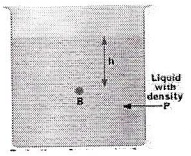
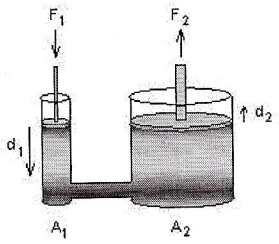
Fluid Mechanics: Hydrostatic Pressure Problems 1

Name: Key Period: _____ Date: _____

Density & Specific Gravity	Pressure	Hydrostatic Pressure	Pascal's Principle
$\rho = \frac{m}{V}$ Units $[\frac{g}{cm^3}, \frac{kg}{m^3}]$ $S.G. = \frac{\rho_{substance}}{\rho_{water}}$ No Units **Density of water:** 1 g/cm^3=1000 kg/m^3 **Density of air:** 0.0012 g/cm^3=1.2 kg/m^3	$P = \frac{F}{A}$ Units $[\frac{N}{m^2} = Pa]$	P=Po + ρgh +... Po=1atm= 1.013x10^5 Pa Po=Atmospheric pressure 	$\frac{F_1}{A_1} = \frac{F_2}{A_2}$ 

Density/Specific Gravity

1. The approximate volume of the granite monolith known as the El Capitan in Yosemite National Park is about $10^8 m^3$. Density of granite is $2.7 \times 10^3 Kg/m^3$. What is its approximate mass? _____

$V = 10^8 m^3$ $\rho = \frac{m}{V}$

$\rho = 2.7 \times 10^3 \frac{kg}{m^3}$

$m = \rho V = [2.7 \times 10^3 \frac{kg}{m^3}][10^8 m^3] = 2.7 \times 10^{11} kg$

2. What is the approximate mass of air in a living room 5.8m X 3.8m X 2.8m? _____

$m = \rho \cdot V = [1.2 \frac{kg}{m^3}][(5.8)(3.8)(2.8)] = 74.05 kg$

3. Estimate your volume [Hint: Because you can swim on or just under the surface of the water in a swimming pool, you have a pretty good idea of your density]. Units in Kg, m^3 _____

$\rho = 1000 kg/m^3$ $\rho = \frac{m}{V}$

$m = 87.72 kg$ $V = \frac{m}{\rho} = \frac{87.72 kg}{1000} = 0.09$

4. Turpentine has a specific gravity of 0.9. What is its density? _____

$S.G. = 0.9$ $S.G. = \frac{\rho_{TUR}}{\rho_W}$ $\rho_{TUR} = 900 kg/m^3$

$0.9 = \frac{\rho_{TUR}}{1000}$

5. A cork has a volume of 4cm^3 and weighs 10^{-2}N. What is the specific gravity of cork? _____

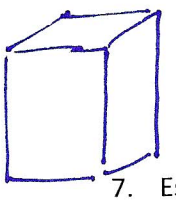
$4 cm^3 \left[\frac{1m}{100 cm}\right]^3 = 4 \times 10^{-6} m^3$ $S.G. = \frac{\rho_{CORK}}{1000} = 0.25$

$F_b = \frac{10^{-2} N}{10}$ $\rho = \frac{m}{V} = \frac{0.001}{4 \times 10^{-6}}$

$F_b = 0.001$ $\rho = 250 kg/m^3$

Pressure

6. A vertical column made of cement has a base area of $0.5m^2$. If its height is 2m, and the specific gravity of cement is 3, how much pressure does this column exert on the ground?



$A = 0.5m^2$
$s.G = 3$
$P = ?$

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

$P = \frac{F}{A} = \frac{m \cdot g}{0.5}$

$m = \rho \cdot V = (3000)(.5)(2)$

$m = 3000$

$P = \frac{(3000)(10)}{.5}$

$P = 60{,}000\ Pa$

$P = 6 \times 10^4\ Pa$

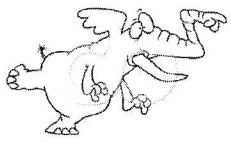
7. Estimate the pressure exerted on a floor by:

a. A 50kg model standing momentarily on a single spike hill (Area=$0.05cm^2$) _____

$A = 0.05cm^2 \cdot \left[\frac{1m}{100cm}\right]^2 = 5 \times 10^{-6} m^2$

$P = \frac{F}{A} = \frac{500}{5 \times 10^{-6}} = 1 \times 10^8\ Pa$

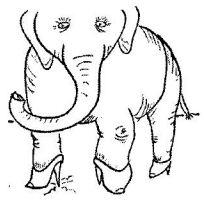
b. The pressure exerted by a 1500kg elephant standing on one foot (Area=$800cm^2$) _____



$P = \frac{F}{A} = \frac{15000N}{8 \times 10^{-2}} = 1.88 \times 10^5\ Pa$

$A = 800cm^2 = 8 \times 10^{-2} m^2$

c. What about a 1500kg elephant, using high heels and standing on one foot? :P (Area=$0.05cm^2$)



$A = 5 \times 10^{-6} m^2$

$F_G = 15{,}000N$

$P = \frac{F}{A} = \frac{15{,}000}{5 \times 10^{-6}} = 3 \times 10^9\ Pa$

d. Who is the most dangerous? Who applies the greatest pressure? elephant with heels!