Physics 113 – November 26, 2013

- Exam 3, Dec. 5 ⟶ During lecture time in Hoyt
- Can use both sides 8.5 x 11 inch sheet
  if you really care... perhaps you need to rethink priorities
- Trying to arrange for room for Q+A Dec. 3 at 4:30

Big day if You are in orgo.

Happy Thanksgiving!

Fluids Are fun!

Statics

Specific gravity $\equiv \rho_{material} / \rho_{H_2O \text{ at } 4°c}$

Pressure $\equiv$ Force/Area N/m², Pascal, torr, Atm

in MKS

Pascal's law

French
1623–1662

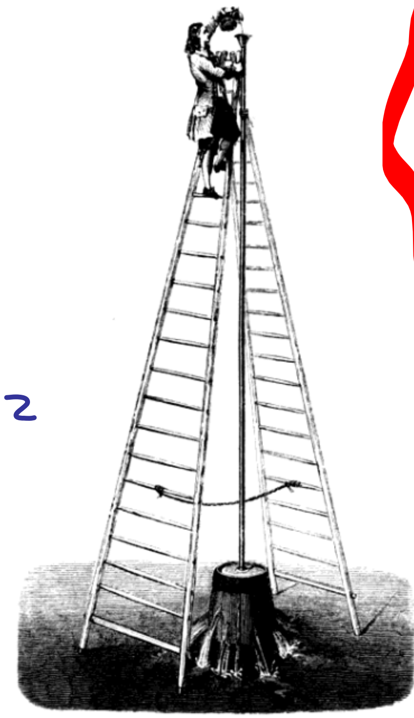
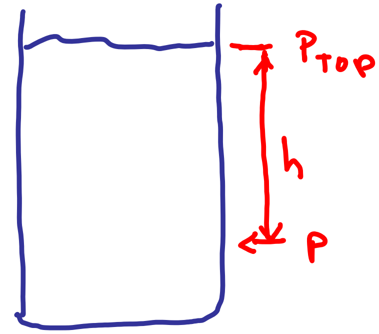


Fig. 45.—Hydrostatic paradox. Pascal's experiment.

$$P - P_{Top} = \Delta P = \rho g h$$

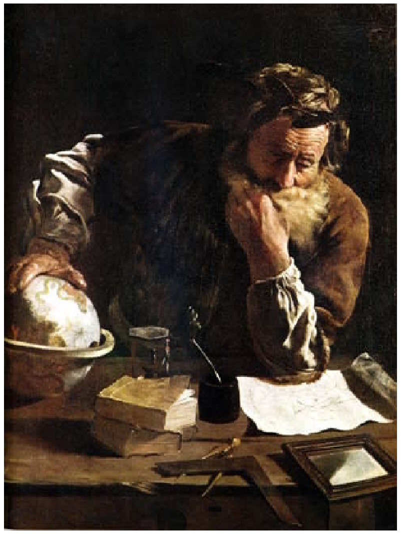
$$P = P_0 + \rho g h$$

↑ pressure of gas on top



Pressure applied to an enclosed fluid is transmitted undiminished to every point in the fluid and the container walls.

It's the height, not the weight!



Archimedes

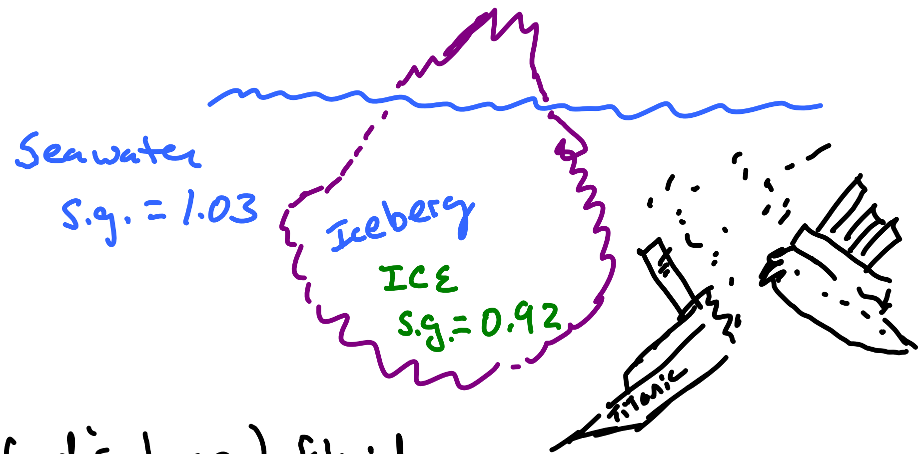
Syracuse, Sicily (Greek at the time)

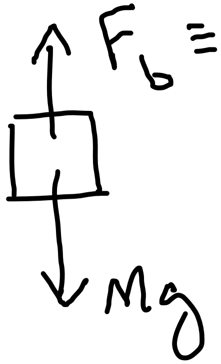
287 - 212 BC

Archimede's Principle

When a body is partially or completely submerged in a fluid, the fluid exerts an upward force (Bouyancy) on the body that is equal to the weight of the displaced fluid.

What fraction of the iceberg is submerged?





F_b = wt of displaced fluid

let V = Volume of iceberg

x = fraction iceberg that is Submerged

$Mg = F_b$ floating at equilibrium

$$(V)(\rho_{ice})\cancel{g} = (\rho_{seawater} Vx)\cancel{g}$$

÷ both sides by $\rho_{H_2O \text{ at } 4^\circ C}$

$$\cancel{V}(Sg)_{ice} = \cancel{V}(Sg)_{seawater}\, x$$

$$\frac{Sg_{ice}}{Sg_{seawater}} = x = \frac{0.92}{1.03} = 89\%$$

Fluid dynamics — hydrodynamics

ideal Fluid → No viscosity (No "friction")

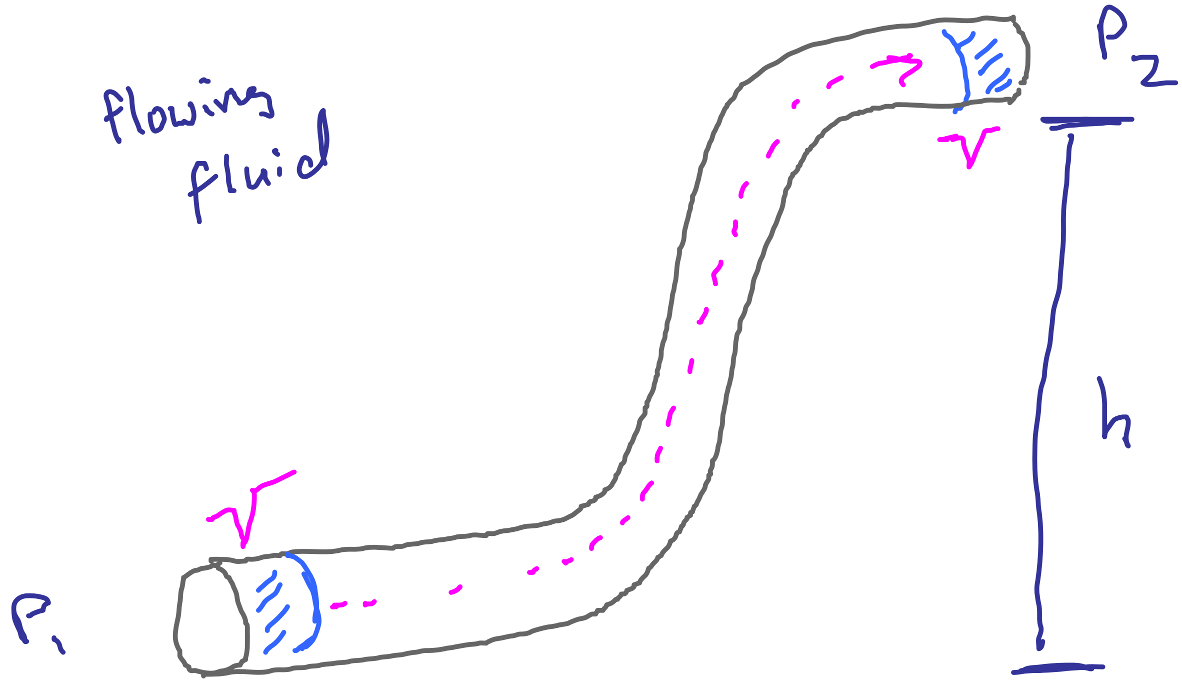
→ incompressible

Volume in = Volume out

$$A_1 V_1 \Delta t = A_2 V_2 \Delta t$$

$$\boxed{A_1 V_1 = A_2 V_2}$$

Equation of continuity



Energy Conservation for some fluid element

$\mathcal{V}$ = volume of this element

$$W + \frac{1}{2}mv^2 + mgh \sim \text{CONSTANT}$$

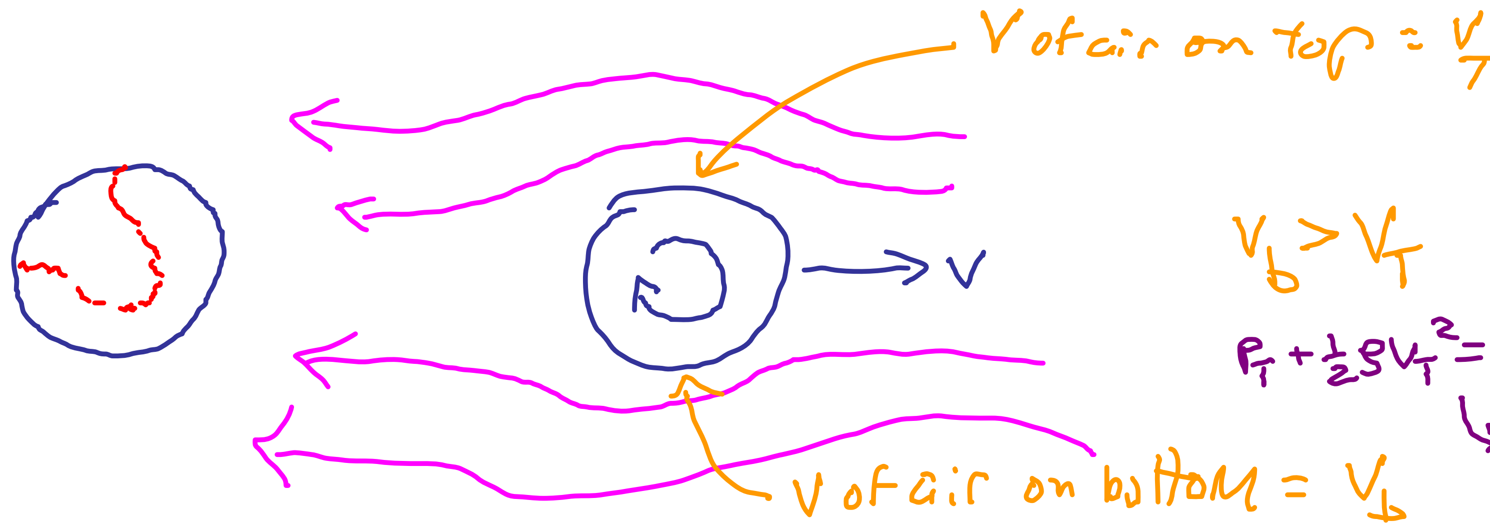
$$\frac{F \cdot d}{\mathcal{V}} + \frac{1}{2}\frac{mv^2}{\mathcal{V}} + \frac{mgh}{\mathcal{V}} \qquad \mathcal{V} = A \cdot d$$

$$\frac{F \cdot d}{V} + \frac{\frac{1}{2}mv^2}{V} + \frac{mgh}{V} \sim \text{CONSTANT}$$

$A \cdot d$

$$P + \frac{1}{2}\rho v^2 + \rho g h \sim \text{const}$$

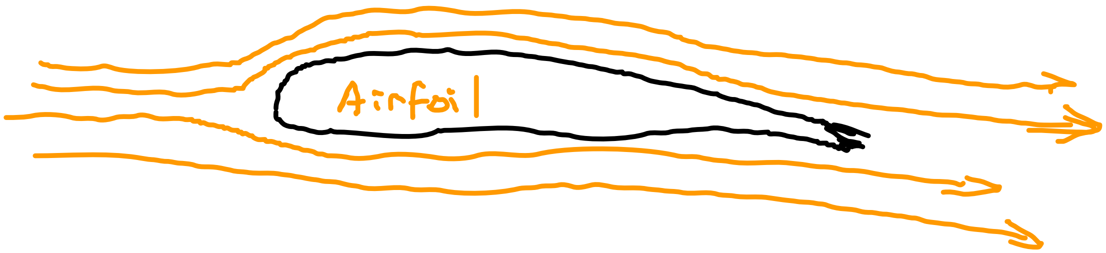
Bernoulli's equation

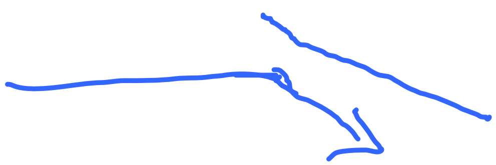


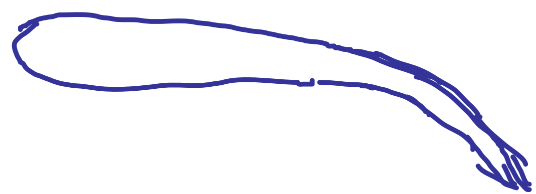
$V_b > V_T$

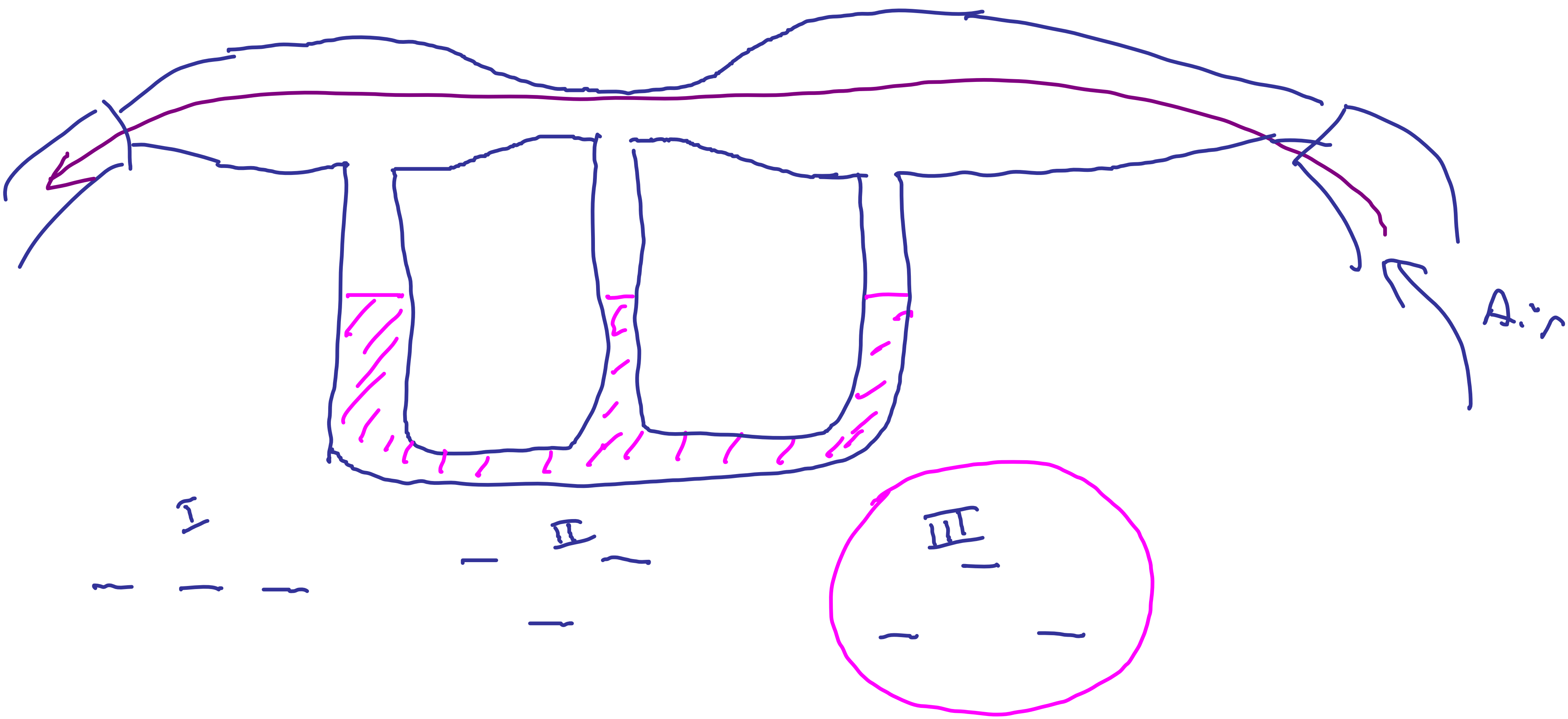
$$P_T + \frac{1}{2}\rho V_T^2 = P_b + \frac{1}{2}\rho V_b^2$$

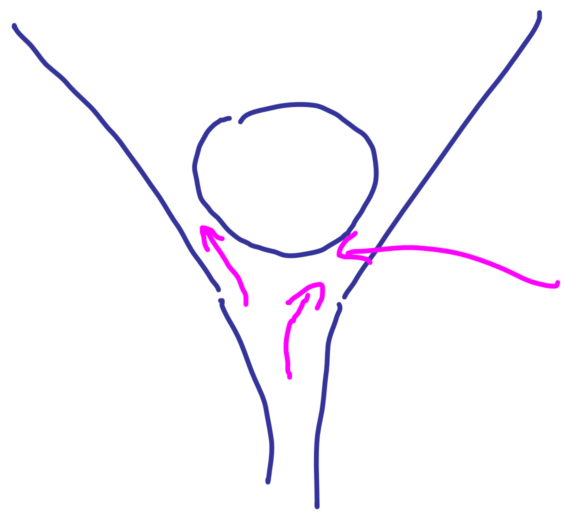
$P_T > P_b$


Airfoil






Air
I
II
III



v big

ρ small

ball stays in funnel