Properties of Fluids

Pre-Class Questions

Problem Set (due next time)
Ch 13 - 1, 14, 17, 23

Lecture Outline
1. The Definition of Density
2. The Definition of Pressure
3. Pressure in a Static Fluid

Density

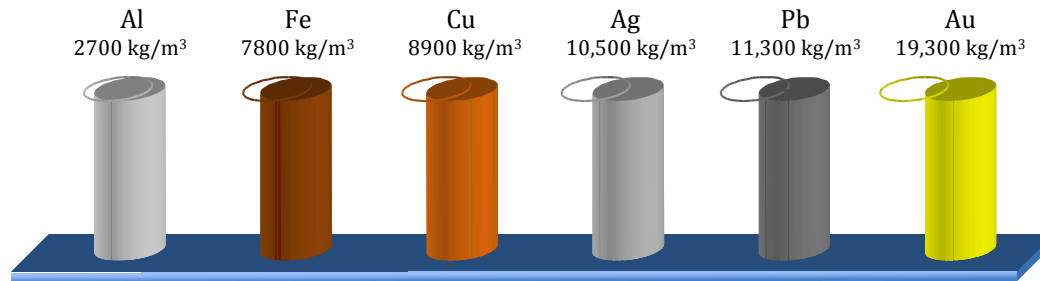1. Which weights more, a pound of feathers or a pound of gold? Explain.

2. Which fills a larger volume a pound of feathers or a pound of gold? Explain.

3. Which has a greater density a pound of feathers or a pound of gold? Explain.

Example 1: A commercial claims that all the world's gold can be put into a cube 18.0m on a side. The density of gold is $19.3 \times 10^3 kg/m^3$. Find the mass of the world's gold and the fraction of Earth made of gold.

Do You Feel Any Pressure?

1. The six cylinders below are each made of different metals and rest on a horizontal surface. They all have the same radius and height. The density of each is listed. Rank these cylinders from highest to lowest based upon the pressure they exert on the surface.

Al	Fe	Cu	Ag	Pb	Au
$2700 \ kg/m^3$	$7800 \ kg/m^3$	$8900 \ kg/m^3$	$10{,}500 \ kg/m^3$	$11{,}300 \ kg/m^3$	$19{,}300 \ kg/m^3$

highest _____ _____ _____ _____ _____ _____ lowest

2. Six new cylinders, one of each metal, are prepared so that they all have the same mass and radius. Sketch them below.

Al   Fe   Cu   Ag   Pb   Au
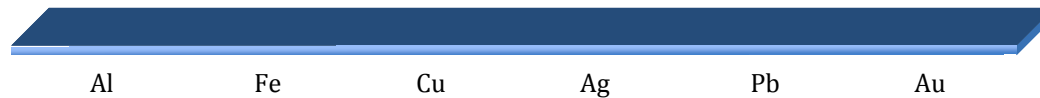
3. Rank these cylinders from highest to lowest based upon the pressure they exert on the surface.

highest _____ _____ _____ _____ _____ _____ lowest
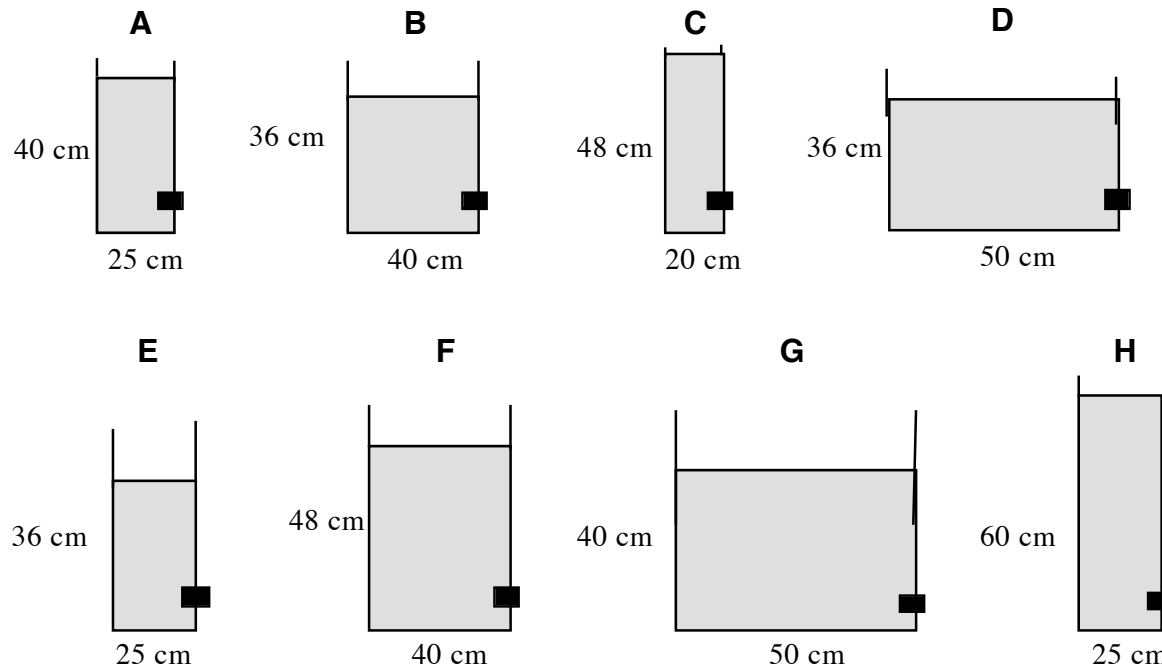
Example 2: Find the pressure that the gold exerts on the ground below it.

Units of Pressure

Converted to	1Pascal 1Pa	1 atmosphere 1atm	1mmHg 1Torr	1lb/in^2 1psi
Pa	1	101kPa	133Pa	6.90kPa
atm	9.87×10^{-6}atm	1	1.32×10^{-3}atm	6.81×10^{-2}atm
mmHg	7.50×10^{-3}mmHg	760mmHg	1	51.7mmHg
psi	1.45×10^{-4}psi	14.7psi	1.93×10^{-2}psi	1

The figures below show side views of eight hollow cylinders that have varying amounts of water in them. The widths of the cylinders and the heights to which they have been filled with water vary. The cylinders all have a hole cut in the side. All of the holes are the same size and they are all at the same height above the bases of the cylinders. There are corks in all of the holes.

Rank these situations, from greatest to smallest, on the basis of the pressure on the cork by the water.

A

40 cm

25 cm

B

36 cm

40 cm

C

48 cm

20 cm

D

36 cm

50 cm

E

36 cm

25 cm

F

48 cm

40 cm

G

40 cm

50 cm

H

60 cm

25 cm

Greatest   1_____ 2_____ 3_____ 4_____ 5_____ 6_____ 7_____ 8_____ Smallest

Or, the pressure is the same for all these cases. _____

Please carefully explain your reasoning.

Example 3: City water mains have a pressure of 100psi. Find the maximum height of a building that won't need a pump to get water to the top.

Example 4: Use atmospheric pressure to estimate the mass of the atmosphere.

Lecture 33 - Summary

The Definition of Density $\quad \rho \equiv \dfrac{m}{V}$

The Definition of Pressure $\quad P \equiv \dfrac{F}{A}$

Pressure in a Static Fluid
- External pressure transmitted undiminished
- Exerted equally in all directions
- Depends only on depth, $P = \rho g h$