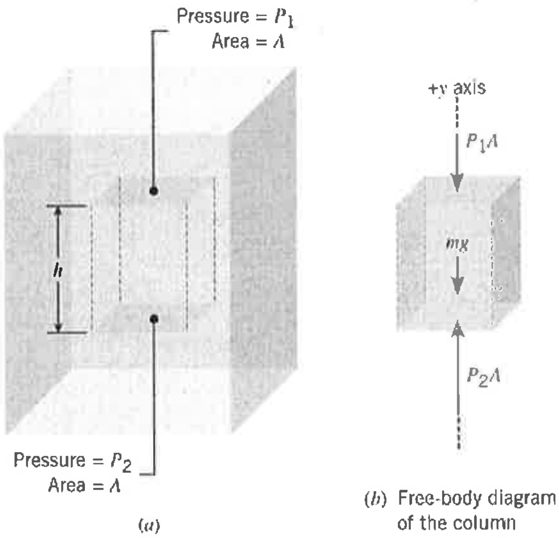
PHYS 201 HWK-22 Name: Key

1. In the presence of gravity, the upper layers of a fluid push downward on the layers beneath, with the result that fluid pressure is related to depth. In an incompressible static fluid whose density is ρ, show that, $P_2 = P_1 + \rho g h$; where P_1 is the pressure at one level, P_2 is the pressure at a level that is h meters deeper, and g is the magnitude of the acceleration due to gravity.



$\Sigma F_y = 0$

$P_2 A = P_1 A + mg$

$m = \rho V = \rho \cdot A \cdot h$

$P_2 A = P_1 A + \rho A h g$

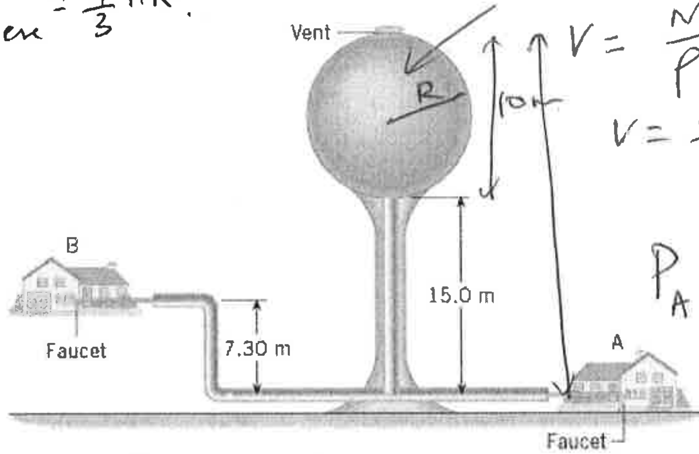
$\div A$: $P_2 = P_1 + \rho h g$

$\boxed{P_2 = P_1 + \rho g h}$

$\boxed{P_2 - P_1 = \rho g h}$

2. A water tower is a familiar sight in many towns. The purpose of such a tower is to provide storage capacity and to provide sufficient pressure in the pipes that deliver the water to customers. The drawing shows a spherical reservoir that contains 5.25×10^5 kg of water when full. The reservoir is vented to the atmosphere at the top. For a full reservoir, find the gauge pressure that the water has at the faucet in (a) house A and (b) house B. Ignore the diameter of the delivery pipes. $\rho_{water} = 1000\ kg/m^3$.

$V_{sphere} = \frac{4}{3}\pi R^3$



$M = 5.25 \times 10^5$ kg

$V = \frac{M}{\rho} = \frac{5.25 \times 10^5}{1000} = 525\ m^3$

$V = \frac{4}{3}\pi R^3 \rightarrow 525 = \frac{4}{3}\pi R^3$

$R^3 = \frac{3 \times 525}{4\pi} \rightarrow \boxed{R = 5\ m}$

$P_A = \rho g h$, $h = 15 + 10\ m = 25\ m$

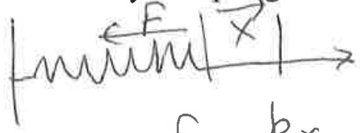
$P_A = 1000 \times 9.8 \times 25 = \underline{2.45 \times 10^5\ N/m^2}$

$P_B = \rho g h$, $h = 25 - 7.3 = 17.7\ m$

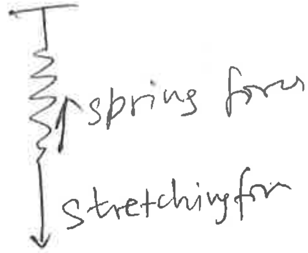
$P_B = \rho g h = 1000 \times 9.8 \times 17.7 = \underline{1.73 \times 10^5}\ N/m^2$

PHYS 201 Sample Final Question Name: Key

1. State Hooke's law. Also sketch a spring and show the forces: stretching force and the force by the spring.



$F = -kx$



2. A 10.1-kg uniform board is wedged into a corner and held by a spring at a 50.0° angle, as the drawing shows. The spring has a spring constant of 176 N/m and is parallel to the floor.

a. Draw a free-body diagram for the board

b. Find the force exerted by the spring.

c. Find the amount by which the spring is stretched from its unstrained length.

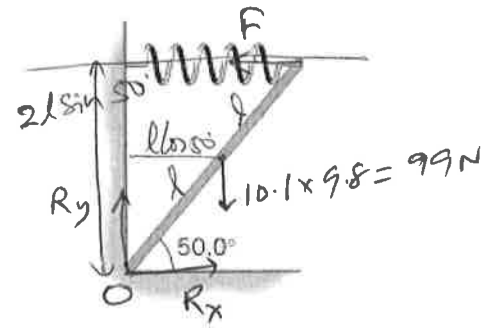
Assume the length of board = $2l$

$\Sigma \tau = 0$ about O.

$F \times 2l \sin 50 = 99 \times l \cos 50$

$F = \dfrac{99 \times l \cos 50}{2l \sin 50}$

$F = 41.5\ N$



$F = kx \rightarrow x = \dfrac{41.5}{176} = 0.24\ m = 0.236\ m$

PHYS 201 Archimedes' Principle Name: Key

$F_b = \rho_f v_f g$ Density of water = 1 g/cm³ = 1000 kg/m³.

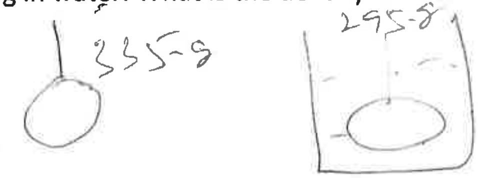
https://www.youtube.com/watch?v=eQsmq3Hu9HA

1. State Archimedes' principle.

Buoyant force is equal to the weight of the displaced fluid $B = \rho_F V g$

2. Uses for Archimedes' principle:

a. Volume measurement for density: A solid metal alloy has a mass of 335-g in air and 295-g in water. What is the density of the metal alloy?



$335 - 295 = 40\,g \rightarrow 40\,cm^3$

$\rho = \frac{m}{V} = \frac{335}{40} = 8.375\ g/cm^3$

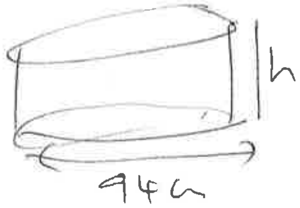
b. Cavity detection: A metal ornament (gold) has a mass of 155-g in air and 142-g in water. Does it have a cavity inside? If so what is the volume of the cavity? [Density of gold = 19.3 g/cm³]

$13\ cm^3$

$V = \frac{m}{\rho} = \frac{155}{19.3} = 8.03\ cm^3$

Cavity = $13 - 8 = 5\ cm^3$

c. Loading capacity for floating objects: A cylindrical container of mass 24 kg, height 15 cm, and diameter 94 cm is floating in a fresh water lake. What is the maximum load in Kg it can support without sinking.



$V = \pi r^2 . h$
$= \pi(.47)^2 \times 0.15 = 0.104\ m^3 = V$
$1000\ kg/m^3 = \rho$
$104\ kg = m$

Load = 80 kg

d. Density of a liquid: A chunk of metal with a mass of 390 g in air and volume 49 cm³ is found to have an apparent mass of 337 g when completely submerged in an unknown liquid. Calculate the density of the unknown liquid.

B.F in the liq = 53 g ← mass of liq. displaced

$\rho = \frac{53\,g}{49\ cm^3} = 1.08\ g/cm^3$