

Summary of the Lesson: Physical Quantities and Measurements

This chapter focuses on measuring physical quantities like **volume**, **area**, **density**, and **speed**, including their formulas and measurement techniques.

1. Measurement of Volume

Definition: Volume is the amount of space an object occupies.

- **SI Unit:** Cubic metre (m^3)
- **Other Units:** Cubic centimetre (cm^3), litre (L), millilitre (mL)

Formulas for Volume of Regular Solids

1. **Cube:** $V = l^3$

- Example: A cube of side 4 cm has volume
 $V = 4^3 = 64 \text{ cm}^3$

2. **Cuboid:** $V = l \times b \times h$

- Example: A cuboid of dimensions 5 cm \times 3 cm \times 2 cm has volume
 $V = 5 \times 3 \times 2 = 30 \text{ cm}^3$

3. **Cylinder:** $V = \pi r^2 h$

- Example: A cylinder with radius 7 cm and height 10 cm has volume
 $V = \pi \times 7^2 \times 10 = 1540 \text{ cm}^3$

4. **Sphere:** $V = \frac{4}{3}\pi r^3$

- Example: A sphere of radius 6 cm has volume
 $V = \frac{4}{3}\pi \times 6^3 = 904.32 \text{ cm}^3$

5. **Cone:** $V = \frac{1}{3}\pi r^2 h$

- Example: A cone with radius 5 cm and height 12 cm has volume
 $V = \frac{1}{3}\pi \times 5^2 \times 12 = 314.16 \text{ cm}^3$

Volume of Irregular Solids (Displacement Method)

- A solid is submerged in water, and the displaced water's volume equals the solid's volume.

- **Formula:**

$$V_{\text{solid}} = V_{\text{final}} - V_{\text{initial}}$$

- Example: If the initial water level is **50 mL** and the final level after submersion is **80 mL**, the object's volume is
 $V = 80 - 50 = 30 \text{ cm}^3$

2. Measurement of Area

Definition: Area is the space occupied by a 2D object.

- **SI Unit:** Square metre (m^2)
- **Other Units:** Square centimetre (cm^2), hectare (ha), square kilometre (km^2)

Formulas for Area of Regular Shapes

1. Square: $A = s^2$

- Example: A square of side 5 cm has area
 $A = 5^2 = 25 \text{ cm}^2$

2. Rectangle: $A = l \times b$

- Example: A rectangle of length 8 cm and width 3 cm has area
 $A = 8 \times 3 = 24 \text{ cm}^2$

3. Triangle: $A = \frac{1}{2} \times b \times h$

- Example: A triangle with base 6 cm and height 4 cm has area
 $A = \frac{1}{2} \times 6 \times 4 = 12 \text{ cm}^2$

4. Circle: $A = \pi r^2$

- Example: A circle of radius 7 cm has area
 $A = \pi \times 7^2 = 153.94 \text{ cm}^2$

5. Parallelogram: $A = b \times h$

- Example: A parallelogram with base 10 cm and height 5 cm has area
 $A = 10 \times 5 = 50 \text{ cm}^2$

Measuring Area of Irregular Shapes

- Place the object on **graph paper** and count squares:
 - **Full squares:** Count as 1 unit each.
 - **More than half squares:** Count as 1 unit.
 - **Less than half squares:** Ignore.

3. Measurement of Density

Definition: Density is the amount of mass per unit volume.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} \quad (D = \frac{M}{V})$$

- **SI Unit:** kg/m^3
- **Other Unit:** g/cm^3 ($1g/cm^3 = 1000kg/m^3$)

Examples

1. A **metal block** has mass 50 g and volume 25 cm³. Its density is:

$$D = \frac{50}{25} = 2 \text{ g/cm}^3$$

2. A **liquid sample** of volume 2 L has mass 1.6 kg. Its density is:

$$D = \frac{1.6}{2} = 0.8 \text{ kg/L}$$

Determining Density of Irregular Solids

1. Measure mass using a weighing scale.
2. Find volume using the **displacement method**.
3. Calculate density using $D = \frac{M}{V}$.

4. Measurement of Speed

Definition: Speed is the distance traveled per unit time.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} \quad (s = \frac{d}{t})$$

- **SI Unit:** Metres per second (m/s)
- **Other Units:** km/h, cm/s

Examples

1. A cyclist covers **140 km in 7 hours**. Speed:

$$s = \frac{140}{7} = 20 \text{ km/h}$$

2. A car moves at **60 km/h**. How much distance does it cover in **3 hours**?

$$d = s \times t = 60 \times 3 = 180 \text{ km}$$

Types of Motion

- **Uniform Motion:** Object covers **equal distances in equal intervals** of time.
- **Non-Uniform Motion:** Object covers **unequal distances in equal intervals** of time.

Key Conversions

Measurement	Conversion
1 m ³	10 ⁶ cm ³
1 L	1000 mL = 1000 cm ³
1 m ²	10 ⁴ cm ²
1 km ²	10 ⁶ m ²
1 hectare	10 ⁴ m ²
1 g/cm ³	1000 kg/m ³

Conclusion

- **Volume** is measured for **3D objects** using standard formulas or **displacement method**.
- **Area** is measured for **2D shapes** using formulas or **graph paper method** for irregular shapes.
- **Density** tells how much matter is packed in a given volume.
- **Speed** is the rate of motion of an object.
- SI units are crucial for accuracy in measurements.