

# PHYS 1443 – Section 003

## Lecture #20

Monday, Nov. 17, 2003

Dr. Jaehoon Yu

1. Density and Specific Gravity
2. Fluid and Pressure
3. Absolute and Relative Pressure
4. Pascal's Law
5. Buoyant Force and Archimedes' Principle

Quiz #4 on Wednesday, Nov. 19, 2003!!

Wednesday's lecture will be given by the mystery person!!



# Density and Specific Gravity

Density,  $\rho$  (rho) , of an object is defined as mass per unit volume

$$\rho \equiv \frac{M}{V}$$

Unit?  $kg / m^3$   
Dimension?  $[ML^{-3}]$

Specific Gravity of a substance is defined as the ratio of the density of the substance to that of water at 4.0 °C ( $\rho_{H_2O}=1.00g/cm^3$ ).

$$SG \equiv \frac{\rho_{\text{substance}}}{\rho_{H_2O}}$$

Unit? None  
Dimension? None

What do you think would happen of a substance in the water dependent on SG?

$SG > 1$  Sink in the water  
 $SG < 1$  Float on the surface



# Fluid and Pressure

What are the three states of matter?

Solid, Liquid, and Gas

How do you distinguish them?

By the time it takes for a particular substance to change its shape in reaction to external forces.

What is a fluid?

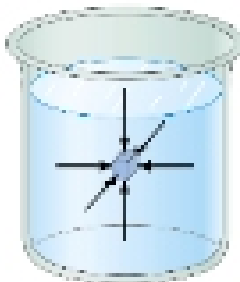
A collection of molecules that are randomly arranged and loosely bound by forces between them or by the external container.

We will first learn about mechanics of fluid at rest, **fluid statics**

In what way do you think fluid exerts stress on the object submerged in it?

Fluid cannot exert shearing or tensile stress. Thus, the only force the fluid exerts on an object immersed in it is the forces perpendicular to the surfaces of the object. This force by the fluid on an object usually is expressed in the form of the force on a unit area at the given depth, the pressure, defined as

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



Expression of pressure for an infinitesimal area  $dA$  by the force  $dF$  is

$$P = \frac{dF}{dA}$$

Note that pressure is a scalar quantity because it's the magnitude of the force on a surface area  $A$ .

What is the unit and dimension of pressure?

Unit:  $N/m^2$

Dim.:  $[M][L^{-1}][T^{-2}]$

Special SI unit for pressure is Pascal

$$1Pa \equiv 1N / m^2$$

