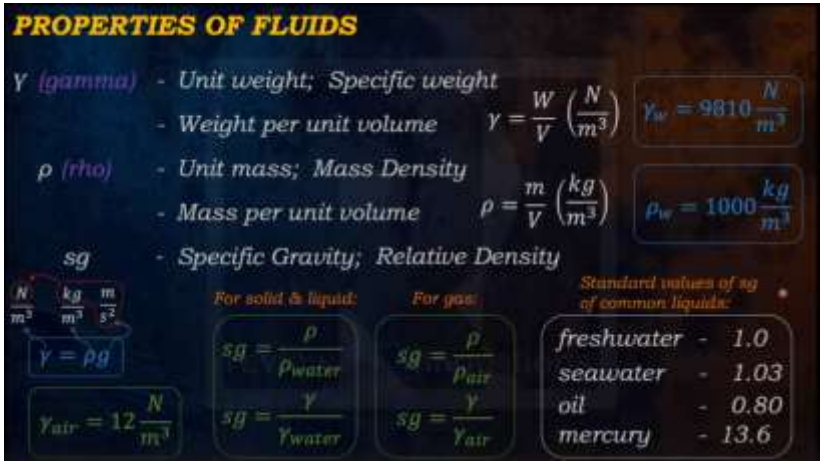
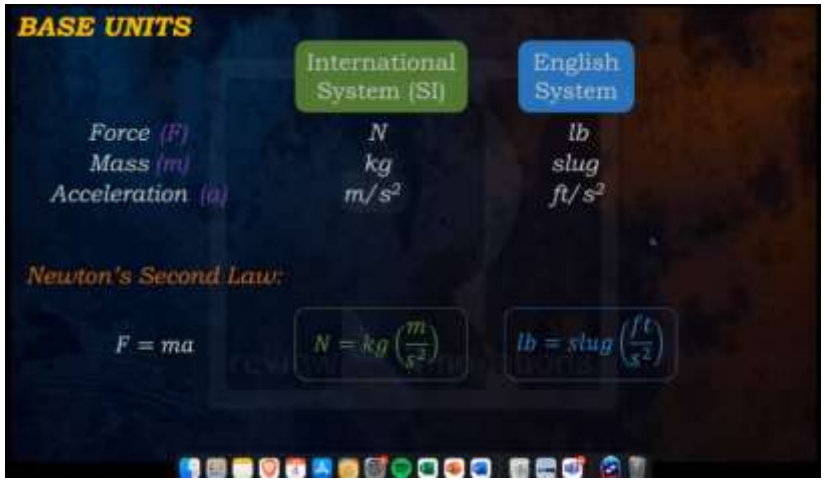
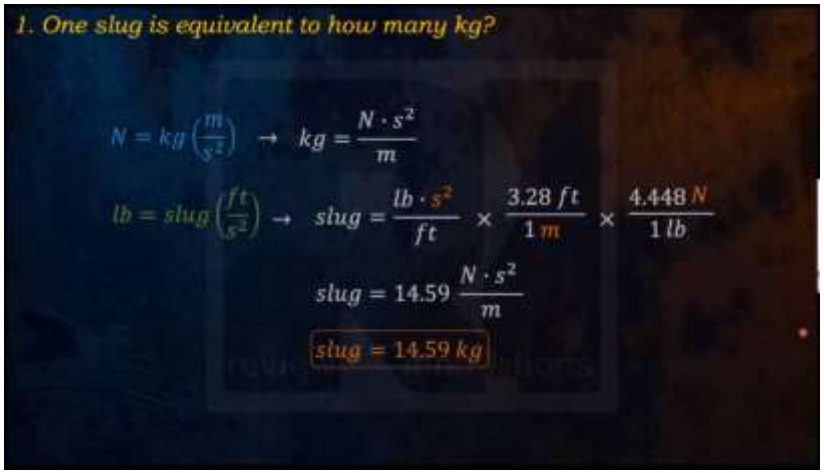
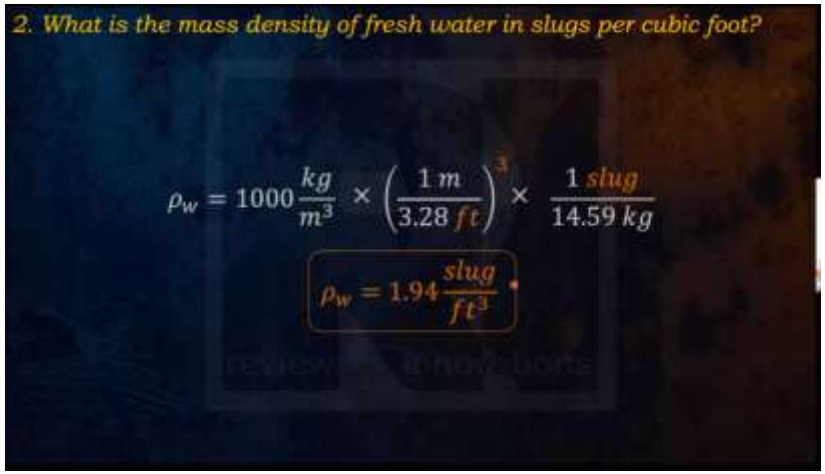
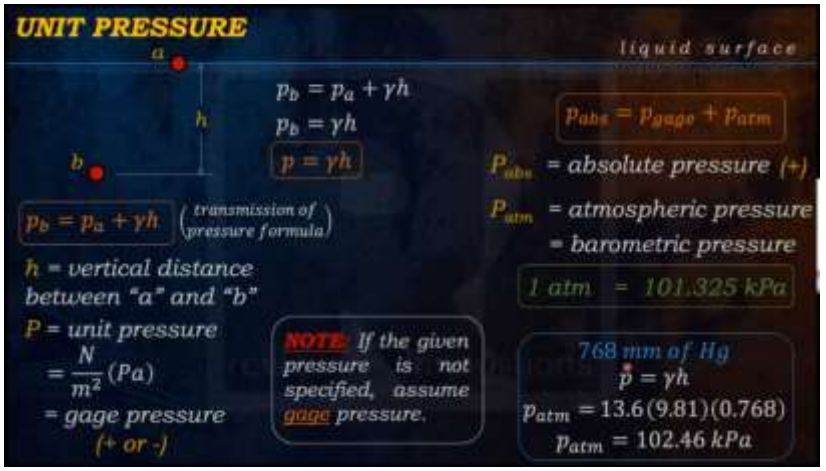

HYDRAULICS 1
Base Units
Properties of Fluids
Unit Pressure


PROPERTIES OF FLUIDS
γ (gamma) - Unit weight; Specific weight
- Weight per unit volume
ρ (rho) - Unit mass; Mass Density
- Mass per unit volume
sg - Specific Gravity; Relative Density
For solid & liquid:
For gas:
Standard values of sg of common liquids:
freshwater - 1.0
seawater - 1.03
oil - 0.80
mercury - 13.6

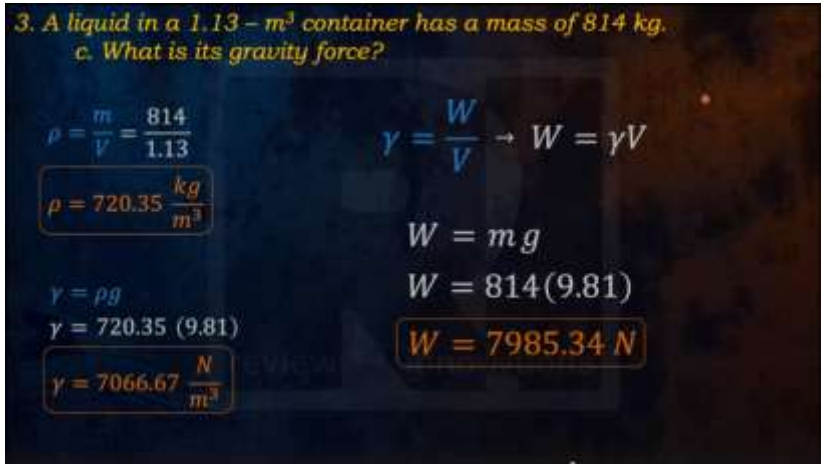

BASE UNITS
International System (SI)
English System
Force (F) N lb
Mass (m) kg slug
Acceleration (a) m/s² ft/s²
Newton's Second Law:
F = ma

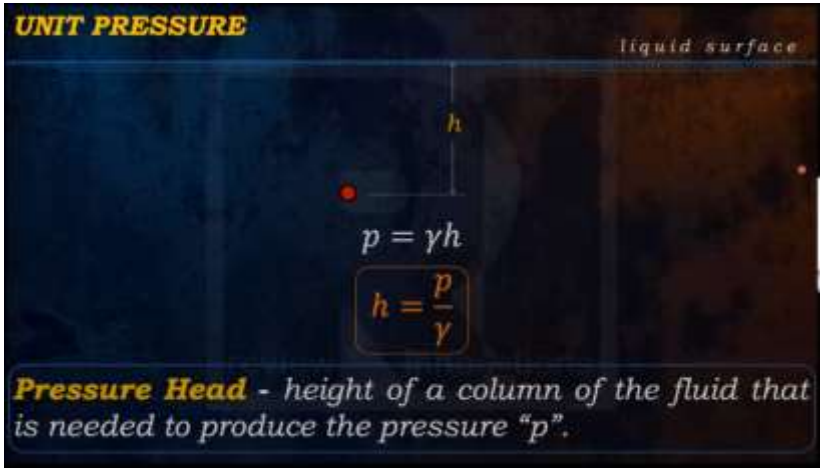

1. One slug is equivalent to how many kg?
slug = 14.59 N·s²/m
slug = 14.59 kg





Gamma of water in English System = 62.4lb per cubic ft.





UNIT PRESSURE

Convert the pressure head of liquid "A" to the pressure head of liquid "B"

$$\gamma_A h_A = \gamma_B h_B$$

$$sg_A(\gamma_w)h_A = sg_B(\gamma_w)h_B$$

$$h_B = \frac{sg_A}{sg_B}(h_A)$$

4. Evaluate the greatest pressure of water in the tank shown.

$$p_1 = 0 + 35$$

$$p_2 = 9.81(1) + 35$$

$$p_{max} = 35 + 9.81(1.9)$$

$$p_{max} = 53.639\ kPa$$

Pascal's Law *- In a fluid at rest in a closed container, a pressure change in one part is transmitted without loss to every portion of the fluid and to the walls of the container.*

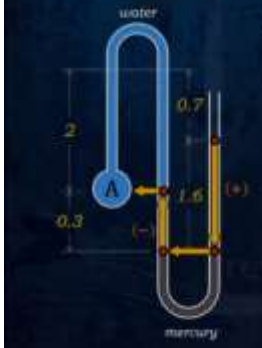
5. The pressure gage in a given tank reads 125 mm Hg. Calculate the equivalent height of column of oil.

$$h_{oil} = \frac{sg_{Hg}}{sg_{oil}} h_{Hg}$$

$$h_{oil} = \frac{13.6}{0.80}(0.125)$$

$$h_{oil} = 2.125\ m$$

6. Determine the gage pressure at A in the given open-type manometer.



ΣPressures:

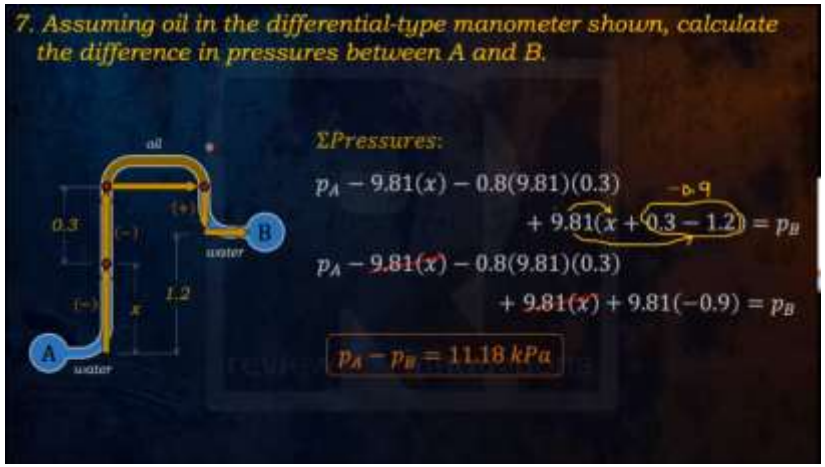
$$0 + 13.6(9.81)(1.6) - 9.81(0.3) = p_A$$

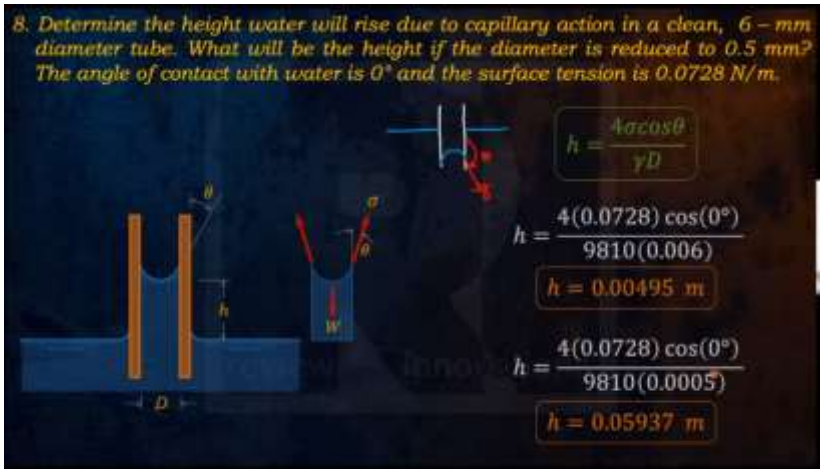
$$p_A = 210.52\ kPa$$

ΣPressure Heads:

$$0 + \frac{13.6}{1}(1.6) - 0.3 = \frac{p_A}{\gamma}$$

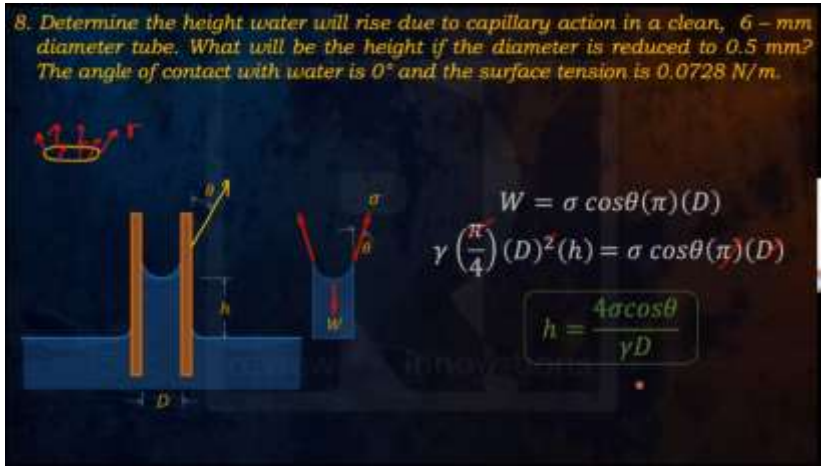
$$p_A = 210.52\ kPa$$

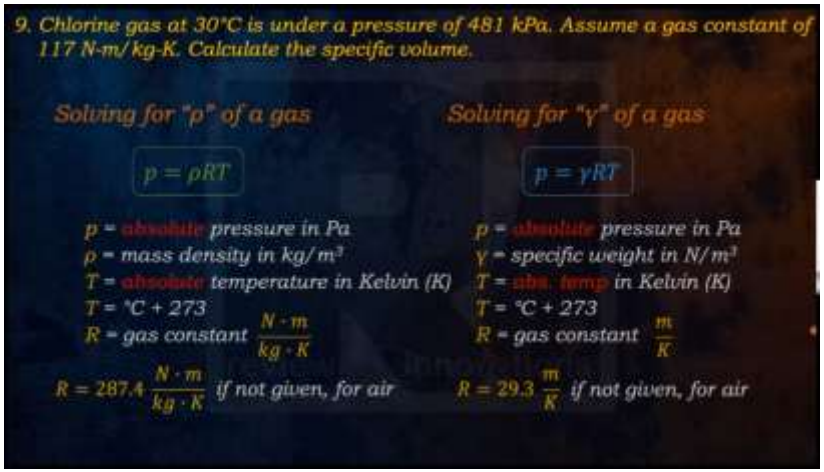




If theta is greater > than 90 deg. = depression (downwards)

If liquid is mercury, always depression





9. Chlorine gas at 30°C is under a pressure of 481 kPa. Assume a gas constant of 117 N-m/kg-K. Calculate the specific volume.

$$p = \rho RT$$

$$(481 + 101.325)(1000) = \rho(117)(30 + 273)$$

$$\rho = 16.426 \frac{kg}{m^3}$$

$$sp.vol. = \frac{1}{\rho} = \frac{1}{16.426}$$

$$sp.vol. = 0.061 \frac{m^3}{kg}$$

6

Density of water is maximum at

A. 0°C
B. 4°C ✓
C. 100°C
D. 20°C

Fluid is a substance that

A. cannot be subjected to shear forces
B. always expands until it fills any container
C. has the same shear stress at a point regardless of its motion
D. cannot remain at rest under action of any shear force ✓

Property of a fluid by which its own molecules are attracted is called

A. adhesion
B. cohesion ✓
C. viscosity
D. surface tension

Property of a fluid by which molecules of different kinds of fluids are attracted to each other is called

- ✓ A. adhesion
- B. cohesion
- C. viscosity
- D. surface tension

Specific weight of sea water is more that of pure water because it contains

- A. dissolved air
- B. dissolved salt
- C. suspended matter
- ✓ D. all of the above

The normal stress in a fluid will be constant in all directions at a point only if

- A. it is incompressible
- B. it has zero viscosity
- C. it is frictionless
- ✓ D. it is at rest

Free surface of a liquid tends to contract to the smallest possible area due to force of

- ✓ A. surface tension
- B. viscosity
- C. friction
- D. cohesion

A liquid would wet the solid, if adhesion forces as compared to cohesion forces are

A. less
✓ B. more
C. equal
D. less at low temperature and more at high temperature

Manometer is used to measure

✓ A. pressure in pipes, channels etc
B. atmospheric pressure
C. very low pressure
D. velocity in pipes

Barometer is used to measure

A. pressure in pipes, channels etc
✓ B. atmospheric pressure
C. very low pressure
D. difference of pressure between two points

If cohesion between molecules of a fluid is greater than adhesion between fluid and glass, then the free level of fluid in a dipped glass tube will be

A. higher than the surface of liquid
B. the same as the surface of liquid
✓ C. lower than the surface of liquid
D. unpredictable

When a fluid is subjected to resistance, it undergoes a volumetric change due to

A. Cohesion
B. Strain
✓ C. Compressibility
D. Adhesion

The rise or depression of liquid in a tube due to surface tension with an increase in size of tube will

A. increase
B. remain unaffected
C. may increase or decrease depending on the characteristics of liquid
✓ D. decrease

Liquids transmit pressure equally in all the directions. This is according to

A. Boyle's law
B. Archimedes principle
✓ C. Pascal's law
D. Newton's formula

Mercury is often used in barometer because

A. it is the best liquid
B. the height of barometer will be less
C. its vapor pressure is so low that it may be neglected
✓ D. both (b) and (c)