Physics of Engineer
Chapter 10: Property of Matter

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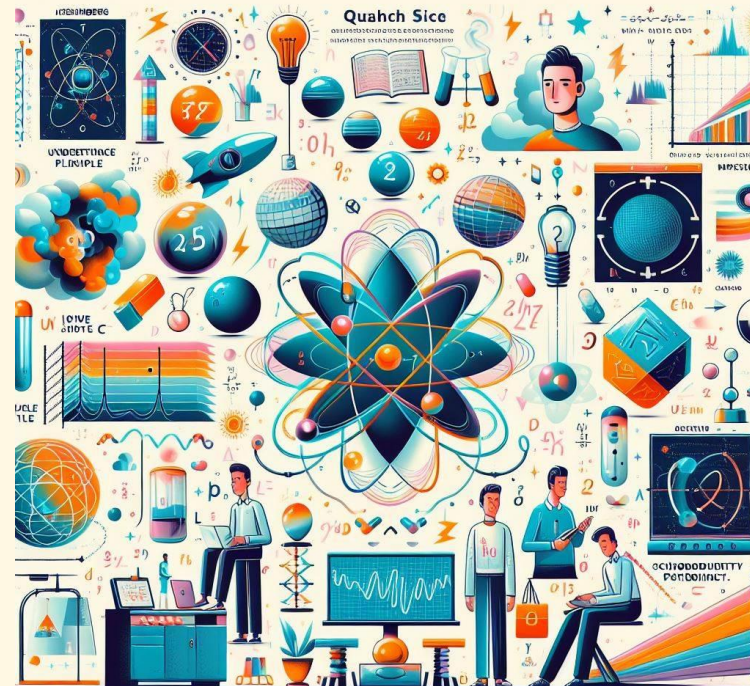
Faculty of Science and Technology

Outline

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Outline

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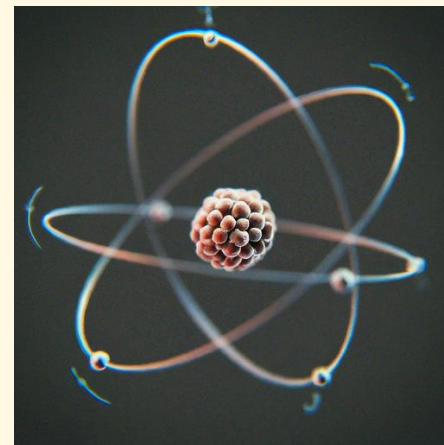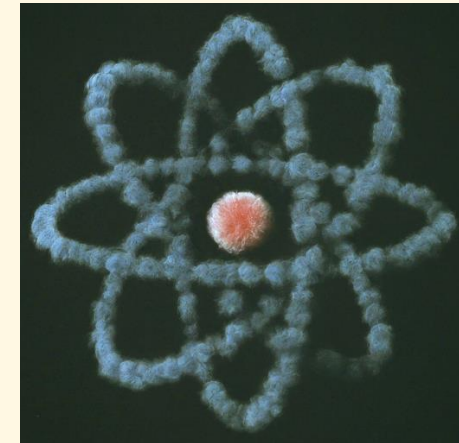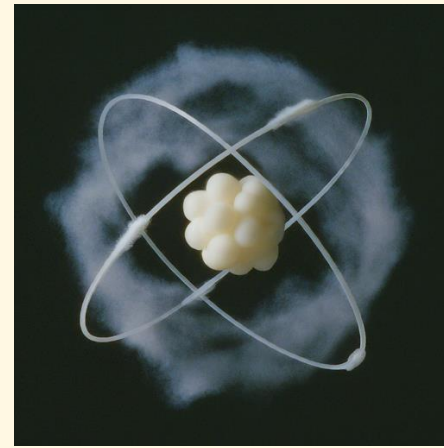
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# Properties of Matter: An Exploration

What is Matter?

- Matter: Anything that has mass and occupies space.

- Made up of tiny particles called atoms.

Physical vs. Chemical Properties

• Physical Properties: Characteristics identified without changing the composition (color, density, hardness, etc.)

• Chemical Properties: Behavior of a substance during a reaction (flammability, reactivity, etc.)
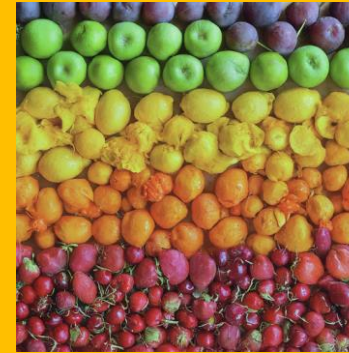
Mass

- Definition: The amount of matter in an object.

- Unit: Measured in grams (g), kilograms (kg), etc.

- Symbol: 'm'

- Example: The mass of a book tells you how much matter it contains, regardless of its size or shape.

Volume

- Definition: The amount of space occupied by an object.

- Unit: Measured in cubic meters (m^3), liters (L), etc.

- Symbol: 'V'

- Example: The volume of a swimming pool tells you how much water it can hold.

Density

- Definition: Mass per unit volume.

- Formula: D = m/V (density equals mass divided by volume)

- Unit: Derived unit (kg/m³, g/cm³)

- Example: A denser object sinks in a less dense liquid (e.g., steel ball in water).

Examples of Density

- Osmium (very dense) – Used in tips of pen nibs due to its high wear resistance.

- Water (relatively dense) – Essential for life as most organisms depend on its properties.

- Air (very light density) – Allows airplanes to achieve lift due to the pressure difference between its wings.

States of Matter

- Solid: Fixed shape and volume, particles tightly packed with minimal motion (e.g., ice).

- Liquid: Definite volume, takes the shape of its container, particles have more motion than solids (e.g., water).

- Gas: No definite shape or volume, particles move freely with large spaces between them (e.g., air).
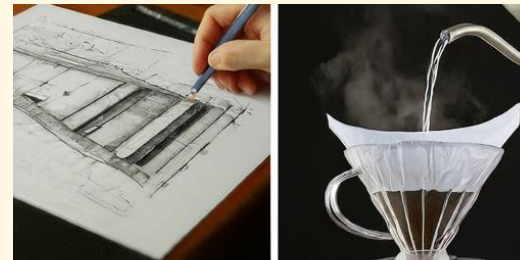
Additional Physical Properties

- Melting Point: Temperature at which a solid transforms into a liquid (e.g., water: 0°C).

- Boiling Point: Temperature at which a liquid transforms into a gas (e.g., water: 100°C).

- Freezing Point: Same as melting point, but used for the solid-to-liquid transition.
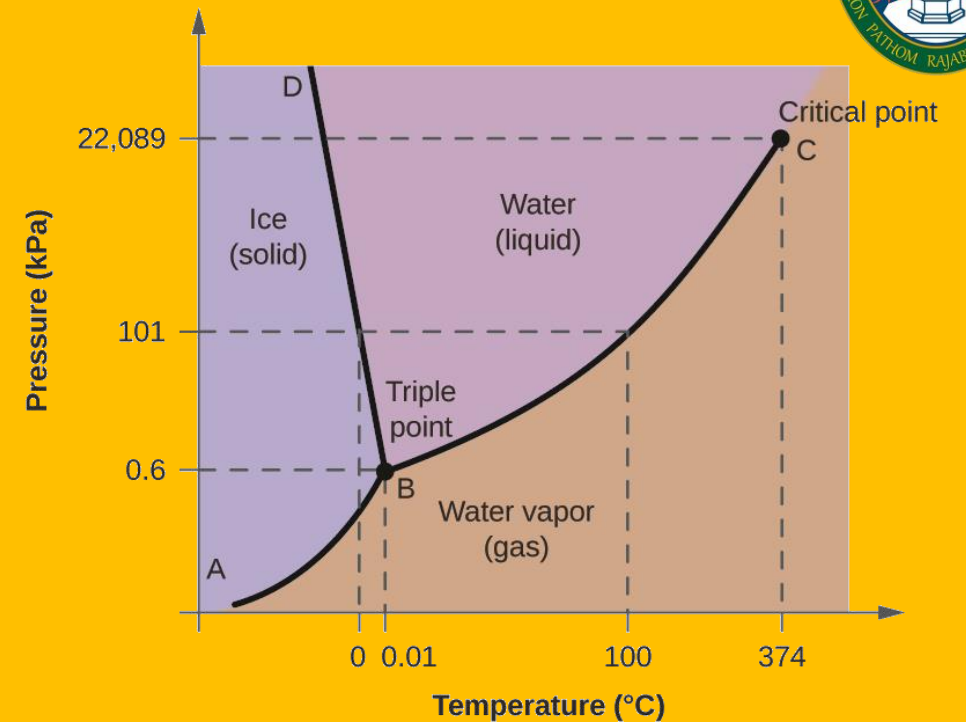
Applications of Physical Properties

- Material selection (e.g., building materials based on strength and density)

- Separation techniques (e.g., filtration based on particle size)

- Daily life (e.g., cooking – boiling water for pasta)

Conclusion

- Physical properties are essential for understanding and working with matter.

- They help us identify, differentiate, and utilize materials in various applications.
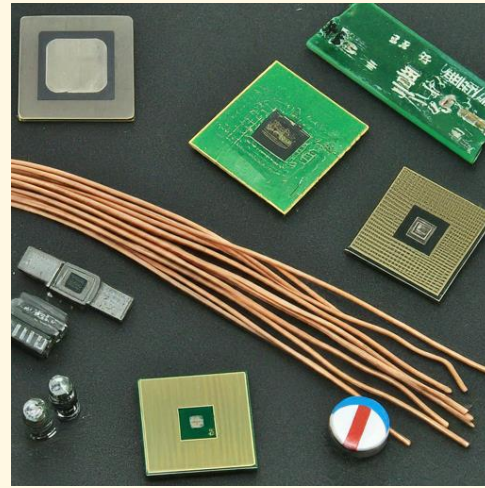
Resources and References

Textbooks:

- "Chemistry" by Zumdahl and Zumdahl (Latest Edition) [This is a widely used general chemistry textbook]

- "Physical Science" by Hewitt (Latest Edition) [A good resource for introductory physics concepts]

Websites:

- https://www.khanacademy.org/science/chemistry/states-of-matter-and-intermolecular-forces (Khan Academy: Matter and Its Properties) [Provides interactive exercises and explanations]

- https://www.vedantu.com/jee-main/chemistry-states-of-matter (Vedantu: States of Matter) [Offers clear explanations and visualizations]

- https://byjus.com/chemistry/difference-between-physical-and-chemical-properties/ (BYJU'S: Difference Between Physical and Chemical Properties) [Compares and contrasts physical and chemical properties]

Interactive Simulations:

- https://phet.colorado.edu/en/simulation/density (PhET Interactive Simulations: Density) [An interactive simulation for exploring density concepts]

- https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html (PhET Interactive Simulations: States of Matter) [A simulation for visualizing particle behavior in different states]

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