मेधावाटिका

A Garden of Intellect

Pathfinder

Grade 7 - Medhavatika Pathfinder

Notes that make learning simple.

Reflection of Light

Definition

Reflection of light is the phenomenon in which light rays bounce back from a surface into the same medium, following specific laws.

Formula

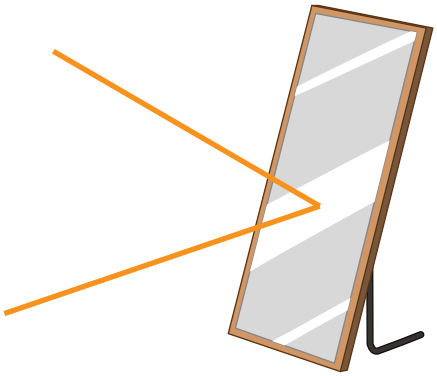
Law of Reflection:

θi=θr\theta_i = \theta_rθi=θr

where:

θi\theta_iθi = angle of incidence

θr\theta_rθr = angle of reflection



Key Points

Two types: Regular reflection (smooth surfaces) and Diffuse reflection (rough surfaces).

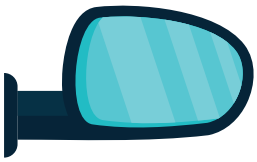
Follows two laws of reflection:

The incident ray, reflected ray, and normal lie in the same plane.

Angle of incidence = Angle of reflection.

Occurs on mirrors, shiny metals, and still water surfaces.

Essential for image formation.



Applications

Mirrors in homes, vehicles, and instruments.

Periscopes and other optical devices.

Reflection-based technologies like solar cookers.

Optical instruments such as telescopes and microscopes.

Road safety mirrors and reflectors.

Advantages

Allows clear image formation in mirrors.

Helps direct light to desired locations.

Useful in designing optical instruments.

Enables non-contact viewing of objects.

Disadvantages

Excessive reflection can cause glare (hurts vision).

Loss of light intensity if the surface is not perfectly smooth.

Can cause unwanted heat build-up in concentrated light setups.

Reflection from rough surfaces leads to distorted images.

Tuning Fork

Definition

A tuning fork is a U-shaped metal instrument that produces a pure tone of fixed frequency when struck. It is used to study the properties of sound such as frequency, wavelength, and speed.

Formula

Formula

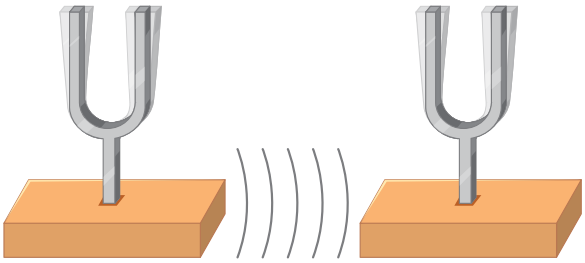
v=f×λv = f \times \lambdav=f×λ

where:

vvv = speed of sound

ff = frequency (Hz)

λ\lambdaλ = wavelength (m)



Key Points

Produces a pure sound with no overtones.

Frequency depends on the length, mass, and elasticity of prongs.

Longer prongs; lower pitch; shorter prongs; higher pitch.

Used with resonance tube to find speed of sound in air.

Generates longitudinal sound waves in air.

Applications

Testing hearing (in medical audiometry).

Tuning musical instruments.

Experiments to measure speed of sound.

Physics education and demonstrations.

Used in resonance experiments.

Advantages

Produces a steady and known frequency.

Easy to handle and use in experiments.

Inexpensive and durable.

Gives pure tone with minimal distortion.

Disadvantages

Produces low volume (sound not very loud).

Sound fades quickly after striking.

Limited to a fixed frequency (cannot be adjusted).

Needs a resonator for louder sound in some experiments

Oscillation

Definition

Oscillation is the repetitive to-and-fro motion of an object about its mean (equilibrium) position. Example: motion of a pendulum, vibrations of a tuning fork.

Formula

For a simple harmonic oscillator:

T=2πmkT = 2\pi \sqrt{\frac{m}{k}}T=2πkm

where:

TTT = time period

mmm = mass of the object

kkk = force constant (spring constant)

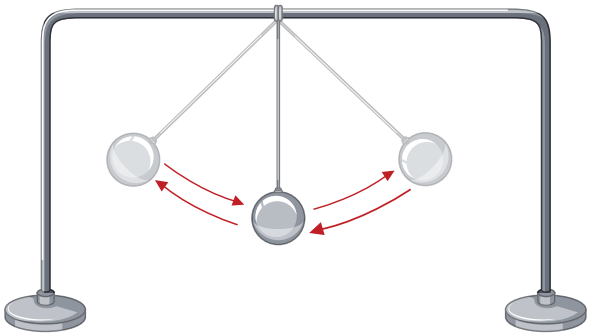
For a simple pendulum:

T=2πLgT = 2\pi \sqrt{\frac{L}{g}}T=2πgL

where:

LLL = length of pendulum

ggg = acceleration due to gravity



Key Points

Amplitude (A): Maximum displacement from mean position.

Frequency (f): Number of oscillations per second.

Time period (T): Time for one complete oscillation.

Phase: Describes the state of motion at a given time.

Simple Harmonic Motion (SHM): Special case where restoring force displacement.

Applications

Timekeeping devices (pendulum clocks, quartz watches).

Musical instruments (guitar strings, drums).

Measuring properties like mass and spring constant.

Study of waves and vibrations in engineering.

Seismographs for earthquake detection.

Advantages

Helps in designing accurate clocks and timing systems.

Used in scientific instruments for measurement.

Explains natural phenomena like sound, waves, and light vibrations.

Disadvantages

Oscillations may cause resonance, leading to structural damage.

Unwanted vibrations can reduce machine efficiency.

In some systems, energy loss due to damping is unavoidable.

Density of Object

Definition

Density is the mass per unit volume of a substance. It determines how heavy a material is for its size and helps predict whether it will float or sink in a liquid.

Formula

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

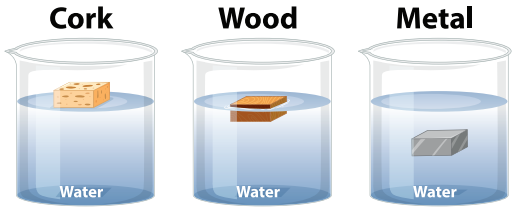
where:

ρ = density (kg/m³ or g/cm³)

m = mass

V = volume

Density of Matters



Key Points

Solids: Density found by measuring mass and volume (volume via dimensions or water displacement method).

Liquids: Density measured using a hydrometer or mass of known volume.

Density of water at 4°C = 1000 kg/m³ (1 g/cm³).

If density of object > density of liquid it sinks.

If density of object < density of liquid it floats.

Applications

Ship and submarine design (buoyancy calculations).

Quality testing of materials.

Determining concentration of liquids (milk, alcohol).

Identifying unknown substances.

Oil-water separation in industries.

Advantages

Simple method to identify materials.

Helps in buoyancy and fluid mechanics applications.

Non-destructive testing in many cases.

Disadvantages

Requires precise measurements for accuracy.

Temperature changes can affect density values.

Not suitable for very porous or irregular objects without special methods.

Volume of Displacement

Definition

Volume by displacement is a method of finding the volume of an irregularly shaped object by measuring the amount of fluid it displaces when submerged.

Formula

Volume of object=Final water level-Initial water level\text{Volume of object} = \text{Final water level} - \text{Initial water level}Volume of object=Final water level-Initial water level

Key Points

Based on Archimedes' Principle.

Works for solids that do not dissolve or absorb the liquid.

Usually done with a measuring cylinder or overflow can.

Volume is measured in cubic centimeters (cm^3) or milliliters (mL).

Applications

Measuring volume of irregular objects in physics labs.

Determining density when mass is known.

Used in archaeology to measure artifacts' volume without damage.

Quality control in manufacturing of solid components.

Advantages

Simple and easy to perform.

No need for complex mathematical calculations.

Works for irregular shapes.

Disadvantages

Not suitable for objects that float unless fully submerged with a sinker.

Cannot be used if the object absorbs or reacts with the liquid.

Requires accurate reading to avoid errors.

Archimedes' Principle

Definition

When a body is wholly or partially immersed in a fluid, it experiences an upward force (buoyant force) equal to the weight of the fluid displaced by it

Formula

$Fb=\rho \times g \times V$

Where:=

Buoyant force (N)

ρ = Density of the fluid (kg/m^3)

g = Acceleration due to gravity ($9.8\ m/s^2$)

V = Volume of fluid displaced (m^3)

Key Points

Buoyant force acts vertically upward on the immersed object.

Floating or sinking depends on the balance between weight and buoyant force.

Principle applies to both liquids and gases.

Basis for measuring density using displacement method.

Applications

Shipbuilding – explains how large ships float.

Submarines – adjust buoyancy to sink or rise.

Hot-air balloons – float as heated air is less dense.

Hydrometer – measures liquid density using buoyancy.

Advantages

Helps to find whether things float or sink in water.

Can measure density of objects (even odd-shaped ones).

Used in ships, submarines, hot air balloons.

Does not damage the object while testing.

Useful in many science and engineering fields.

Disadvantages

Works only in liquids or gases (not in solids or vacuum).

Needs clean, uniform liquid for accurate results.

Hard to measure for very small objects.

Not accurate in thick or sticky liquids.

Very light objects can be affected by surface tension, giving wrong results.