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SIERRA INNOVATIONS

Index

2 Chapter

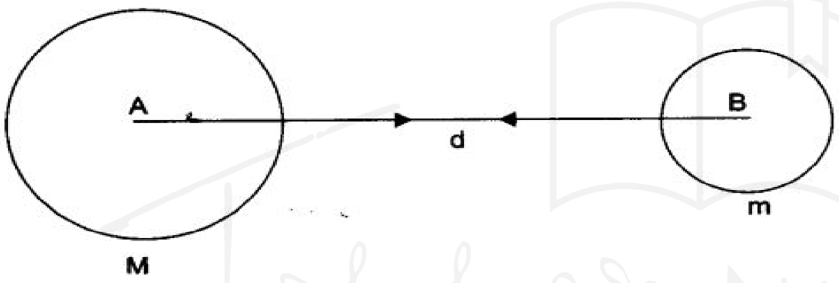
Physics

Gravitation

- **Force** that **attracts** a **body towards centre** of earth, or **towards any other physical body** having mass.
- **Every object** that has **mass exerts** a **gravitational pull** or force on every other mass.
- **Strength** of this pull **depends on** the **masses** of **objects**
- **Gets weaker** with **distance**.
- **Keeps planets in orbit** around sun and moon around the Earth
- **First discovered** in 1687 by Sir Isaac **Newton**.

Universal law of gravitation

- **Every object** in the universe **attracts** every **other object with a force** which is **proportional to** the **product** of their **masses** and **inversely proportional** to the **square** of the **distance** between them.
- The **force** is **along** the **line joining** the **centres** of **two objects**.



Gravitational force between two uniform objects is directed along the line joining their centres.

Formula:

$$F = \frac{G \times M \times m}{d^2}$$

- Here M and m = masses of the objects interacting
- d- distance between the center of the masses
- G -gravitational constant ($6.674 \times 10^{-11}\ m^3 \cdot kg^{-1} \cdot s^{-2}$)

Mass

- **Quantity of matter contained** in a **body**.
- A **scalar** quantity.
- **Unit** - **kilogram**.
- A body **contains** the **same quantity** of **matter whether** it be on the **earth**, **moon** or even in **outer space**. Thus, **mass** is **constant** and **does not change** from place to place.
- **Denoted** by the small letter **'m'**.
- **Cannot be zero**.

Weight

- Measure of **force of gravity** acting on a body.
- **Formula** : w = mg
- **Unit**- Newton (as it is a force).
- **Vector quantity**

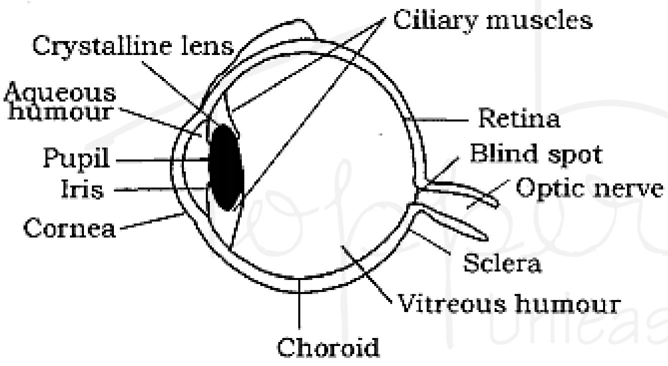
Difference between Mass and Weight

Mass	Weight
• **Quantity of matter** possessed by a body	• **Force** with which a **body** is **attracted towards** the **centre** of the earth.
• **Scalar** quantity.	• **Vector** quantity.
• S.I. unit - **kilogram** (kg.)	• S.I. unit - **Newton** (N).
• **Remains constant** at all places	• **Changes** from place to place.
• **Never zero**.	• **Becomes zero** at the centre of the earth.
• **Measured** by a **beam balance**.	• **Measured** by a **spring balance**.

Human eye and Defects

- **Human Eye** is a natural optical instrument which is used to see the objects by human beings.
  - It is like a camera which has a lens and screen system.

Structure of the Human Eye



The various parts of eye and their functions

Human Eye Part	Functions
Pupil	Opens and closes in order to regulate and control the amount of light.
Iris	Controls light level similar to the aperture of a camera.
Sclera	Protects the outer coat.
Cornea	A thin membrane which provides 67% of the eye’s focusing power.
Crystalline lens	Helps to focus light into the retina.
Conjunctive	Covers the outer surface (visible part) of the eye.
Aqueous humour	Provides power to the cornea.
Vitreous humour	Provides the eye with its form and shape.powe

Retina	Captures the light rays focussed by the lens and sends impulses to the brain via the optic nerve.
Optic nerve	Transmits electrical signals to the brain.
Ciliary muscles	Contracts and extends in order to change the lens shape for focusing.

Persistence of Vision:

- It is the time for which the sensation of an object continue in the eye.
- It is about 1/16th of a second.

Power of Accommodation:

- The ability of the eye lens to adjust its focal length accordingly as the distances is called power of accommodation.

Ciliary muscles

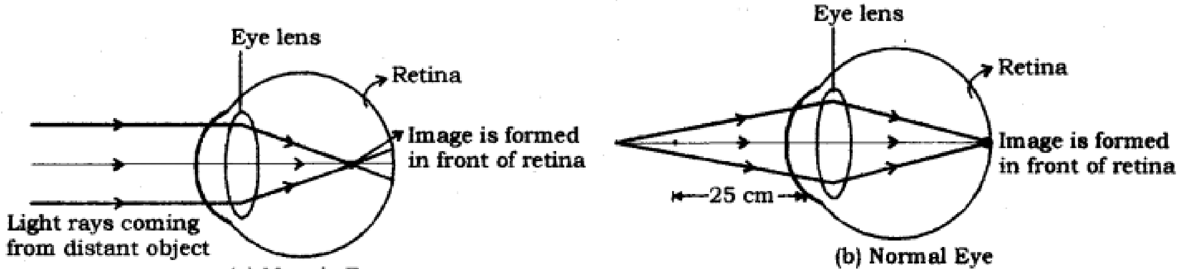
Relaxed	Contract
1. Eye lens become thin.	1. Eye lens become thick.
2. Increases the focal length.	2. Decreases the focal length.
3. Enable us to see distant object clearly.	3. Enable us to see nearby object clearly.

Near point of the Eye	Far point of the Eye
It is 25 cm for normal eye. The minimum distance at which object can be seen most distinctly without strain.	It is infinity for normal eye. It is the farthest point upto which the eye can see object clearly.

Defects of Vision and their Correction

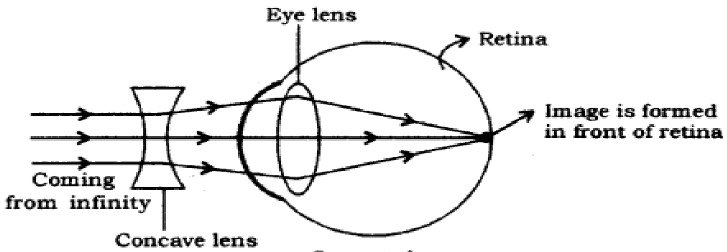
Myopia (Short-sightedness):

- A kind of defect in the human eye due to which a person can see near objects clearly but he cannot see the distant objects clearly. Myopia is due to
  - excessive curvature of the cornea.
  - elongation of eyeball.



(a) Myopic Eye (b) Normal Eye

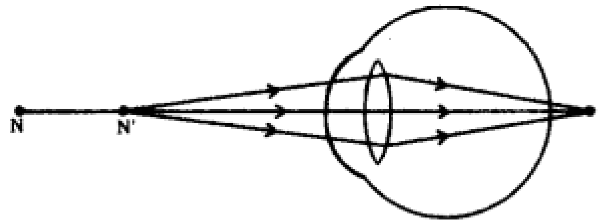
- **Correction**
  - Since a concave lens has an ability to diverge incoming rays, it is used to correct this defect of vision.
  - The image is allowed to format the retina by using a concave lens of suitable power as shown in the given figure.



Corrected eye

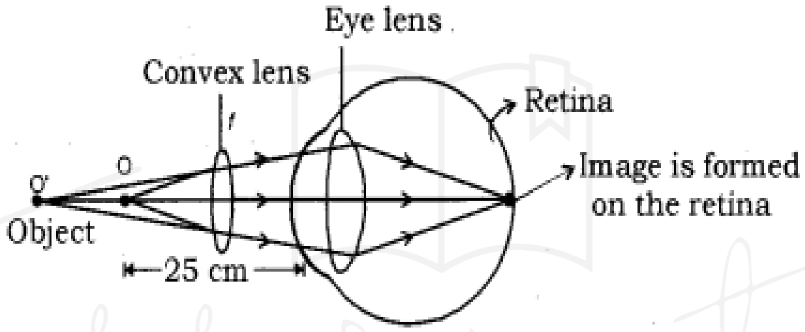
Hypermetropia (Long-sightedness)

- It is a kind of defect in the human eye due to which, a person can see distant objects properly but cannot see the nearby objects clearly. It happens due to
  - decrease in the power of eye lens i.e., increase in focal length of eye lens.
  - shortening of eyeball.



Hypermetropic eye

- A hypermetropic eye has its least distance of distinct vision greater than 25 cm.
- **Correction:**
  - Since a convex lens has the ability to converge incoming rays, it can be used to correct this defect of vision.
  - The ray diagram for the corrective measure for a hypermetropic eye is shown in the given figure.



Heat

- When water is boiled in a kettle the steam built up in the kettle raises its lid up and when the steam escapes out the lid falls down.
- Heat thus can do work, so, it is a form of energy.
- This property of steam was used to build steam engines – the devices which convert heat of steam into mechanical work.
- In fact work done against friction is always converted into heat.
- The equivalence of work and heat was noticed and experimentally established by J. P. Joule.
  - While boring the barrel of a gun with a blunt borer Joule found that so huge amount of heat was produced in the process that even water in which the process of boring was being carried out started boiling.
  - Through further experiments he found that one Calorie (Unit of heat prevalent at that time) of heat is equivalent to 4.2 Joule of work.

Temperature

- A quantity which tells us how hot a body is.
- If a hot body is kept in contact with a colder body for some time, we will find that the hotter body does not remain that hot and the colder body becomes some what hotter.
- Thus heat is transferred from a hotter body (a body at higher temperature) to a Colder body (i.e. a body at lower temperature).
- Hence temperature is the degree of hotness of a body which determines the direction of flow of heat.
- Heat always flows from a body at higher temperature to a body at lower temperature.

Effect of heat

- When a body is heated changes may occur in some of its properties .
- These changes are the effects of heat.

Some of the effects of heat:

- Rise in temperature
  - When a body is heated its temperature increases, that is why, it appears warmer when touched.
- Change of state
  - When heat is supplied to a substance in solid state its temperature rises till at a particular temperature it may change into its liquid state without any further change in its temperature.
  - This characteristic constant temperature at which a solid changes into its liquid state is called melting point of the solid.
  - The melting point of a substance is a characteristic, constant value and different substances may have different values of melting points.
  - Conversion of a solid into its liquid state at its melting point is called change of state from solid to liquid (fusion) and the heat that is transferred to the substance during melting is called Latent Heat of Fusion.
    - Because, it does not becomes apparent in the form of rise in temperature.
  - Latent heat of fusion of a solid substance is defined as the amount of heat (in joules) required to convert 1kg of the substance from solid to liquid state at its melting point.
  - Similarly, when heat is supplied to a substance in liquid state its temperature rises but there is a possibility that it changes into its vapour state at a constant temperature.
    - The heat supplied in this case is called Latent Heat of Vaporization.
  - Latent heat of vaporization of a liquid is defined as the amount of heat (in joules) required to convert 1kg of the substance from its liquid to gaseous state at a constant temperature.
  - Vaporization may take place in two different ways:
    - Evaporation from the surface of a liquid at any temperature
    - Boiling of the whole mass of the liquid at a constant temperature called boiling point of the liquid.

S. No.	Name of Material	Melting Point (°C)	Latent heat of fusion ($\times 10^3$ J/kg)	Boiling Point (°C)	Latent heat of vaporization ($\times 10^3$ J/kg)
1.	Helium	–271	–	-268	25.1
2.	Hydrogen	–259	58.6	–252	452
3.	Air	–212	23.0	–191	213
4.	Mercury	–39	11.7	357	272
5.	Pure Water	0	335	100	2260
6.	Aluminum	658	322	1800	–
7.	Gold	1063	67	2500	–

Static and Current Electricity

- A controllable and convenient **form of energy** used in homes, schools, hospitals, industries,etc **for operating devices**.

We will write down the differences between the two on a number of factors in the form of a table.

Basis of difference	Static electricity	Electric current
Material	It can be developed on any type of material, either it be conductor or an insulator.	The current is produced only in conductors as it is due to movement of electrons.

Time period	Time period is short, as it exists for a very short period of time.	A comparative long time period.
Measuring device	It can be measured with a Gold leaf electroscope.	It can be measured with an Analog or a Digital meter.
Magnetic Field	Static electricity doesn't induce any magnetic field.	A magnetic field is induced every time an electric current is produced.
Example	Lightning in the sky etc.	It can be seen in electrical equipment like TV, bulb etc.

Electric charge:

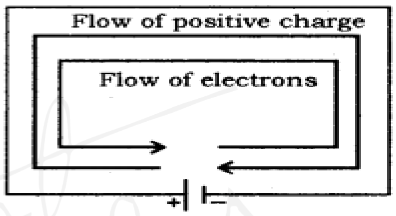
- **Fundamental unit of electricity** (without charge, no electricity).
- **2 types:** Positive & Negative.
- **SI Unit**: Coulomb

Electric current:

- **Rate of flow of electric charges.**
- **Caused by moving electrons** through a conductor.
- **Flows** in the **opposite direction** to the **movement** of **electrons**.

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

  Where,
  I= Electric current
  Q= Electric charge
  t= time

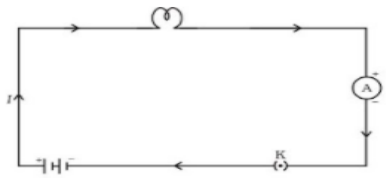


Conventional flow of electric charge.

- **Unit** - ampere (A)
- **Measured**: Ammeter

Electric circuit

- **Closed conducting path** through which **current flows**.

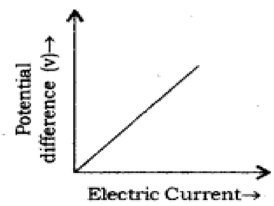


Potential Difference:

- **Work done to move a unit charge from one point to the other** within an electric field..
  V = W Q
- **SI unit:** volt (V)
- **When** the **cell** is **connected to** a **conducting circuit element**, the potential difference sets the charges in motion in the conductor and produces an electric current.

OHM'S LAW:

- **Potential difference** between **two points** is **directly proportional** to **electric current**, at a **constant temperature**.
  $V \propto I$
  $V = RI$
  $I = V/R$



- Here, R is the constant k/a resistance.

Resistance:

- **Property** of a conductor to **resist flow of charges** through it.
- **SI Unit:** Ohm (Ω).

1 Ohm of resistance (R)
Equal to flow of 1A of current through a conductor between two points having a potential difference equal to 1V.

Factors on which Resistance of a Conductor depends:

1. **Nature of Material:**
    - **Conductors** & **insulators**.
    - **Silver** - best conductor of electricity.
2. **Length of Conductor:**
    - **Resistance increases** with **increase** in **length** of the conductor.
3. **Area of Cross Section:**
    - **Resistance decreases** with an **increase** in **area** of conductor and **vice versa**.

Resistivity:

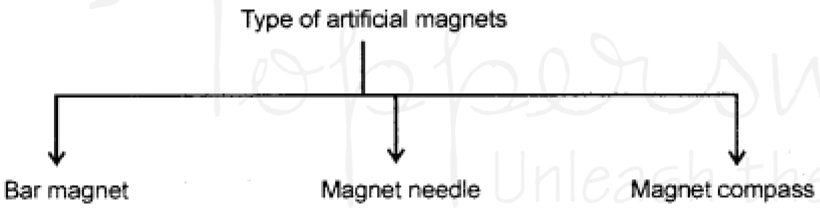
- **Resistance offered by a cube of a material** of side 1m **when current flows perpendicular to its opposite faces.**
- **SI unit** - ohm-meter (Ωm).
- **aka** specific resistance.
- **Depends** on the **nature of** the **material** of the conductor.
- **Varies** with **temperature**.

Heating Effect of Electric Current:

- **When electric current passes** through a **purely resistive conductor**, **energy** of electric current is **dissipated** `entirely in the **form of heat** and as a result, **resistor gets heated**.
- **Eg**. light bulb

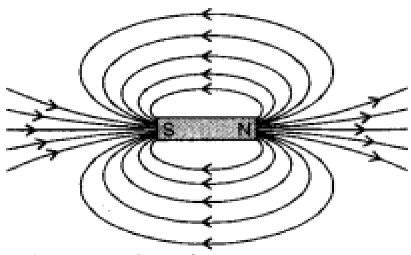
Magnetism

Magnet:



- An **object that attracts objects** made **of iron**, **cobalt** and **nickel**.
- **Use**:
    - in refrigerators.
    - in radio and stereo speakers.
    - in audio and video cassette players.
    - in children's toys and;
    - on hard discs and floppies of computers.
- **Properties**:
    - A **freely suspended magnet** always **points** towards **north** and **south** direction.
    - **Pole** which points **toward north** direction **-north pole**.
    - **Pole** which points **toward south** direction - **south pole**.
    - **Like poles repel** each other while **unlike poles attract** each other.

Magnetic field:



- **Influence of force surrounding** a **magnet**.
- **Force exerted** by a magnet in a magnetic field **detected using** a **compass** or any **other magnet**.
- **Represented** by **magnetic field lines**.

- A **quantity** that has **both direction** and **magnitude**.
- **Properties**:
    - **Inside magnet** - direction of field lines- **south pole to north pole**. Thus magnetic field lines are **closed curves.**
    - **Relative strength** of magnetic field is **shown by** degree of **closeness of field lines**.
    - **No two field**-**lines cross** each other.

Fleming's Right-Hand Thumb Rule:

- If a **current carrying conductor** is **held by right hand**, **keeping thumb straight** and if the **direction** of **electric current** is **in direction of thumb**, then **direction of wrapping** of **other fingers** will **show** the **direction of magnetic field**.

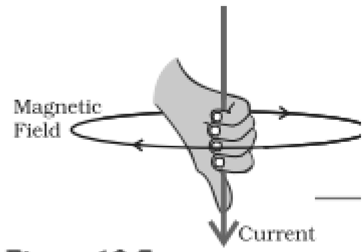


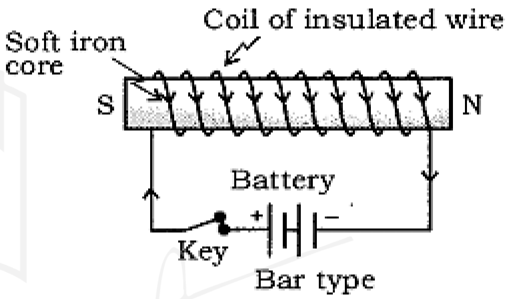
Figure 13.7
Right-hand thumb rule

Electromagnetism

- A phenomenon in which a magnetic field is generated with the help of the current in the conductor.
- Made of two different aspects - electricity and magnetism.
- Electricity and magnetism were considered as different and separate forces up until the 19 th century.
- After more research, they were regarded as interrelated phenomena due to Einstein's Special Theory of Relativity.
- With the help of this theory we can understand that even though both electricity and magnetism possess varying properties, they are still defined by one common phenomenon.
- Electric charges help produce electric forces at rest or while in motion. Meanwhile, magnetic forces can only be formed when there exists a motion of charged particles.

Electromagnet:

- Consists of a **long coil of insulated copper wire wrapped** on a **soft iron**.
- **Formed by producing magnetic field inside** a **solenoid**.



Fleming's left-hand rule:

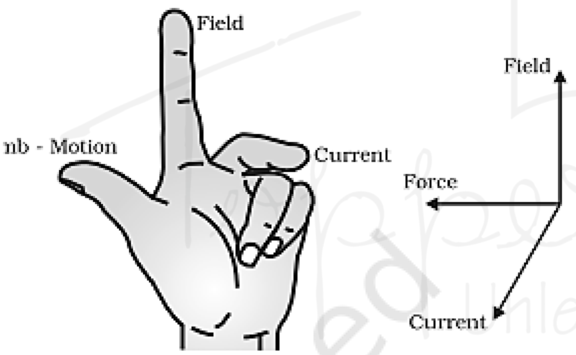
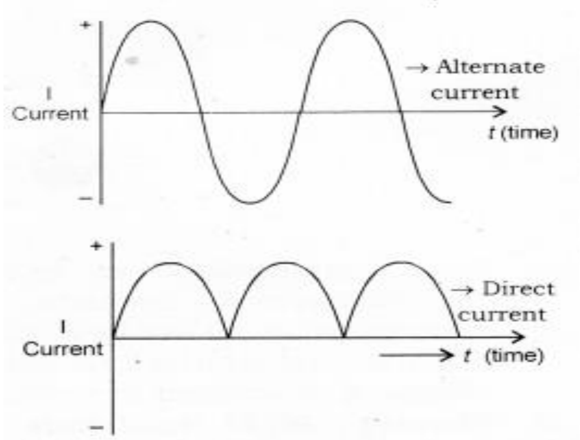
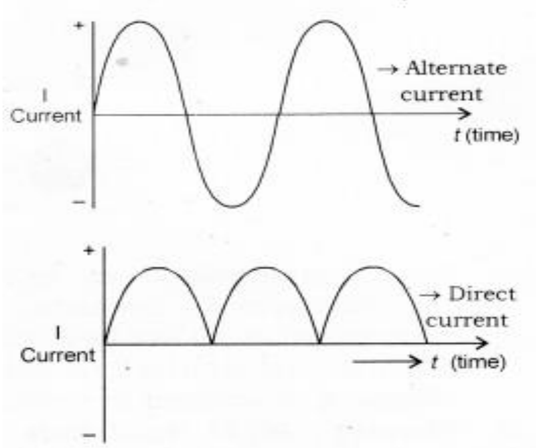


Figure 13.13
Fleming's left-hand rule

- If the **left hand** is stretched in a way that the **index finger**, **middle finger** and **thumb** are in **mutually perpendicular directions**, then **index finger** and **middle finger** of a stretched left hand **show direction of magnetic field** and **direction of electric current** respectively and the **thumb shows** the **direction of motion** or **force acting on** the **conductor**.

Alternate Current:





- **Current in which direction** is **changed periodically**.
- **Frequency** of A.C in India is **50 Hz.**
- **Transmitted** to a **long distance without much loss** of **energy**.

Direct Current:

- **Current** that **flows** in **one direction** only.
- **Electrochemical cells** produce direct current.

Advantages of A.C over D.C

- **Cost of generator** of A.**C** << **D.C.**
- A.C **easily converted to D.C.**
- A.C **controlled by use** of **choke** - **less loss** of **power** whereas, **D.C controlled** using **resistances** - **high energy loss**.
- **AC transmitted over long distances without** much **loss** of **energy**.
- **AC machines** are **stout** and **durable** and **do not need** much **maintenance**.

Disadvantages of AC

- Cannot be used for electrolysis or showing electromagnetism as it reverses its polarity.
- More dangerous than DC.

Sound

A form of energy which produces a sensation of hearing in our ears.

Production of Sound

- Sound is produced due to the vibration of objects.
- Vibration is a periodic back-and-forth motion of the particles of an elastic body or medium about a central position. It is also named as oscillation.
- Eg:
  - Stretched strings of a guitar vibrate to produce sound.
  - When membrane of a table is struck, it vibrates to produce sound.

Propagation of Sound

- The travelling of sound is called propagation of sound.
- Sound is propagated by the to and fro motion of particles of the medium.
- When an object vibrates, the particles around the medium vibrate.
- The particle in contact with the vibrating object is first displaced from its equilibrium position.
- Each particle disturbs the other particle in contact.
- Thus, the disturbance is carried from the source to the listener.
- Only the disturbance produced by the vibrating body travels through the medium but the particles do not move forward themselves.

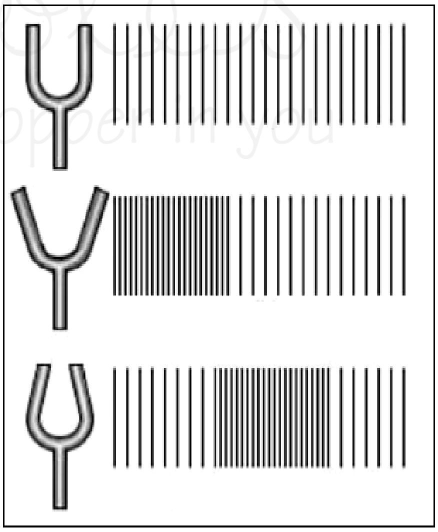


Fig. Representation of particle disturbance moving forward

Medium

- The matter or substance through which sound is transmitted is called a medium.
- A medium is necessary for the propagation of sound waves.
- The medium can be solid, liquid or gas.
- Sound cannot travel in vacuum.

Wave

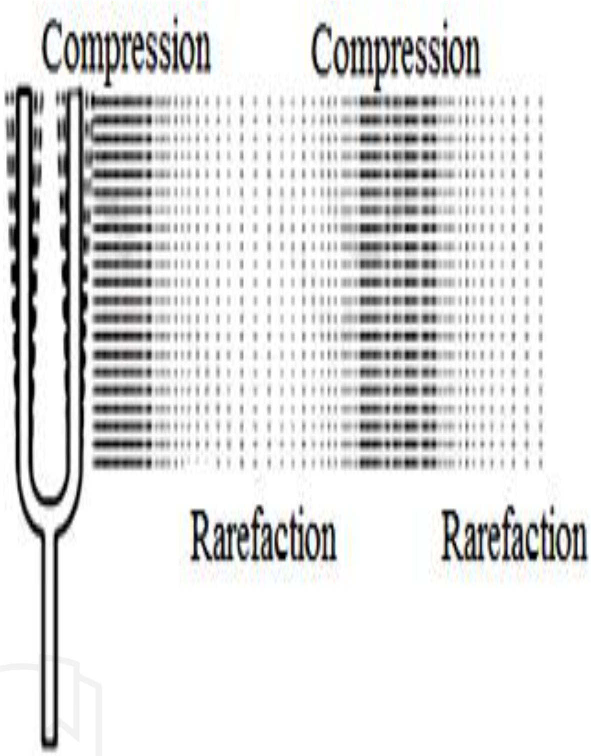
- Wave is a phenomenon or disturbance in which energy is transferred from one point to another without any direct contact between them.
- For example: Heat, light and sound is considered as a wave.

Types of Waves

- **Longitudinal waves:** These are the waves in which the particles of the medium vibrate along the direction of propagation of the wave. For example: sound wave.
- **Transverse waves:** In this type of wave the particles of the medium vibrate in a direction perpendicular to the direction of propagation of the wave. For example: waves produced in a stretched string.
- Another type of waves which do not require any medium for propagation are called electromagnetic waves.
  - These waves can travel through vacuum also.
    - For example, light waves, X-rays.

Compressions and Rarefactions:

- Compression is the- part of wave in which particles of the medium are closer to one another forming the region of high pressure and density.
  - Represented by the upper portion of the curve called **crest.**
- Rarefaction - part of the wave where particles spread out to form a region of low pressure and density.
  - Rarefactions are represented by the lower portion of the curve called **trough.**



Characteristics of a sound wave

Amplitude

- The maximum displacement of each particle from its mean position is called amplitude.
- It is denoted by A.
- Its SI unit is metre (m).

Wavelength

- The distance between two nearest (adjacent) crests or troughs of a wave is called its wavelength.
- It is denoted by the Greek letter lamda (λ).
- Its SI unit is metre.

Frequency

- The number of vibrations per second is called frequency.
- The SI unit of frequency is hertz (Hz).
- The symbol of frequency is v (nu).

Time period

- The time taken to complete one vibration is called time period.
- It is denoted by T.
- Its SI unit is second (s).
- The frequency of a wave is the reciprocal of the time period. i.e., $v = 1/T$

Velocity

- The distance travelled by a wave in one second is called velocity of the wave or speed of the wave.
- Its S.I. unit is metres per second (m/s).
- Velocity = Distance travelled/Time taken

Pitch and loudness of Sound

- **Pitch:** It represents shrillness or flatness of sound.
  - It depends on the frequency of vibration.
  - Higher the frequency of sound wave, the higher will be the pitch of sound and vice-versa.
- **Loudness:** It is a measure of the sound energy reaching the ear per second.
  - It depends on the amplitude of the sound wave.
  - It is measured in decibel 'dB'.

Music And Noise

- **Music:** It is the sound that is pleasant to hear. For example: Sound coming out of musical instruments)
- **Noise:** It is the sound that is unpleasant to hear. For example: Sound produced by vehicles.

  Tone and Note
- **Tone:** A pure sound of single frequency is called tone.
- An impure sound produced by mixture of many frequencies is called a note.
  - For example: A musical note has tones of various frequencies.

Audible Frequency

- The audible range of human ear is 20 Hz and 20,000HZ, i.e., the human ears can hear only those waves whose frequency lies between 20 Hz and 20,000HZ.

Electro- Magnetic Waves

- A wave radiated by an accelerated or oscillatory charge in which varying magnetic field is the source of electric field and varying electric field is the source of magnetic field.
- Thus two fields becomes source of each other and the wave propagates in a direction perpendicular to both the fields.
- Transverse in nature, i.e. electric and magnetic fields are perpendicular to each other and to the direction of wave propagation.
- Electromagnetic waves are not deflected by electric and magnetic fields.

Basic Properties of Electromagnetic Waves

- Electromagnetic waves are transverse in nature.
- They propagate by varying electric fields and magnetic fields, such that these two fields are at right angles to each other and at a right angle with the direction of propagation of the wave.
- Electromagnetic waves travel with a constant velocity in vacuum. The speed of the waves is 3 x 108 m/s.
- Electromagnetic waves are non-mechanical waves. They do not require any material medium for propagation.
- They obey the equation c = fλ. Here, f is the frequency is Hertz and λ is the wavelength metres. The product of wavelength and frequency is equal to a constant c, the speed of light which is equal to 3 x 108 m/s. From this relation between wavelength, frequency and speed of light we can understand that the electromagnetic waves will travel with the speed of light regardless of wavelength and frequency.
- The oscillating electric field and magnetic field are in the same phase. The ratio of the amplitudes of the electric field and the magnetic field is equal to the velocity of the wave.

Seven types of electromagnetic waves

Wave	Wavelength	Uses
Gamma rays	10-14 to 10-10m	It provides information about the structure of atomic nuclei It has medical applications too.
X-rays	10-11to 3 ×10-8m	It reveals the structure of inner atomic electron shells and crystals. Helps in medical diagnosis. Assists in industrial radiography
UV rays	10-8 to 4 × 10-7m	Helps in the detection of invisible writing, forged documents and fingerprints. It helps detect forged currency as real banknotes do not turn fluorescent under UV light. Helps in preserving foodstuffs and detecting adulteration Used in water sterilisation
Visible rays	4 ×10-7to 8 ×10-7m	Reveals structure of molecules and arrangement of electrons in external shells of atoms. Allows you to see objects
Infrared rays	8×10-7 to 5 × 10-3m	In greenhouse effect, it is responsible for keeping plants warm It helps to look through haze, fog, and mist in wars. Helps cure crop diseases Treats muscular strains In astronomy

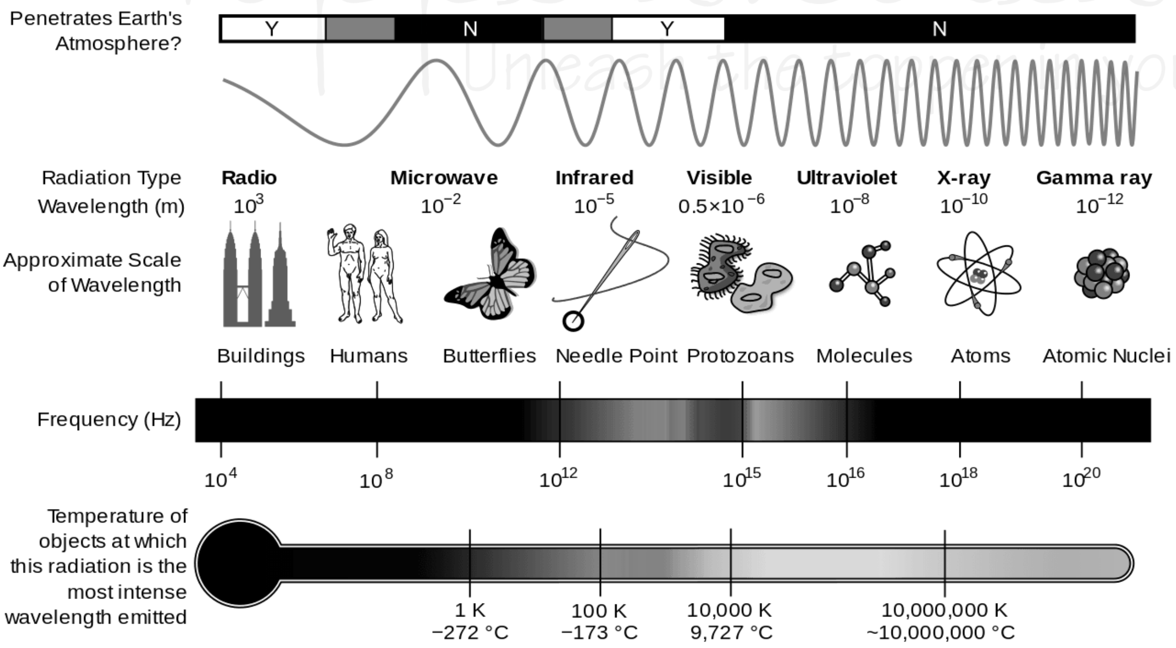
Microwaves	10-3 to 3 × 10-1m	In radar Long-distance wireless communication via satellites In microwave ovens
Radio waves	10-1 to 10-4m	In radio and television communication systems Marine and navigation use

Propagation of Electromagnetic Waves

- The sequence of electromagnetic wave movement is as follows:
  - Generation → propagation → reflection → reception
- The EM waves can be propagated from the transmitter to the receiver in the following ways:
  - Ground waves: They can be propagated along the surface of the ground, and the process is called ground wave propagation.
  - Skywaves: When the EM waves are propagated via sky, it is called sky wave propagation. In this type of propagation, the waves get reflected back to the earth from the ionosphere.
  - Space waves: EM waves often propagate from the transmitter to the receiver antenna without any reflection or refraction; then, it is called space wave propagation.

Magnetic resonance imaging and Nuclear magnetic resonance

- Nuclear Magnetic Resonance is an analytical chemistry technique used in **quality control** & research.
- **Nuclear Magnetic Resonance (NMR)** can **determine the content at the molecular level**.
- **NMR spectroscopy** is the study of molecules
- by recording the **interaction of radiofrequency (Rf) electromagnetic radiations**
- with the **nuclei of molecules**
- placed in a **strong magnetic field**.
- Hence NMR can be used to determine the **purity of a sample** as well as its **molecular structure**.
- The NMR test is **not required for honey that is being marketed locally** but is **needed for export**.



Magnetic Resonance Imaging (MRI)

- **MRI is a medical imaging application of nuclear magnetic resonance (NMR)**.
- MRI is used in radiology to form pictures of the anatomy and the physiological processes of the body.
- **Radiology**: a medical discipline that uses medical imaging to diagnose & treat diseases.

- Imaging techniques in radiology: X-ray (ionizing radiation), ultrasound (no ionizing radiation – it uses sound waves and sonar technology), computed tomography (CT – 5 to 10 times more ionizing radiation than X-ray), magnetic resonance imaging (MRI – no ionizing radiation), etc.
- MRI scanners use **strong magnetic fields** and **radio waves** to generate images of the organs in the body.
- MRI does **not involve X-rays or the use of ionizing radiation**, which distinguishes it from **CT**.
- Hence MRI is seen as a better choice than a CT scan.
- Compared with CT scans, MRI scans typically take longer and are louder.
- In addition, people with metal medical implants may be unable to undergo an MRI examination safely.
- This is because of the **strong magnetic fields** employed by the MRI Scanner.

Magnetic Field in an MRI Scanner

- MRI scanners have **giant electromagnets** with field strengths of between **0.5 tesla and 1.5 tesla** (1,500 times more powerful than a fridge magnet and **30,000X the geomagnetic field**).
- For reference, a fridge magnet is about 0.001 tesla, and the **Earth's magnetic field is 0.00005 tesla**.

Working of an MRI Scanner

- The human body is mostly water (hydrogen and oxygen), and when in the massive, stable magnetic field of the scanner, the **hydrogen protons** get aligned in the same direction.
- A radiofrequency source is then switched on and off, repeatedly knocking the protons out of line and back into alignment.
- Receivers pick up radio signals that the protons send out, and by combining these signals, the machine creates a detailed image of the body's inside.

Because of the machine's giant magnetic field, hospitals and diagnostic centers issue detailed guidelines to ensure **no metal objects are brought close**.

Nuclear fission and Fusion

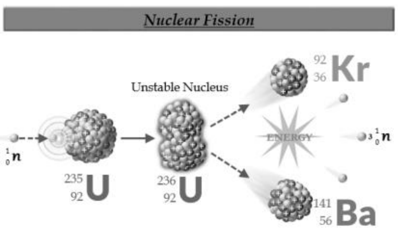
Nuclear fission

- Reaction where **nucleus of an atom splits into two or more smaller nuclei**, while releasing energy.
- **These extra neutrons hits** other surrounding U-235 atoms,
  - which will **also split and generate additional neutrons** in a multiplying effect,
  - thus **generating a chain reaction** in a fraction of a second.
- **Release of energy** each time the reaction occurs : in the **form of heat and radiation.**
- The **heat can be converted into electricity** in a nuclear power plant.
- **Most of the** Nuclear power plants are **nuclear fission based.**

Fission of Uranium Atom

- Naturally occurring Uranium is **in the form of its isotope U-238**(around 99%) and **rest in the form of U-235.**
- **Only U-235** can **undergo nuclear fission easily** to any great extent.
- **Enriched Uranium** : used in nuclear power applications whose **concentration varies from Low Enriched Uranium (LEU) having 3 to 5% enrichment to higher levels.**
- **When U-235 absorbs a slow moving neutron** - a **nuclear fission reaction takes place.**

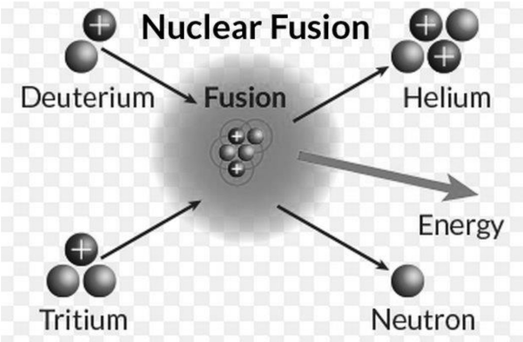
235U + 1 neutron = 89Kr + 144Ba + 3 neutrons + Energy



https://www.tutorix.com/question/36223/what-is-nuclear-fission-and-nuclear-fusion

Nuclear fusion

- Reaction in which **two or more lighter nuclei join together to form one or more heavier** elements.
- **Products of fusion reactions :** usually **different atomic nuclei and sub-atomic particles** such as neutrons and protons.
- **Change in mass takes place** between the reactants and products & manifested as **either the release of energy or absorption of energy.**
- **Nuclear fusion is opposite to nuclear fission** where the heavy nucleus splits apart.
- A **large amount of heat and pressure is required** for nuclear fusion reaction.
- **Nuclear fusion - takes place in the sun** and other active stars.
- **In the Sun :** hydrogen nuclei combine together to produce helium(Nuclear Fusion).
- **Energy potential of nuclear fusion :** 1st exploited in **thermonuclear weapons**, or **hydrogen bombs** etc.
- **Tech to generate electricity from fusion** - not developed yet.



https://www.bangkokpost.com/opinion/opinion/937073/forging-a-role-in-low-end-nuclear-fusion

Nuclear fuel

- **Fuel :** used **in a nuclear reactor to sustain a nuclear chain reaction.**
- These fuels are **fissile.**
- **Most common nuclear fuels :** radioactive metals **Uranium-235 and Plutonium-239.**
- **Major fuel elements:** Uranium dioxide, Uranium nitride, Uranium carbide, Plutonium, Thorium etc.
- The **pellets of Uranium oxides** : arranged in tubes **forming fuel rods.**
- These rods - **arranged in fuel assemblies** inside the nuclear reactor core.