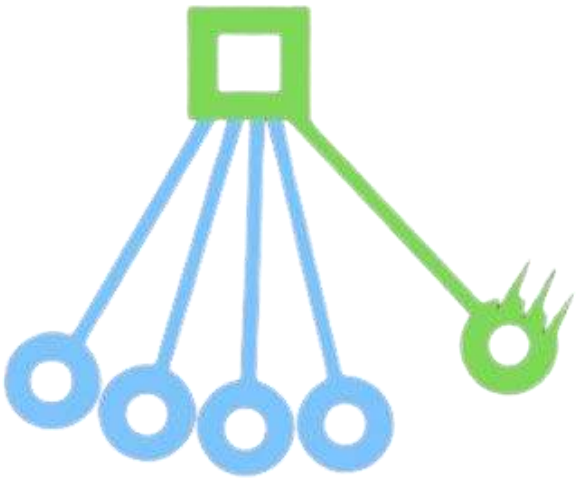
NABONEX

Curiosity Meets Clarity



PHYSICS

Class IX

Part I & II

English Medium

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MSc , MPhil Physics

PPTMYHSS CHERUR

1- REFRACTION OF LIGHT

Transparent medium

mediums which allow the passage of light are called transparent mediums.

Eg: - air, water, glass, diamond

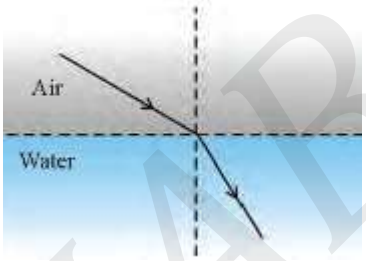
- The speed of light differs in various mediums.
- The path of light ray should be straight when it passes through one medium.
- If the ray of light enters from one medium to another, there will be a deviation in its direction.
- The change in direction is caused by the change in the speed.

Optical density

The ability of a medium to influence the speed of light through the medium.

- The speed of light will be lower in a medium of higher optical density (optically denser medium).
- The speed of light will be higher in a medium of lower optical density (rarer medium).

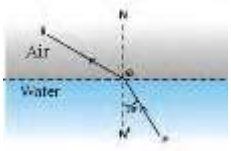
Refraction



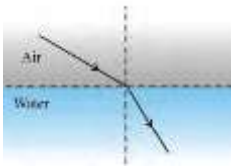
When a ray of light enters obliquely from one medium to another of different optical densities, it undergoes a deviation at the surface of separation of the mediums. This phenomenon is refraction.

- The angle of incidence and angle of refraction are always different.
- The ability of light to undergo refraction in a medium depends on the optical density of the medium.
- The incident ray, refracted ray and the normal are all lying on the same plane.

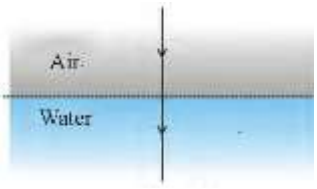
when light enters from a denser medium to a rarer medium, the refracted ray bends away from the normal.



- when light enters from a rarer medium to a denser medium, the refracted ray bend towards the normal.



- There is no deflection of light when light enters normally from one medium to another.



Refractive index

It is the ratio of the speed of light in vacuum to the speed of light in the medium.

$$\text{Refractive index} = \frac{\text{the speed of light in vacuum}}{\text{the speed of light in medium}}$$

$$\mathbf{n = \frac{c}{v}}$$

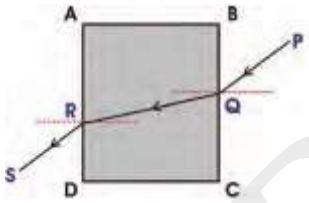
The speed of light in vacuum = 3×10^8 m/s

- The optical density and refractive index are directly proportional.
- The speed of light and refractive index are inversely proportional.

As the refractive index of a medium increases, the speed of light decreases.

- The refractive index of glass is 1.5. That means the speed of light through the glass is 1.5 times lesser as that of air or vacuum.

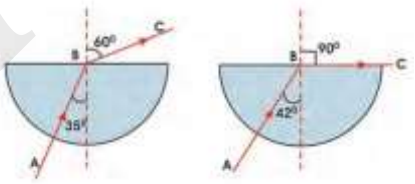
Refraction on a glass Slab



Practical examples

- The bottom of a pond appears elevated when viewed from distance.
- Sun is visible for some time even after sun set (delayed sunset).
- Sun is visible earlier before actual sun rise (early sunrise).
- Twinkling of stars due to atmospheric refraction.

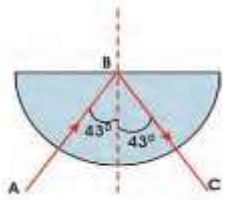
Critical angle



When a ray of light enters from an optically denser medium to a rarer medium, the angle of incidence at which the angle of refraction becomes 90° is the critical angle.

- The critical angle of,
  glass = 42°
  water = 48.6°

Total internal reflection

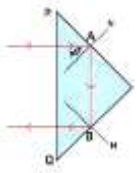


When a ray of light enters from an optically denser medium to a rarer medium, at angle of incidence greater than the critical angle, the ray is reflected back completely to the same medium without undergoing refraction. This phenomenon is total internal reflection.

E g: - mirage [water seems to be logged in roads.

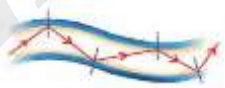
Applications

1. Reflector



2.Periscope

3. Optical fibre



Reflection from a plane mirror	Total internal reflection
• The light is not completely reflected. • Reflection occurs at any angle of incidence.	• The light is completely reflected. • Occurs at angle of incidence greater than critical angle.

ADDITIONAL QUESTIONS

1.As the refractive index of media increases, the speed of light _____.

[increases, decreases, remains constant]

Ans) Decreases

2.Arrange the following media in the increasing order of speed of light.

[water, air, diamond, glass]

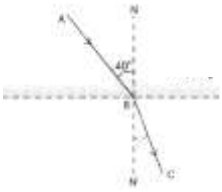
Ans) Diamond < Glass < Water < Air

3.The refractive index of glass is 1.5. If the speed of light through vacuum is 3×10^8 m/s, find the speed of light through the glass?

Ans) $n = \frac{c}{v}$

$v_{glass} = \frac{c}{n} = \frac{3\times108}{1.5} = 2\times10^8$ m/s

4.Observe the given figure and find the angle of refraction.



Ans) 20°

5.Write the reason behind following phenomena;

a) The bottom of a pond appears elevated.

b) Water seems to be logged on roads on summer times.

c) Twinkling of stars.

d) Brilliance of diamonds.

Ans)

a) Refraction b)Total internal reflection
c) Atmospheric refraction d)Total internal reflection

6.The refractive index of kerosene is 1.33 and that of water is 1.44.

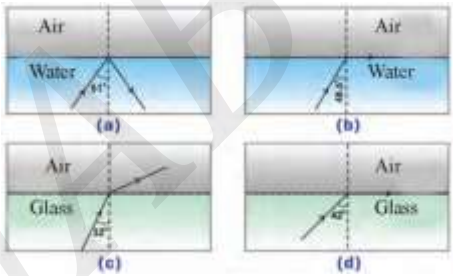
a) Which one has higher optical density?

b) Which one has less speed of light?

Ans)

a) Water b) Water

7.Which one of the following figures show total internal reflection?



Ans) Figure a

2 – EQUATION OF MOTION

Motion

It is the change in position of an object with respect to time.

The study about motion is known as mechanics.

Distance	Displacement
• Total path length travelled by an object. • Depends on the path followed. • The magnitude never becomes zero. • It is a scalar quantity. • Its unit is metre(m).	• The shortest distance between initial position and final position. • Independent of the path. • The value may be zero, positive or negative. • It is a vector quantity. • Its unit is metre.

NOTE:

- Magnitude of displacement and distance are equal only when an object is moving along a straight line in the same direction.
- If a body started from a point and returned to the same point, then the displacement is zero.

Scalar quantity	Vector quantity
• Quantities only have magnitude. • E g: - time, distance, speed, mass	• Quantities have both direction and magnitude. • E g: - displacement, velocity, force

Speed	Velocity(v)
• it is the distance travelled in unit time. **Speed** = $\frac{\textbf{distance}}{\textbf{time}}$ • value is always positive. • Scalar quantity. • Unit is m/s.	• Displacement travelled in unit time. $\mathbf{V = \frac{s}{t}}$ • Value may be positive, negative or zero. • Vector quantity. • Unit is m/s.

NOTE: -

$$1 \text{ km/hr} = \frac{1000\ m}{3600\ s} = \frac{5}{18} \text{ m/s}$$

$$18 \text{ km/hr} = 18 \times \frac{5}{18} = 5 \text{ m/s}$$

Uniform velocity

If the magnitude and direction are equal at equal intervals of time, then the body is in uniform velocity.

Eg: -

1. Light travels through vacuum.
2. A train travelling at a uniform speed in the same direction.

Non uniform velocity

If the magnitude or direction of a body is varying in equal intervals of time, then it is non uniform.

Eg: -

1. Motion of a stone dropped from a height.
2. Motion of a swing.

Acceleration

It is the change in velocity of an object in unit time.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$\mathbf{a = \frac{v-u}{t}}$$

- Its unit is m/s^2.
- It is a vector quantity.

Eg: -

1. Motion of a coconut falling from a coconut tree.
2. Motion of a vehicle starting from rest.

Retardation

- It is the negative acceleration.
- It is the rate of decrease in velocity.

Eg: -

1. Train arriving at a station.
2. The upward motion of a stone thrown upwards.

Uniform acceleration	Non uniform acceleration
• The rate of change of velocity is equal at equal interval of time. • Eg: - The motion of a body which is in free fall	• The rate of change of velocity varies differently at equal intervals of time. • E g: - A vehicle comes to rest when breaks are applied.

Traffic rules for pedestrians

- Pedestrians should walk along the right side of the road.
- Cross the road only at the zebra crossing.
- Avoid wearing black colour dresses during night.

Sign board on roads

i. Mandatory Signs

These signs are warning signs that must compulsorily be followed.

Fig 2.10 (b)

ii. Cautionary Signs

These signs are meant to warn about the road conditions in the journey ahead.

Fig 2.10 (c)

iii. Informatory Signs

These signs provide information about the direction in which the driver has to go, the distance to various places and the availability of other facilities.

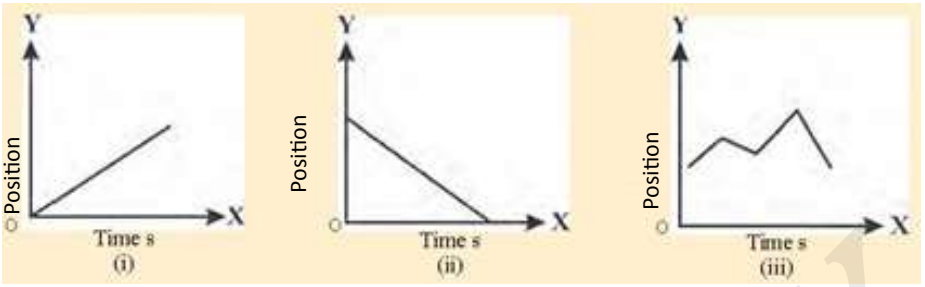
Graphical representation of motion

A graph can be used to understand and illustrate the relation between quantities and to formulate equations based on them.

Position-time graph

The graph in which, position is marked in y-axis and time is marked in x-axis.

Uniform motion Uniform motion (-v) non-uniform motion

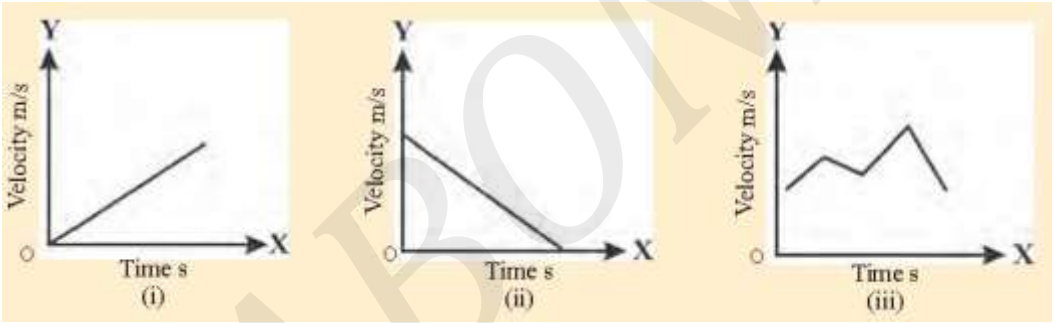


- The slope of position-time graph gives the velocity.

Velocity-time graph

Graph shows time in x-axis and velocity in y-axis.

Uniform Acceleration Uniform retardation non-uniform velocity



Displacement from v-t graph

The shape under the velocity time graph at a particular time interval will give the displacement at that time.

- The slope of v-t graph gives acceleration.

Equations of motion

For an object moving with uniform acceleration,

$$v = u + at$$

$$s = u\,t + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

t – time

s – displacement

u – initial velocity

v – final velocity

a – acceleration

ADDITIONAL QUESTIONS

1.Find out the odd one

[velocity, displacement, speed, acceleration]

Ans) Speed – others are vectors.

2.The magnitude of distance and displacement are equal when the body travels in……

Ans) straight line.

3.The area of the shape under a velocity – time graph will give the _____.

Ans) Displacement.

4.An object falls down from rest and moves with an acceleration 5 m/s^2, hits the ground with a velocity 10 m/s. From what height does the object fall.

Ans) u = 0, a = 5 m/s^2, v = 10 m/s

$v^2 = u^2 + 2as$

$20^2 = 0^2 + 2\times10\times s$

$s = \frac{400}{20} = 20$ m

5.A bus starts from rest and attains a speed of 36 km/hr in 5 s. Find the acceleration and displacement of the train.

Ans) u = 0, v = 36 km/hr = $36\times \frac{5}{18} = 10$ m/s

$a = \frac{v-u}{t} = \frac{10-0}{5} = 2\ m/s^2$

$s = u\,t + \frac{1}{2}\,at^2$

$s = 0 + \frac{1}{2}\times2\times5^2 = 25$ m

6.A velocity – time graph is given. Find the answers of the following situations.

a) Acceleration for the time (0-2) s. b) Displacement for the time (2-5) s.

c) Acceleration for the time (5-6) s.

Ans)

a) $a = \frac{v-u}{t} = \frac{2-0}{2} = 1\ m/s^2$

b) Displacement = Area = 3×2 = 6 m

c) $a = \frac{0-2}{1} = -2\ m/s^2$

3 - LAWS OF MOTION

Force

Force is that which can change or tend to change the state of rest or uniform motion of a body along a straight line.

Balanced forces

If the resultant force acting on a body is zero, then the forces are called balanced forces.

Such forces can neither move an object at rest nor change the direction or speed of an object in motion.

Unbalanced forces

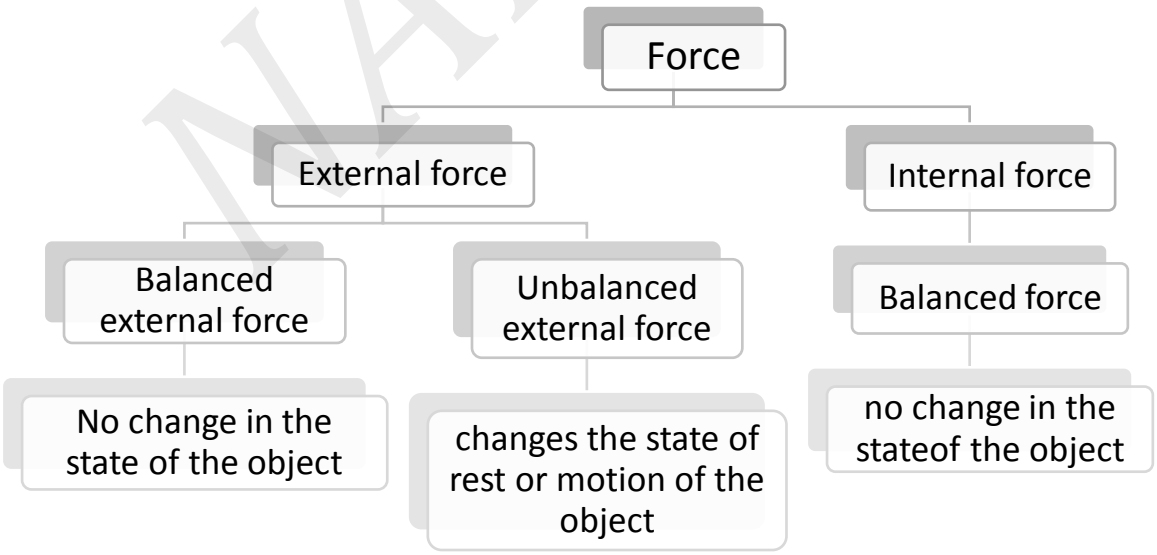
If the resultant force acting on a body is not zero, then the forces are unbalanced. Such forces can either move an object at rest or change the direction or speed of an object in motion.

External forces

The force acting outside a body.

Internal forces

The force acting inside a body.



Galileo's inference

An unbalanced external force is not required to maintain uniform motion along straight line.

Newton's first law of motion

Every body will continue in its state of rest or uniform motion in a straight line unless and until an unbalanced external force act on it.

- The first law of motion helps us to define the physical quantities inertia and force.
- Newton's first law of motion is also called law of inertia.

Inertia

It is the tendency of a body to continue in its state of rest or uniform motion.

There are two types of inertia.

Inertia of rest	Inertia of motion
• When a bus moves forward suddenly, the passengers tend to fall backward. • On shaking the branch of a mango tree, the mangoes get detached.	• A ball set rolling on a horizontal floor keeps moving forward. • A participant in long jump competition, runs some distance and then jumps.

Mass and inertia

Inertia and mass of the object are directly proportional. As the mass increases, inertia of the object also increases.

Eg: -

1. People have to run in zig-zag manner to escape from an elephant attack.
2. Heavy loaded vehicles slip off in curved roads.

Momentum

It is the ability of a moving body to make an impact on another body.

The momentum of a body increases with increase in its mass or velocity.

- The momentum of a body in motion is the product of its mass(m) and velocity(v).

Momentum = mass × velocity

$$\mathbf{P = m \times v}$$

Its unit is kg m/s^2.

It is a vector quantity.

Rate of change of momentum

Rate of change of momentum = $\frac{mv-mu}{t}$

Newton's second law of motion

The rate of change of momentum of a body is directly proportional to the unbalanced force acting on the body. The change of momentum takes place in the direction of the resultant force.

Equation of motion

$\frac{m(v-u)}{t} \alpha F$

$F \alpha K ma$ [K=1]

F = ma

- Its unit is kg m/s^2 ⇨ Newton (N)
- It is a vector quantity.
- If the force is negative, that means the force applied is in the opposite direction.

Impulsive force

It is a very large force acting on a body for a short interval of time.

- It is the product of force and time.

Impulse = force × time

I = F × t

- Its unit is Ns or kg m/s.
- It is a vector quantity.

Impulse – momentum principle

$I = F \times t$, $F = \frac{m(v-u)}{t}$

$I = \frac{m(v-u)}{t} \times t$

$I = m(v-u)$

Impulsive force is equal to the change in momentum.

Eg: - Hammering a nail on a concrete wall hitting a ball with a bat.

NOTE: -

As the time increases, impulsive force decreases. This feature utilizes in many practical situations.

Eg: -

i. While taking a catch, cricketer draws his hands backwards.
ii. A foam bed is placed in a pole vault pit.

Newton's third law of motion

For every action there is an equal and opposite reaction.

- When force acts on two different bodies, the force on second body by first body is considered as action(F_{12}). Then the opposite force on first body by second body is the reaction (F_{21}).

$$\mathbf{F_{12} = - F_{21}}$$

NOTE: -

- Action and reaction act on two different bodies simultaneously, so they do not cancel each other.
- When an internal force is applied, action and reaction are experienced on the same object.
- It is very difficult to walk along an icy surface, because due to the lack of inertia, there is no action and so there is no reaction.

Examples of third law

1. While rowing a boat the water is pushed back, but the boat moves forward.
2. When the bullet is fired from a gun, the gun recoils back.

ADDITIONAL QUESTIONS

1.All internal forces are _____. [Balanced or unbalanced]

Ans) Balanced.

2.When a bus stops suddenly, the passenger tend to fall forward. What is the reason?

Ans) Inertia of motion.

3.Find out the odd one

[Mass, time, momentum, speed]

Ans) Momentum

4.Fill in the blanks

Force: kg m/s^2

Momentum: _____

Ans) kg m/s

5.A force of 50 N is applied on a body of mass 5 kg. Calculate the acceleration produced.

Ans) F = ma

$a = \frac{F}{m} = \frac{50}{5} = 10\ m/s^2$

6.A body of mass 10 kg starts from rest and acquires a velocity of 3 m/s in the third second. If so,

a) What is its initial momentum?
b) What is its final momentum?
c) What is the change in momentum?
d) What is the rate of change of momentum.

Ans)

a) Initial momentum = m × u

= 10 × 0 = 0

b) Final momentum = m × v

= 10 × 3 = 30 kg m/s

c) Change in momentum = mv - mu

= 30 – 0 = 30 kg m/s

d) Rate of change of momentum = $\frac{m(v-u)}{t}$

$= \frac{30}{3} = 10\ kg\ m/s^2.$

7.A ball of 600 g is moving with a velocity of 10 m/s. Find the force if a person catches the ball in 0.2 s.

Ans) F = ma = $\frac{m(v-u)}{t}$ m = 600 g = 0.6 kg

$F = \frac{0.6\ (0-10)}{0.2} = \frac{6}{0.2} = 30\ N$ t = 0.2 s

4 - GRAVITATION

Force of gravity

Earth attracts all objects towards its centre. This is the gravitational force of earth.

- As the mass of the body increases, the force of gravity also increases.
- As the distance from the earth to the object increases, the force of gravity decreases.
- Not only earth has a force of attraction, but also all celestial bodies of the universe also exert mutual force of attraction.

Universal law of gravitation

- Isaac Newton formulated universal law of gravitation.

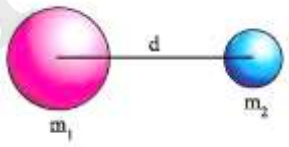
All objects in the universe attract each other.

The force of attraction between two objects is directly proportional to the product of their masses and inversely proportional to the square of distance between them.

$$F \alpha m_1 \times m_2 \ , \quad F \alpha \frac{1}{d^2}$$

$$F \alpha \frac{m_1 \times m_2}{d^2}$$

$$\mathbf{F = G \frac{m_1 \times m_2}{d^2}}$$



- G is known as **gravitational constant**.
- The value of G is 6.67×10^{-11} Nm^2/kg^2.
- The value of G is determined by the scientist, Henry cavendish.
- When two objects of mass 1 kg each are separated by a distance of 1 m, the force of attraction between them will be G newton.

NOTE: -

- If any one of the mass of a body is doubled, the force of attraction also doubled.
- If both the two masses are doubled, the force of attraction increases four times.
- If the distance is halved, the force of attraction increases four times.
- If the distance is doubled, the force of attraction decreases four times [$\frac{1}{4}$ times].
- If the distance between the objects quartered, the force increases 16 times.

Acceleration due to gravity(g)

The acceleration of objects by the force of gravity is known as acceleration due to gravity.

Consider the mass of the object as m, mass of the earth as M and the radius of the earth as R, then according to law of gravitation, the force of attraction exerted by the earth is,

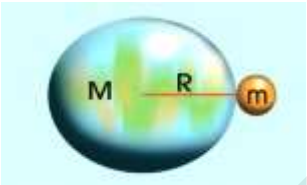
$$\mathbf{F = G\frac{Mm}{R^2}}$$

According to second law of motion, the force

$$F = ma = mg$$

ie, $mg = G\frac{Mm}{R^2}$

$$\mathbf{g = \frac{GM}{R^2}}$$



- The acceleration due to gravity is independent of the mass of the object.
- The acceleration due to gravity at earth is, $\mathbf{g = 9.8\ m/s^2}$.
- the value of g is maximum at the polar region, because the distance from centre is less.
- The value of g is minimum at equatorial region, because the distance from the earth is greater.
- The value of g at the centre of the earth is zero. Because the forces of attraction on an object at the centre from all sides of the earth are equal.
- When the same force is applied, object with a greater mass will experience lesser acceleration.

Acceleration due to gravity on the moon

$$g_{moon} = \frac{GM}{R^2} = 1.62\ m/s^2$$

The value of g on the moon is $\frac{1}{6}^{th}$ of the value of g on the earth.

Mass(m)	Weight(w)
• Amount of matter included in a body. • Scalar quantity. • Does not change from place to place. • It can be measured by using common balance. • Unit is kg.	• Gravitational force exerted by the earth on the body. $\mathbf{w = m \times g}$ • Vector quantity. • Can changes from place to place. • It can be measured by using spring balance. • Unit is N (kg wt).

1 kg wt

It is the force of attraction exerted by the earth on an object of mass one kilogram.

$F = mg = 1\ kg \times 9.8\ m/s^2 = 9.8\ N$

1 kg wt = 9.8 N

Free fall

If an object is allowed to fall from a height only under the influence of gravitational force of earth, then that motion is called free fall.

E g: - For a person who orbits the earth in space stations.

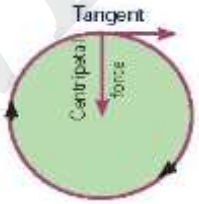
Circular motion

If a body covers a circular path, then it is in circular motion.

- If the body moving along a circular path covers equal distances at equal intervals of time, then it is in uniform circular motion.

Eg: -

i. Whirling a stone tied to a string.
ii. Electrons revolve around the nucleus.
iii. Satellites revolve around the earth.



- The body has uniform speed, but non uniform velocity in uniform circular motion.
- Its direction of velocity always changes and it is acting along the tangent of the circle at that point.
- Since the direction changes, there should be an acceleration.

Centripetal acceleration

The acceleration of an object moving along a circular path is centripetal acceleration.

- The direction of this acceleration is acting towards the centre.
- The force required for this acceleration is called centripetal force.
- Gravitational force is the required centripetal force for a satellite to orbit around the earth.
- It is due to the centripetal force that vehicles help to pass over curves on the roads.

ADDITIONAL QUESTIONS

1.If the distance between two bodies is doubled, then the gravitational force among them becomes _____.

Ans) $\frac{1}{4}$ times

2.Which is the source of centripetal force for a satellite to orbit the earth?

Ans) Gravitational force

3.The weight of a body experiences on the earth is maximum, at

[poles, equator, centre]

Ans) At poles

4.The speed and velocity of a body are always equal when it is in uniform circular motion. Comment on this statement.

Ans) This statement is wrong. Because speed is always equal. But the direction of velocity varies instantaneously.

5.The mass of an object in the earth is 10 kg. Find mass and weight of this body at the moon.

Ans) m = 10 kg

Weight = mg = $10 \times 1.62 = 16.2$ N

5 - BUOYANT FORCE

Fluids

The material which are flowing are called fluids.

Liquids and gases are commonly fluids.

E g: - Water, air, milk, etc

Buoyant force

When an object is fully or partially immersed in a fluid, the upward force exerted by the fluid on the object is the buoyant force.

Examples

- Air bubbles rising from water.
- A stone experiences loss of weight in water.
- Hydrogen filled balloons rise up.

How to measure buoyant force

It can be measured by taking the difference between weights of a body in the air and that in a fluid.

Buoyant force = loss of weight

$$F_B = W_{Air} - W_{Fluid}$$

Factors influencing buoyant force

1. Density of the fluid

As the density of fluid increases, buoyancy also increases.

2. Volume of the object

As the volume of the object increases, its density decreases, and so get more buoyancy.

NOTE: -

As a ship moves from freshwater lake to sea, it rises further. Because sea water has more density than freshwater, so it exerts more buoyancy on the ship.

Archimede's principle

When an object is completely or partially immersed in a fluid, the buoyant force acting on the object is equal to the weight of the fluid displaced by the object.

Buoyant force = weight of the fluid displaced

Principle of floatation

When an object floats on a fluid, the weight of the object and the weight of the fluid displaced are equal.

NOTE: -

The buoyant force experienced by an object immersed in a liquid is less than the weight of the object. But the buoyant force acting on a floating object is equal to the weight of the object.

Relative density

It indicates how many times the density of the substance is to the density of water.

$$\textbf{Relative density} = \frac{\textbf{density of substance}}{\textbf{density of water}}$$

E g: - Relative density of kerosene = $\frac{810}{1000}$ = 0.81

Density greater than water	Density less than water
Salt water Glycerin Mercury copper	Coconut oil Kerosene Wax Ice

Hydrometer

- The device used to measure the relative density of a substance.
- The reading of hydrometer shows 1 in water.
- Hydrometer shows a reading less than one in the substances of higher density. But the magnitude will be greater than 1.

Lactometer

- It is the device used to measure the relative density of milk.
- In fat – removed milk, lactometer sinks more. Because its density is less than that of pure milk.

ADDITIONAL QUESTIONS

1.The device used to measure the impurity added in milk is called _____.

Ans) Lactometer

2.An egg sinks in freshwater but floats on saltwater. Why?

Ans) Salt water has more density than freshwater., so it exerts more buoyancy.

3.If an object weighs 40 N in air and 25 N when fully immersed in water, find the following;

a) The loss of weight of the object.

b) The buoyant force.

c) Weight of water displaced.

Ans)

a) 40 N – 25 N = 15 N
b) Buoyancy = 15 N
c) 15 N

4.What is the density of mercury if its relative density is 13.6.

Ans) Relative density = $\frac{d_{water}}{d_{mercury}}$

$d_{mercury} = \frac{1000}{13.6}$ kg/m^3

5.A body floats on water. If its weight in air is 250 N,

a) What is the weight of the body in water?

b) What is the weight of the water displaced?

Ans)

a) Zero
b) 250 N

6 – WORK AND ENERGY

Work

Work is said to be done by a force if there is a displacement for the object in the direction of the applied force.

- The factors influencing the quantity of work are force and displacement.

Work done = force × displacement

W = F × s

- The unit of work is Nm ie, Joule (J) in SI unit
- It is a scalar quantity.

One Joule of work

If a force of 1 N is applied on an object and the object is displaced by 1 m in the direction of the force, then the work done on the object by the force is 1 J.

Work done against gravity

An object can be lifted only if at least an equal force (mg newton) is applied in the upward direction.

- Here, work is done against the gravitational force.

F = mg , s = h

Work done, W = m g h

Work can be classified into two types,

positive work	Negative work
• Displacement of an object is along the direction of force. E g: - 1. A man pushing a trolley into motion. 2. The work done by gravity when a coconut falls from a coconut tree.	• Displacement of an object is opposite to the direction of force. E g: - 1. The work done by the friction when a body slides over a surface. 2. The work done by gravity when a ball thrown upwards.

Energy

- It is the ability to do work.
- Its unit is **Joule(J).**
- Another unit is calorie, **1 cal = 4.2 J**
- It is a scalar quantity.

Different forms of energy

- Light energy
- Electrical energy
- Heat energy
- Chemical energy
- Nuclear energy
- Mechanical energy

Mechanical energy

It is the energy that object acquires by virtue of their motion, position or configuration.

It can be classified into two types,

1. Potential energy (E_p)

It is the energy possessed by objects due to their position or configuration.

Due to position	Due to configuration
• Water stored in a dam. • Energy in a coconut on a coconut tree.	• In a compressed spring. • Stretched bow. • Energy in the pole due to its bending.

Potential energy is equivalent to the quantity of work done on the object against the gravity.

Potential energy due to position is, $\mathbf{E_p = m\ g\ h}$

2. Kinetic energy (E_k)

It is the energy possessed by an object due to its motion.

E g: - 1. A travelling car.

2.Flowing water.

3. Blowing wind.

The factors affecting kinetic energy are;

a. Mass of the object.
b. Velocity of the object.

Equation for kinetic energy,

From, $v^2 = u^2 + 2as$

$u = 0$, $v^2 = 2as$

$as = \frac{v^2}{2}$

$W = mas = \frac{mv^2}{2}$

$$\mathbf{E_k = \frac{1}{2}mv^2}$$

- If the velocity of an object is doubled, its kinetic energy increases four times.
- If velocity is halved, kinetic energy decreases four ($\frac{1}{4}$) times.

Law of conservation of energy

It states that, energy can neither be created nor be destroyed. One form of energy can be converted into other forms of energy without loss or gain of energy.

NOTES: -

- If a body at its maximum height, its potential energy is maximum and kinetic energy is zero.
- If a body touches ground, its potential energy is zero and kinetic energy is maximum.
- The ultimate source of energy of the earth is sun.
- The energy transformation taking place in a hydroelectric power station is,

Power

It is the quantity of work done per unit time.

Or it is the rate of doing work.

$Power = \frac{work}{time}$

$$\mathbf{P = \frac{W}{t}} \qquad \mathbf{W = P \times t}$$

- Its unit is J/s. That is Watt(W) in SI unit.
- Another unit is Horse Power (HP), **1 HP = 746 W.**
- It is a scalar quantity.

ADDITIONAL QUESTIONS

1.Find out the odd one

[work, force, energy, power]

Ans) Force. It is vector, others are scalar.

2.A boy pushes a trolley into 15 m distance by applying a force of 30 N. Find the work done.

Ans) W = F × s = 30 × 15 = 450 J

3.Write the way of getting potential energy for the following situations,

a) A flower pot on the terrace. b) A stretched bow.

c) Water stored in a dam. d) A pressed spring.

Ans)

a) position b) Configuration c) Position d) Configuration

4. Energy is the capacity to do work

a) Write unit of energy.

b) If a mango possesses an energy of 840 kJ, what is its equivalent energy in calorie.

c) Which type of energy is acquired by the motion of object.

Ans)

a) Joule (J) b) Energy = 840 kJ = 840000 J

1 cal = 4.2 J

Energy in calorie = $\frac{840000}{4.2}$ = 200000 cal

5.A ball of mass 0.5 kg at a certain height above the ground.

a) If the potential energy of the ball is 98 J, how high will the ball be? (g=9.8 m/s^2)

b) What will be the kinetic energy of the ball just before hitting the ground, if it is allowed to fall freely.

Ans) a) E_p = m g h

$$h = \frac{E_P}{mg}$$

$$= \frac{98}{0.5 \times 9.8} = \frac{10}{0.5} = 20 \text{ m}$$

b)Kinetic energy at the ground = potential energy at the maximum height

$E_k = 98$ J

6.An electric motor does 15 kJ work for 10 s. Find its power.

Ans) $P = \frac{W}{t}$ $W = 15$ kJ $= 15000$ J

$= \frac{15000}{10} = 1500$ J/s

7.Write the energy transformation taking place in the following device.

a) Generator b) Electric motor

Ans) a) Mechanical energy ⟶ electrical energy

b)Electrical energy ⟶ Mechanical energy

7 – ELECTRIC CURRENT

Electricity

- The presence of charge is the reason for the electricity.
- The electric charge is represented by the letter Q and its unit is Coulomb (C).
- The device used to detect the presence of charge is called electroscope.
- The device used to store electric charge is known as capacitor. Its unit is Farad(F).
- If an atom loses an electron, it becomes positive; if it receives an electron it becomes negative.

Potential difference

For the device in a circuit to work continuously, there must be a flow of electric charge through the device. So there should be an external source to maintain a potential difference.

- Voltage between two points in a circuit is the quantity of work done in moving a unit charge between these points.

$$\text{Voltage} = \frac{\text{work}}{\text{charge}}$$

$$\mathbf{V = \frac{W}{Q}}$$

- The unit of potential difference is Volt(V) ⟶ J/s
- **Voltmeter** is the device used to measure potential difference. It should be connected in parallel to a circuit.

- A source of electricity maintains potential difference between two points in an electric current.

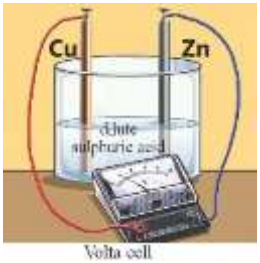
E g: - Battery, solar panel, generator, etc

emf (electro motive force)

It is the potential difference between the terminals of a cell when it is in open circuit.

- It is the maximum potential difference obtained from the source.
- Sources of emf : - dry cell, generator, button cell, etc…

Volta cell



Volta cell

- Alessandro Volta designed volta cell.
- Two metal electrodes are dipped in an electrolyte. Then electrons are transferring to the external circuit.
- As the rate of chemical reaction decreases, the electric energy obtained also decreases.

Primary cell	Secondary cell
• It cannot be reused after a certain period. • Eg: - Dry cell, button cell	• It can be reused and recharged. Also known as storage cells. • Eg: - mobile battery, inverted battery

Combination of cells

- When the cells are arranged in series, the total emf is equal to the sum of the emfs of the individual.
- When the cells are arranged in parallel, the total emf is equal to the emf of a single cell.

Batteries – safety measures

- Do not use the battery if it is over heated.
- Do not put the battery in the mouth or chew it.
- Do not connect the positive and negative terminals of a battery directly using a conductor.

Intensity of electric current

It is the quantity of electric charge flowing through a conductor per unit time.

$$\text{Current} = \frac{\text{charge}}{\text{time}}$$

$$\mathbf{I = \frac{Q}{t}}$$

The unit of current is C/s; that is Ampere(A).

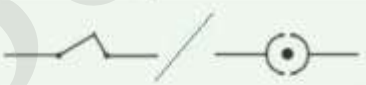
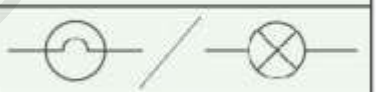
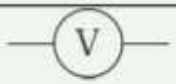
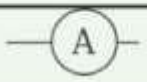
Ammeter is a device used to measure the current.

It should be connected in series to a circuit.

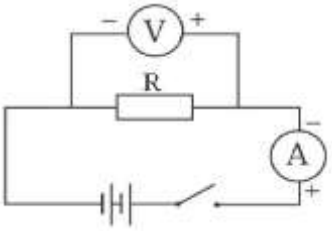
Current through a conductors

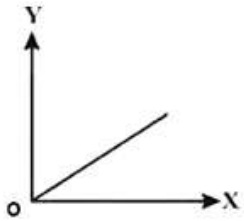
- There are many free electrons in a conductor. It is the reason behind flowing current through a conductor.
- The direction of flow of electron is from negative to positive direction.
- The direction of current is from negative to positive.

Electric components and symbols

Name and symbol of some components in electric circuits	
Component	**Symbol**
Cell	
Battery	
Switch/Key	
Switch/Key on	
Bulb/Lamp	
LED	
Voltmeter	
Ammeter	

Ohm's law



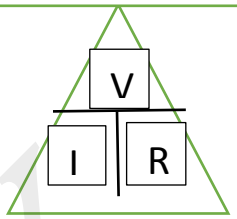


George Simon Ohm formulated the relation between potential difference and current.

> Ohm's law states that, the current through a conductor is directly proportional to the potential difference across the conductor when the temperature is constant.

$V \alpha I$, $R = \frac{V}{I}$

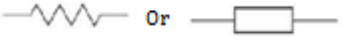
V = I × R



R is constant, it is referred as resistance in the circuit.

Resistance(R)

It is the property of a conductor to oppose the flow of current through it.

- Its unit is V/A, that is Ohm(Ω) in SI unit.
- Its symbol is  Or
- The reason behind the resistance is the collision between free electrons and atoms in the conductor.
- As the resistance increases, electric current decreases.

Factors influencing resistance

1. **Length of the conductor**

As the length of the conductor increases, resistance also increases.

2. **Area of cross section(thickness)**

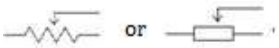
As the thickness increases, resistance decreases.

3. **Nature of the conductor**

E g: - Nichrome has more resistance than copper

Rheostat

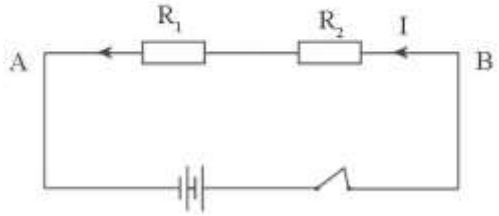
It is the device that is used to change the current by varying resistance in the circuit.

- It has large number of turns, it helps to change the resistance.
- Its symbol  or

Series connection	Parallel connection
• Current is same for each resistor. • Potential difference is different for each one.**V = v_1 + v_2** • Devices cannot be controlled by separate switches. • Total resistance increases.	• Current is different **I = I_1 + I_2** • Potential difference is same. • Device can be controlled by separate switches. • Total resistance decreases.

Arrangement of resistors

1. Series connection



$V = v_1 + v_2$ $\quad V = IR$

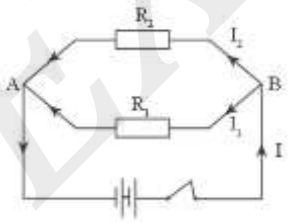
$IR = IR_1 + IR_2$ $\quad v_1 = IR_1$

$v_2 = IR_2$

$$\mathbf{R = R_1 + R_2}$$

- When resistors are connected in series, the effective resistance is the sum of the resistances of all resistors.
- If **n** resistors of resistance **R Ω** each are connected in series, the effective resistance will be **n R**.

2. Parallel connection



$I = I_1 + I_2$ $\quad I = \frac{V}{R}$

$\frac{V}{R} = \frac{v}{R_1} + \frac{v}{R_2}$ $\quad I_1 = \frac{v}{R_1}$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ $\quad I_2 = \frac{v}{R_2}$

$$\mathbf{R = \frac{R_1 \times R_2}{R_1 + R_2}}$$

- When resistors are connected in parallel, the effective resistance decreases.
- If **n** resistors of **R Ω** each are connected in parallel, the effective resistance will be $\frac{\mathbf{R}}{\mathbf{n}}$.

NOTE: -

- Electric appliances should be connected in parallel.
- As the device receives more potential difference and current than required, the device gets damaged.

ADDITIONAL QUESTIONS

1.Which one of the following devices converts mechanical energy into electrical energy?

[Dry cell, generator, solar cell]

Ans) Generator

2.If six identical cells are connected in series to form a battery of 9 V, what is the emf of one cell?

Ans) emf = $\frac{9}{6}$ = 1.5 V

3.A conductor draws a current of 1.5 A for 3 s, find the electric charge.

Ans) I = 1.5 A , t = 3 s

$Q = I \times t = 1.5 \times 3 = 4.5$ C

4.What are the factors influencing the resistance of a conductor.

Ans)

- Length of the conductor.
- Thickness of the conductor.
- Nature of the material.

5.Find the effective resistance if five number of 10 Ω resistors are connected,

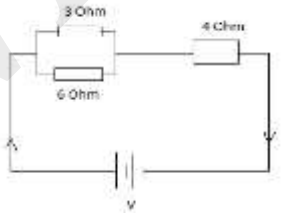
a. Series b. parallel

Ans)

a. Series, $R = n \times R = 5 \times 10 = 50\ \Omega$

b. Parallel, $R = \frac{R}{n} = \frac{10}{5} = 2\ \Omega$

6.Find the effective resistance in the given circuit.



Ans) $R = 4 + \frac{3\times6}{3+6} = 4 + \frac{18}{9} = 4 + 2 = 6\ \Omega$

8 – SOUND

Sound is the form of energy that gives the sense of hearing.

- Sound is produced by the vibration of objects.
- The materials which produce sound is called sources of sound. Every source of sound has a main vibrating part.

Eg: - musical instruments, loud speaker, tuning fork

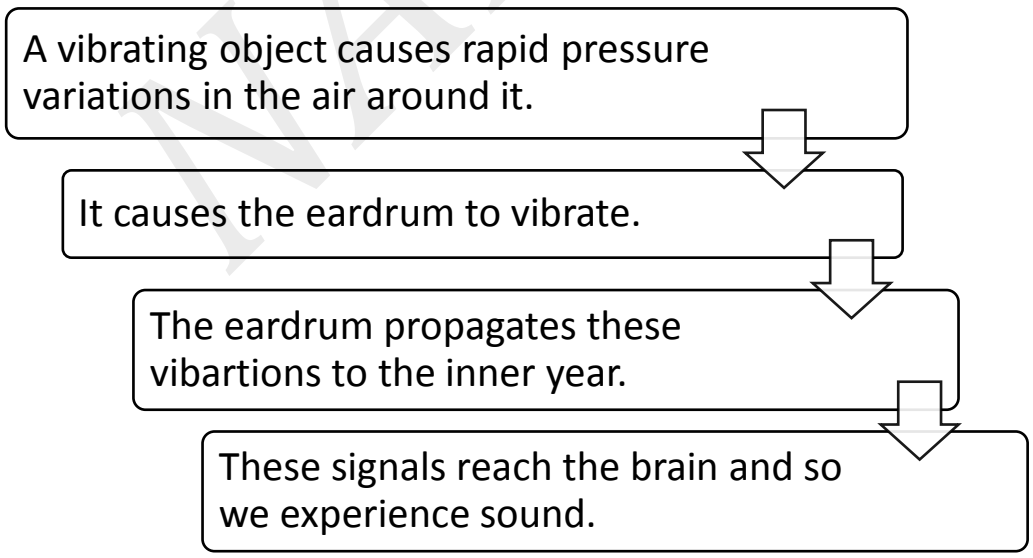
The sound we hear from a source of sound is the result of the vibrations of various parts of the source and the vibrations of the surrounding air.

Eg: - The main vibrating part of 'chenda' is its leather. The wooden frame, the air column inside the chenda are the associated vibrating parts.

Propagation of sound

- Sound needs a medium to travel. Sound cannot travel through vacuum.
- Sound can travel through solid, liquid and gases.
- Speed of sound is greater at solids and lesser at gases.
- As the temperature of the medium increases, the speed of sound also increases.
- In many cases thunder is heard only a shorter time after the flash of lightning is seen. Because the speed of sound is very much less than the speed of light.

Ear and hear



To sense the sound, we need three components source, medium and sense organ for hearing.

Challenges faced by hearing impaired

- A barrier to communication.
- Chance to accidents.
- Difficulty for acquiring knowledge.
- Loneliness.

Approaches to the hearing impaired

- Be empathetic.
- Give consideration and include them in all activities.

Audiometer

- It is the device used to test the hearing capacity of an ear.

Hearing aid

It is an electronic device that helps individuals with hearing loss to hear more clearly.

Music	Noise
Sound has regular vibrations and is pleasant to hear. Eg: - Violin, Guitar	Sound has irregular vibrations and is unpleasant. Eg: - Sound of a coconut shell being rubbed against a stone.

Noise pollution

It is the production of unpleasant, disturbing and unwanted noise that harms human beings and other organisms.

Noise pollution can be reduced

- Don't use air horns in vehicles.
- Use box type instead of horn type loudspeakers.
- Avoid loud noise near hospitals, schools, ..etc
- Plant more trees.

ADDITIONAL QUESTIONS

1.Find the relation and fill in the blanks.

Veena : strings

Harmonium : --------

Ans) Reads

2.Sound is produced when the -------- in the upper part of larynx vibrate?

Ans) Vocal cords

3.Arrange the following materials in the increasing order of speed of sound.

[Steel, Air, Sea water]

Ans) Air < Sea water < Steel

4.A person hears a sound from a fire cracker after 2 s. How far did the explosion take place?

Ans) Distance travelled by sound = Speed × Time

= 350 × 2

= 700 m

5.Which of the given musical instruments produce sound by the vibration of the strings?

[Chenda, Guitar, Flute, Violin]

Ans) Guitar, Chenda