

TOPIC

4

Mass, Weight and Density

Objectives

Candidates should be able to:

- (a) state that mass is a measure of the amount of substance in a body
- (b) state that mass of a body resists a change in the state of rest or motion of the body (inertia)
- (c) state that a gravitational field is a region in which a mass experiences a force due to gravitational attraction
- (d) define gravitational field strength, g , as gravitational force per unit mass
- (e) recall and apply the relationship $\text{weight} = \text{mass} \times \text{gravitational field strength}$ to new situations or to solve related problems
- (f) distinguish between mass and weight
- (g) recall and apply the relationship $\text{density} = \text{mass} / \text{volume}$ to new situations or to solve related problems

NOTES.....

4.1 Mass

- 1. Defined as a measure of the amount of substance in a body.
(SI unit: kilogram, symbol: kg)
- 2. The magnitude of mass depends on the size of the body and the number of atoms in the body.
- 3. Mass is a scalar quantity.

4.2 Inertia

- 1. Defined as the resistance of the body to change in its state of rest or motion due to its mass.
- 2. To overcome inertia of a body, a force has to be applied.
This force is dependent on the body's mass.

4.3 Gravitational Field Strength

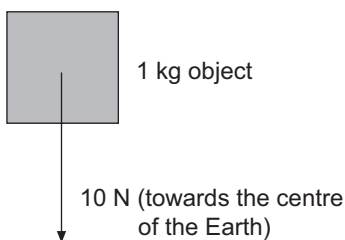
Defined as the gravitational force acting on a body per unit mass.

	Gravitational Field Strength
Earth	10 N kg^{-1}
Moon	1.6 N kg^{-1}

Note:

These are approximate values for points close to and on the planets' surface.

i.e. on Earth, a force of 10 N is pulling on a 1 kg falling object.



Note:

Since the resultant force on object is 10 N (weight), the acceleration of the object is (by Newton's 2nd Law) 10 m s^{-2} .

4.4 Weight

1. Defined as the gravitational force W acting on an object of mass m .
2. When a body falls, its gravitational force (weight) can produce an acceleration, g (the acceleration due to gravity).
3. Using Newton's 2nd Law of $F = ma$, we have $W = mg$.
4. Comparison of weight and mass:

		Mass	Weight
1.	definition	the amount of substance in a body	the gravitational pull acting on a body
2.	depends on location	no	yes
3.	measured by using	beam balance	spring balance
4.	unit	kilogram	Newton

4.5 Density

1. The density of a body, ρ , is defined as its mass, m , per unit volume, V .

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$
$$\rho = \frac{m}{V}$$

2. SI Unit: kg m^{-3}
3. For an object to float in a liquid, the object has to be less dense than the liquid. As such, if an object is denser than the liquid, the object will sink in the liquid.

