PHYSICS 103: Lecture 17

Agenda for Today:

- Fluids
  - Gases (Air)
  - Liquids
  - Archimedes Principle

Note: The next several lectures will not follow textbook

Air

Air is gas

- consists of atoms or molecules
- particles are in constant motion
- the measure of this kinetic energy is temperature

Air and Temperature

- the measure of this kinetic energy is temperature
- this thermal kinetic energy is proportional to temperature

Units: Kelvin

O K is absolute zero—no motion
Air and Pressure

Air has pressure
• particles whiz around bouncing off walls
• they exert forces on whatever they hit
• the size of this force depends on the area
• pressure is the force per unit area

Units: \( \text{N/m}^2 = \text{Pa} \)

Air around you \( P \approx 100,000 \text{ N/m}^2 \)

Air and Density

Air has density
• air particles have mass
• each volume of air has mass
• average mass per unit volume is called ‘density’
• Units: \( \text{kg/m}^3 \)

\[ \text{e.g., air has density of } 1.25 \text{ kg/m}^3 \]
\[ \text{- water has density of } 1000 \text{ kg/m}^3 \]

Pressure, Density, Temperature

Pressure \( \propto \) density \( \cdot \) temperature

• increase density \( \Rightarrow \) pack particles closer \( \Rightarrow \) rate at which particles hit a surface increases \( \Rightarrow \) pressure increases

• Increase temperature \( \Rightarrow \) particles move faster \( \Rightarrow \) rate at which they hit surface increases \( \Rightarrow \) pressure increases
Liquids

- Pressure increases with depth
- An object submerged in a fluid feels greater pressure (force) at bottom than top
- The difference in the two forces is the buoyant force

Archimedes Principle

*An object immersed in a fluid experiences an upward buoyant force equal to the weight of fluid it displaces*
Test Your Understanding: Archimedes Principle

How did Archimedes determine if the King’s crown was made of pure gold? For this experiment, assume that Archimedes weighed the King’s crown and found its weight to be 7.84 N. He then weighed it while it was completely immersed in water of density \( 1000 \text{ kg/m}^3 \) and found its weight to be 6.86 N.

Main Points from Today’s Lecture

- Fluids
  - Air (Pressure, density, temperature)
  - Liquids
- Archimedes Principle