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MASS, WEIGHT & DENSITY

Mass

→ the amount of substance packed in an object

→ mass of an object can never be zero

→ directionless (scalar)

→ measured in kg

→ constant

→ measured using an electronic or beam balance

→ $m = pV$ $m = \frac{f}{a}$ $m = \frac{W}{g}$

Weight

→ the gravitational pull of earth on an object

→ weight of an object can be zero (in outer space)

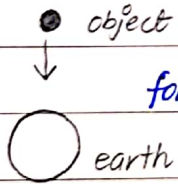
→ ↓ direction (vector)

→ measured in N (Newtons)

→ measured using the Newton meter

→ depends on gravitational pull

→ $W = mg$



Force = weight

$ma = mg$

$a = g$

* g = gravitational field strength

m/s^2, N/kg

* a = acceleration due to gravity

$10\ m/s^2$

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Density

→ the mass packed per unit volume

→ the ratio of mass packed and volume occupied

Density = $\frac{\text{mass}}{\text{volume}}$ $\rho = \frac{m}{V}$ → kg/g

V → m^3/cm^3

→ it is a scalar quantity

→ it is compactness of matter and not related to heaviness or weight

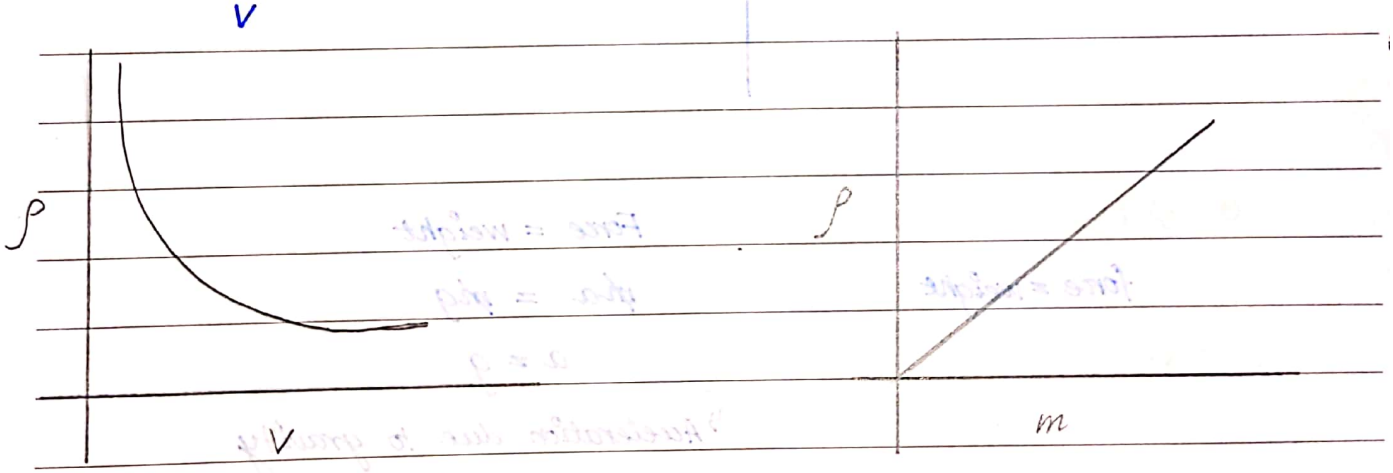
$\rho = \frac{m}{V}$ $\rho = \frac{m}{V}$

* if mass is same, then

$\rho \propto \frac{1}{V}$

* if volume is same, then

$\rho \propto m$



↑ volume = ↓ density

↓ volume = ↑ density

Newtons = kgm/s^2

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⟹ when an object is heated

↓

its molecules gain energy (K.E)

↓

these molecules start to move faster

↓

they make more forceful & frequent collisions

↓

they push each other apart

↓

the intermolecular spaces increase.

↓

volume increases but mass stays same

↓

hence, density decreases on heating

★. This is thermal expansion.

★ molecules never break, the space b/w them increases

→ less dense things always float and more dense things sink

→ density of pure material at given temperature is always same

$\rho = \frac{m}{V}$ → electronic mass balance (easier to read)

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To determine density of a liquid:

→ beam balance, burette, beaker and stand

→ find the mass of an empty beaker with a beam balance

→ shift a known volume of the liquid from burette to the beaker

→ find the mass of beaker and the liquid with the beam balance

mass of liquid = $m_1 - m_2$

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

To determine density of a regular object:

→ beam balance, ruler, regular shaped object

→ determine the mass of the object with a beam balance

→ measure the length, breadth & height using the meter rule

To determine density of an irregular object:

→ find the mass of irregular object using a beam balance

→ fill measuring cylinder with water upto volume (V_1)

→ completely immerse the object into water. Find the new volume.

* → avoid parallelt error

* → place the measuring cylinder on a flat surface

* → read the volume from bottom meniscus

* → measure mass before volume

* → if object floats in water, tie a sinker to the object and subtract it's volume

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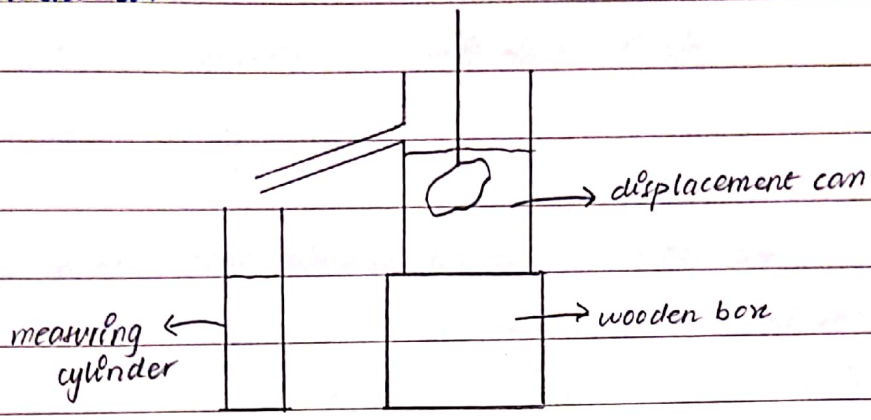
→ if the object is too big to be lowered into the measuring cylinder, use a displacement can



parallax error : an error reading an instrument due to the eye of the observer and pointer are not in a line perpendicular to the plane of the scale

meniscus : curved surface at the top of a column of a liquid

gravitational field : a region in which a mass experiences a force due to gravitational attraction

gravitational field strength : gravitational force acting per unit mass, 10 ~~kg~~ N/kg
(means force of gravity acting on an object of mass 1kg is about 10 N, on the earth's surface)

inertia : the ability of a body to resist when its state of rest or uniform motion tends to be changed
depends on the mass of a body, massive bodies have more resistance when their state of rest or motion is changed i.e they have higher inertial values than lighter values