NO READING ASSIGNMENT

BONUS bip problem tomorrow
(2 Questionaires)

Final Exam equation sheet on class web page

unregistered clickers

[redacted]	217932
all have	223674
been used	247599
in past	294779
week	310667
	332627

Fluids

Fluid is an object which can flow
Does not maintain a fixed shape

Examples: liquids, gas

A convenient way to describe a fluid is density:

$$\rho \text{ (rho)} = \frac{M}{V}$$

often compare an object's density to density of water at 4.0°C

$$\rho \text{ (water at } 4^\circ\text{c)} = 1\ g/cm^3$$
$$= 1.00 \times 10^3\ kg/m^3$$

specific gravity: ratio of density of substance to water at 4.0°C

ex) Lead: density $= 11.3 \times 10^3\ kg/m^3$

specific density $= 11.3$

Pressure

Pressure: Force per unit area

$$P = \frac{F}{A}$$

Force acts perpendicular to surface area A.

units of pressure (S.I.) $\frac{N}{m^2}$ = Pascal (Pa)

U.S: P.S.I. Pounds / square inch

Since atmosphere is always pushing on us with a pressure, Another unit is called an atmosphere

Standard pressure that atmosphere presses on us at sea level

$$1\ atm = 1.013 \times 10^5\ Pa$$

Another common unit is to use mercury.

760 mm of mercury

Torr: $\frac{mm}{Hg}$

1 atm = 760 Torr = 1.013×10^5 Pa

ex) A water bed is 2.0 m square and 30 cm deep.

a) what is its weight?

b) what pressure does bed exert on floor?

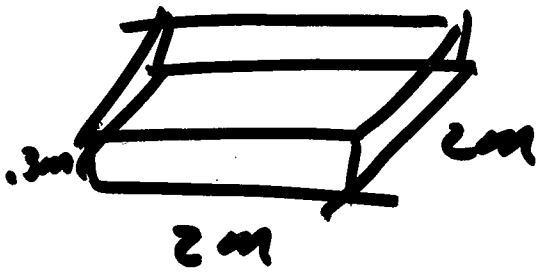
a) $w = mg = \rho V g$

$1000 \frac{kg}{m^3} \cdot (2m)(2m)(.3m)(9.8 m/s^2)$

$= 1.18 \times 10^4 N$

b) $P = \frac{F}{A} = \frac{w}{A} = \frac{1.18 \times 10^4 N}{(2m)(2m)}$

$= 2.95 \times 10^3 Pa$



Properties of pressure in a fluid

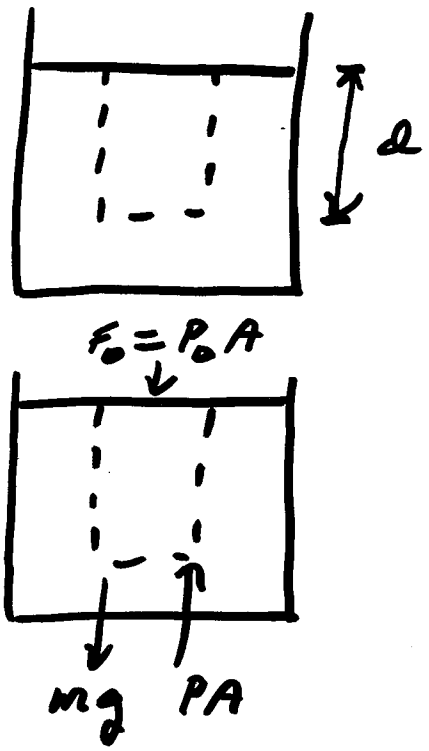
1) At any point that a fluid is in contact with a surface, the pressure is exerted perpendicular to surface

2) At any point inside a fluid, pressure is directed in all directions with same magnitude

3) Pressure at any point depends only on the depth of the point

Suppose there is a volume of fluid with a uniform density which has a depth d and area A

what forces act on this volume of fluid?



$$\Sigma F_y = 0$$

$$PA - mg - P_0 A = 0$$

$$PA - \rho V g - P_0 A = 0$$

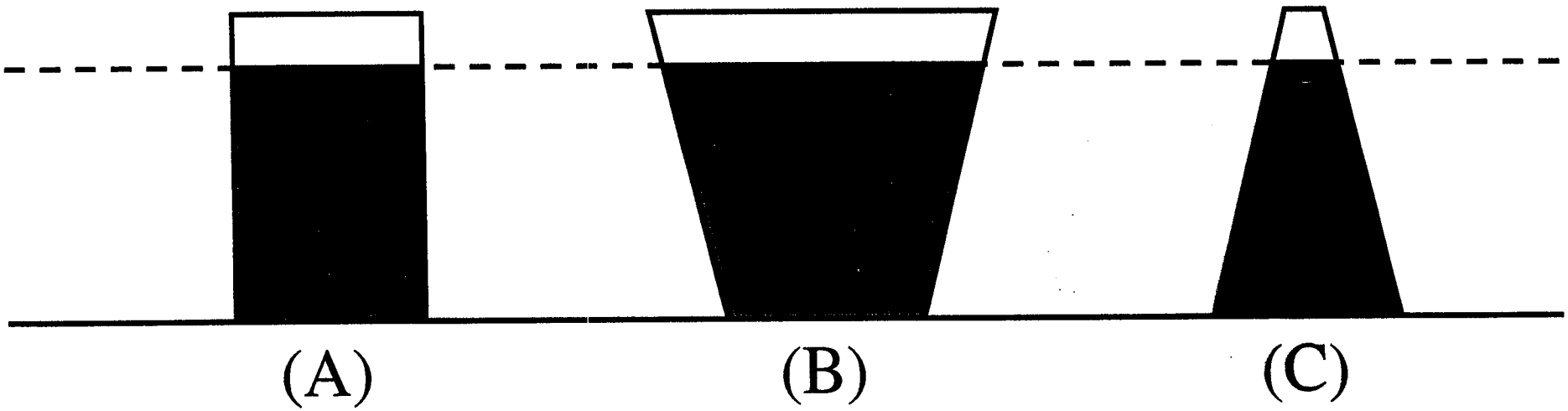
$$PA - \rho d A g - P_0 A = 0$$

$$P - \rho d g - P_0 = 0$$

$$\boxed{P = P_0 + \rho g d}$$

Interactive Question

Three drinking glasses all have the same area base and are all filled to the same level. Which glass has the greatest liquid pressure at the bottom?

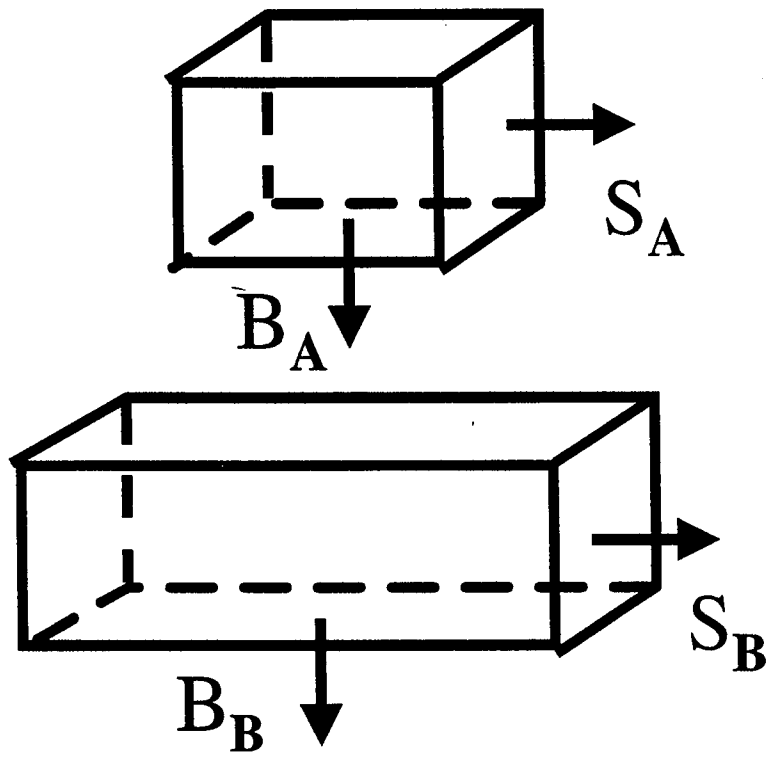


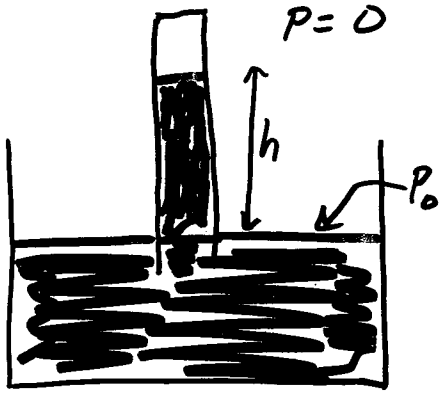
A) Glass A
B) Glass B
C) Glass C
D) All have the same pressure

Interactive Question

Consider two fish tanks that are the same height and the same width. Tank **A** is 3 feet long and tank **B** is 6 feet long. S_A is the force on the side of tank **A**, and S_B is force on the side of tank **B**. B_A is the force on the bottom of tank **A**, and B_B is force on the bottom of tank **B**. Which statement below is true?

A) $S_A = S_B$ and $B_A = B_B$
B) $S_A = 2S_B$ and $B_A = B_B$
C) $2S_A = S_B$ and $2B_A = B_B$
D) $S_A = S_B$ and $2B_A = B_B$
E) $S_A = 2S_B$ and $B_A = 2B_B$





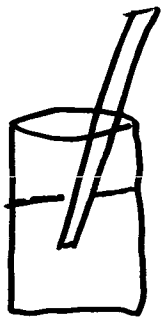
measurements of pressure

$P_0 = \rho g h$

for mercury at atmospheric pressure $P_0 \approx 760\,mm$

water $P_0 \approx 10.3\,m$

Can I suck water through a straw 15 m long?



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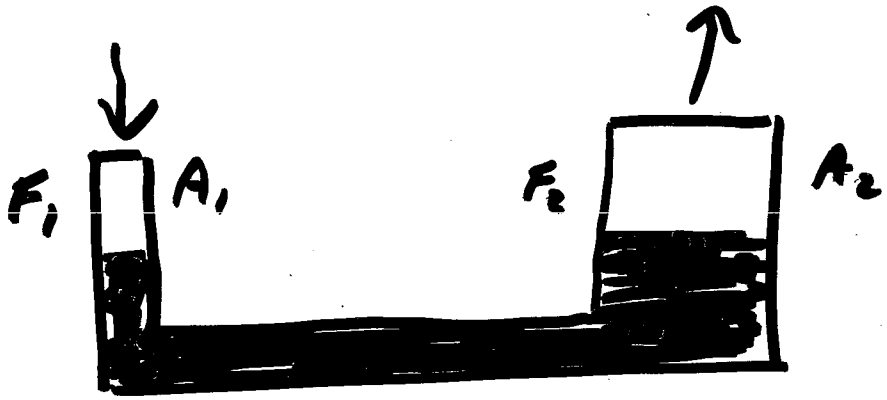
Pascal's principle

$$P = P_0 + \rho g h$$

IF external pressure increases, total pressure increases by same amount

Pressure applied to a confined fluid increases the pressure throughout by the same amount

hydraulic lift



$$P_1 = \frac{F_1}{A_1} \quad P_2 = \frac{F_2}{A_2}$$

Pascal's principle $\Rightarrow P_1 = P_2$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \boxed{F_2 = F_1 \left(\frac{A_2}{A_1}\right)}$$

if $A_2 > A_1$ $F_2 > F_1$

ex] A hydraulic press is used in a trash compactor

radius of input piston = 6.4×10^{-3} m

radius of output piston = 5.1×10^{-2} m

If input force is 330 N, what is output force?

$$F_2 = F_1 \left(\frac{A_2}{A_1} \right)$$

$$F_2 = (330\text{N}) \left(\frac{\pi (5.1 \times 10^{-2}\text{m})^2}{\pi (6.4 \times 10^{-3}\text{m})^2} \right)$$

$$= \boxed{26{,}000\text{ N}}$$