35 railroad cars each of mass M has acceleration a. The net force on the 24th car is
A. Ma B. 11Ma C. 24Ma D. 35Ma

2. Consider a car at rest. We can conclude that the downward gravitational pull of Earth on the car and the upward contact force of Earth on it are equal and opposite because (1 points)
A. the two forces form an interaction pair.
B. the net force on the car is zero.
C. neither of the above

3. Consider the figure shown.
Which of the following **best** represents the free body diagram for $M_1$?




4. A block of weight *W* is suspended by a string of fixed length. The ends of the string are held at various positions as shown in the figures below. The mass is at the midpoint of the string in each case. In which case, if any, is magnitude of the tension along the string the largest? Tsinθ




5. In the 17th century, Otto von Güricke, a physicist in Magdeburg, fitted two hollow bronze hemispheres together and removed the air from the resulting sphere with a pump. Two eight-horse teams could not pull the halves apart even though the hemispheres fell apart when air was readmitted. Suppose von Güricke had tied both teams of horses to one side and bolted the other side to a heavy tree trunk. In this case, the tension on the hemispheres would be

A. twice B. exactly the same as
C. half

what it was before.

Density $= \frac{m}{V} = \rho$ "rho"

$\rho_{H_2O} = 1000 \frac{Kg}{m^3}$

$\rho_{Au} = 19{,}300 \frac{Kg}{m^3}$

$\rho_{air} = 1.28\ Kg/m^3$

$\rho_{U\,nucleus} = 10^{18}\ Kg/m^3$

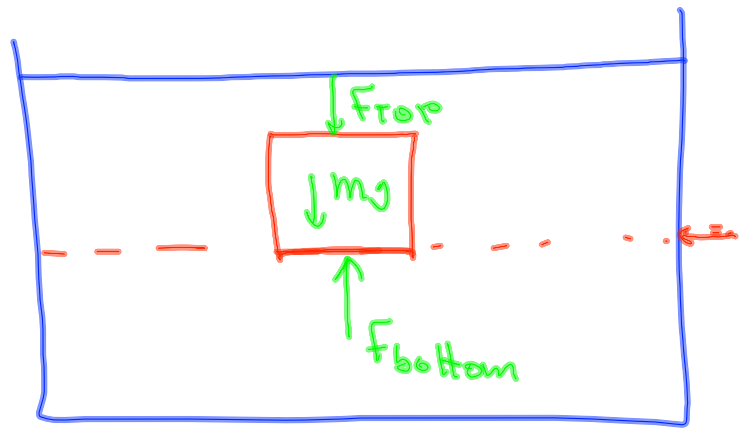
$\rho_{interstellar\ space} \cong 10^{-20}\ Kg/m^3$

If density varies

$$\rho = \frac{dm}{dV}$$

$P = \frac{F}{A}$ where F is component of force $\perp$ to surface

Units $\frac{N}{m^2}$ = Pascal




$$F_{BOTTOM} - F_{TOP} = mg = \rho V g$$

$$P_{BOTTOM}A - P_{TOP}A = \rho V g = \rho_f A h g$$

$$P_{BOTTOM} - P_{TOP} = \rho_f g h$$

$$P_{BOTTOM} = \underbrace{P_{TOP} + \rho_f g h}_{\text{absolute pressure}}$$

$\rho g h$ = called gauge pressure

Move box to top of liquid

$$P_{BOTTOM} = P_{ATM} + \rho g h$$

$$\frac{N}{m^2} = \text{Pascals}$$

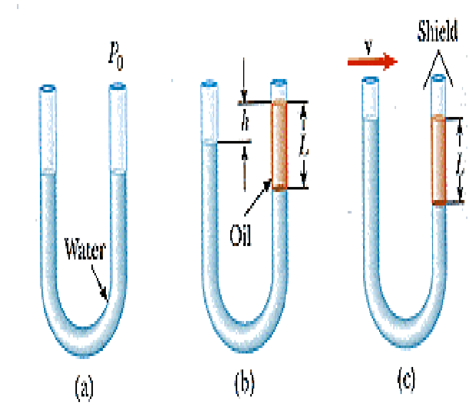
$P_{ATM}$ = 101,300 Pascals

= 14.7 Psi

= 760 mm Hg = 760 torr

= 1 atm

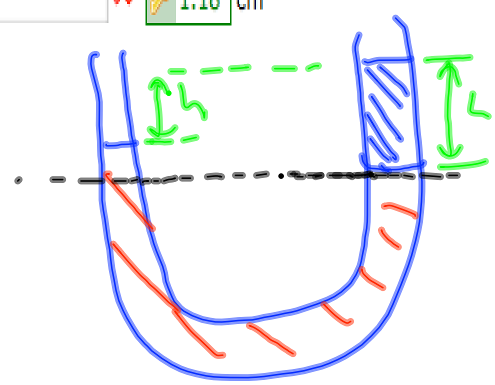
A U-tube open at both ends is partially filled with water (Figure a). Oil having a density of 750 kg/m$^3$ is then poure
the right arm and forms a column $L$ = 4.71 cm high (Figure b).




(a) Determine the difference $h$ in the heights of the two liquid surfaces.

1.18 cm

$P_{Left} = P_{right}$




$\rho_{H_2O}\, g\,(L-h) = \rho_{oil}\, g\, L$

solve for h

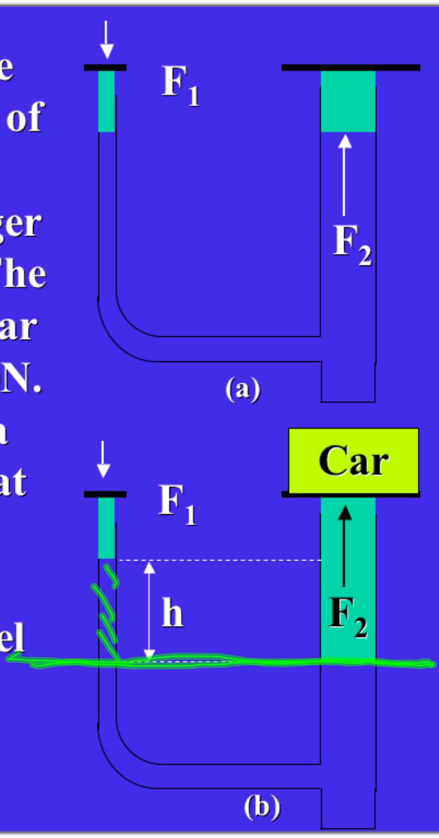
$\rho_{H_2O} L - \rho_{H_2O} h = \rho_{oil} L$

$-\rho_{H_2O} h = (\rho_{oil} - \rho_{H_2O}) L$

$h = \left(\frac{\rho_{H_2O} - \rho_{oil}}{\rho_{H_2O}}\right) L = \left(\frac{1000-750}{1000}\right) 4.71$

$h = 1.18$ cm

**In a hydraulic car lift, the input piston has a radius of 0.0120m and negligible weight. The output plunger has a radius of 0.150m. The combined weight of the car and the plunger is 20,500N. The lift uses oil that has a density of 800kg/m³. What input force is needed to support the car and the output plunger at the level shown in figure b where h=1.20m.**




$$P_{Left} = P_{Right}$$

$$\frac{F_1}{A_1} + \rho_{oil} g h = \frac{F_2}{A_2}$$

$$F_1 = A_1\left(\frac{F_2}{A_2} - \rho_{oil} g h\right)$$

$$= \pi(.012)^2\left[\frac{20{,}500N}{\pi(.15)^2} + (800)(9.80)(1.20m)\right]$$

$$= 127N$$

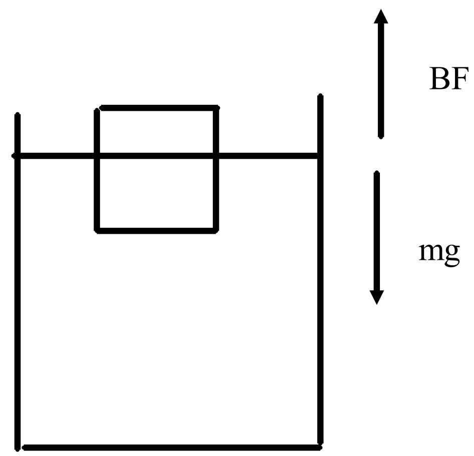
A cube of ice whose edges measure 20.0 mm is floating in a glass of ice-cold water with one of its faces parallel to the water's surface.

(a) How far below the water surface is the bottom face of the block?

m

(b) Ice-cold ethyl alcohol is gently poured onto the water's surface to form a layer 4.50 mm thick above the water. The alcohol does not mix with the water. When the ice cube again attains hydrostatic equilibrium, what will be the distance from the top of the water to the bottom face of the block?

m




**part a**

$mg=BF$

$\rho_{object}V_{object}g=\rho_{water}V_{displaced}g=\rho_{water}(Ah)_{displaced}g$

**part b**

$mg=\rho_{object}V_{object}g=BF_{water}+BF_{alcohol}=$

$=\rho_{water}(Ah)_{displaced}g+\rho_{alcohol}(A0.00450m)_{displaced}g$