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SSC

MTS/HAVALDAR

STAFF SELECTION COMMISSION (SSC)

Volume - 4

General Science and English

SIERRA INNOVATIONS

Table of Content

1 CHAPTER Basics of Everyday Physics

Measurement

Scalar Quantities:

- **Definition:** Quantities that have only magnitude and no direction.
- **Examples:** Mass, temperature, speed, distance, energy.
- **Characteristics:** Described by a single value; can be added or subtracted using simple arithmetic.

Vector Quantities:

- **Definition:** Quantities that have both magnitude and direction.
- **Examples:** Velocity, force, displacement, acceleration.
- **Characteristics:** Represented by arrows; require vector addition for combining; direction is crucial in describing them.

Every measurement has two parts:

- The **first** is a **number** (n) and the **next** is **a unit** (u).
- **Q = nu**.
- **For Example**, the **length** of an **object** = **40 cm**.
- The **number expressing** the **magnitude** of a **physical quantity** is **inversely proportional** to the **unit selected.**
- **If n1** and **n2** are the **numerical values** of a **physical quantity** corresponding to the **units u1** and **u2**, then **n1u1 = n2u2.**
- **For Example**,
  - ✓ 2.8 m = 280 cm
  - ✓ 6.2 kg = 6200 g.

Fundamental Quantities

The **quantities** that are **independent of other quantities** are **called fundamental quantities**.

- The **units** that are **used** to **measure** these **fundamental quantities** are **called fundamental units**.
- There are **four systems** of **units namely**
  - ✓ C.G.S,
  - ✓ M.K.S,
  - ✓ F.P.S,
  - ✓ SI.
- The **quantities** that are **derived using** the **fundamental quantities** are **called derived quantities**.
- The **units** that are **used** to **measure** these **derived quantities** are **called derived units.**

Fundamental and Supplementary Physical Quantities in SI system

Fundamental Quantity	**System of units**		
	C.G.S.	**M.K.S.**	**F.P.S.**
Length	centimeter	Meter	foot
Mass	gram	Kilogram	pound
Time	second	Second	second

Physical quantity	Unit	Symbol
Length	Meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Intensity of light	candela	cd
Quantity of substance	mole	mol

SI Units

- **Most SI units** are **used** in **scientific research**.
- **SI** is a coherent **system of units.**

Cohenrent System Of Units

- A coherent system of units is **one in which** the **units of derived quantities** are **obtained** as **multiples or submultiples** of certain basic units.
- **SI system** is a **comprehensive**, **coherent** and **rationalized** M.K.S. Ampere system (RMKSA system) and was devised **by Prof. Giorgi.**
- **Meter:** A meter is **equal** to **1650763.73 times** the **wavelength** of the **light emitted** in **vacuum due to electronic transition** from 2p10 state to 5d5 **state in Krypton-86**.
  - ✓ But **in 1983, 17th General Assembly** of **weights and measures adopted** a **new definition** for the **meter** in **terms of velocity of light**.
  - ✓ According to this definition, a **meter** is **defined as** the **distance traveled** by **light in vacuum during** a **time interval** of 1/299, 792, 458 of a second.
- **Kilogram:** The **mass** of a cylinder of **platinum-iridium alloy** kept **in** the **International Bureau** of **weights** and **measures preserved** at Serves **near Paris** is **called one kilogram.**
- **Second:** The **duration** of **9192631770 periods** of the **radiation corresponding** to the **transition between** the **two hyperfine levels** of the **ground state** of **cesium-133 atoms** is **called one second.**
- **Ampere:** The **current** which **when flowing** in **each** of **two parallel conductors** of **infinite length** and **negligible cross-section** and placed **one meter apart** in vacuum, **causes** each **conductor** to **experience** a **force** of **2 × 10-7 newtons per meter** of length **is known** as **one ampere.**
- **Kelvin:** The **fraction** of **1/273.16** of the **thermodynamic temperature** of the **triple point** of **water** is **called Kelvin.**
- **Candela:** The **luminous intensity** in the **perpendicular direction** of a **surface** of a **black body** of area **1/600000 m2** at the **temperature** of **solidifying platinum** under a **pressure of 101325 Nm-2** is known as **one candela.**

- **Mole:** The **amount** of a **substance** of a **system** which **contains** as **many elementary entities** as there are **atoms** in **12 × 10-3 kg** of **carbon-12** is known as **one mole.**

- **Radian:** The **angle made** by an **arc** of the **circle equivalent** to its **radius** at the **center** is known as **radian**.
  - ✓ **1 radian = 57 °17 ' 45 ".**
- **Derived SI units with Special Names:**

Physical quantity	**SI unit**	**Symbol**
Frequency	hertz	Hz
Energy	joule	J
Force	newton	N
Power	watt	W
Pressure	pascal	Pa
Electric charge or quantity of electricity	coulomb	C
Electric potential difference and emf	volt	V
Electric resistance	ohm	Ω
Electric conductance	siemen	S
Electric capacitance	farad	F
Magnetic flux	weber	Wb
Inductance	henry	H
Magnetic flux density	tesla	T
Illumination	lux	Lx
Luminous flux	lumen	Lm

Important Measuring Instruments

Instrument	**Function**
Micrometer	Measures small dimensions with high precision (typically in the range of microns).
Vernier Caliper	Measures internal and external dimensions, as well as depth and step measurements.
Anemometer	Measures the speed and velocity of wind or airflow.
Balance (Analytical)	Measures the mass of objects with high precision.
Voltmeter	Measures the potential difference (voltage) between two points in a circuit.
Ammeter	Measures electric current in a circuit.

Manometer	Measures the pressure of gases or liquids.
Seismometer	Detects and measures seismic waves caused by earthquakes or other ground motion.
Hygrometer	Measures the humidity level in the air.
Sphygmomanometer	Measures blood pressure.
Spectrophotometer	Measures the intensity of light absorbed by a sample at various wavelengths.
Tachometer	Measures the speed of rotation of an object (e.g., engine RPM).
Lux Meter	Measures light intensity in an area.
Altimeter	Measures altitude, typically in aviation and mountainous regions.
Pulse Oximeter	Measures oxygen saturation in blood.

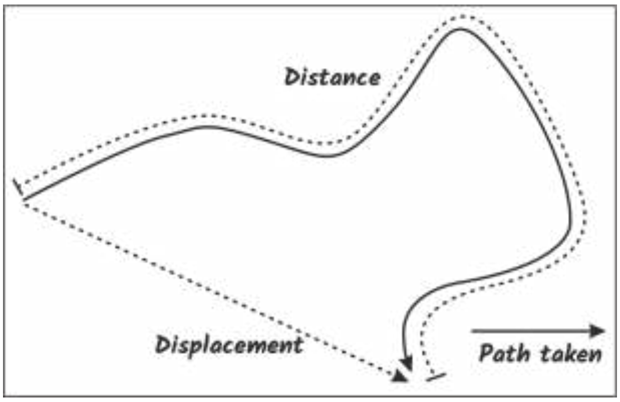
Everyday Equipments and Physics behind them

Equipment	Physical Phenomenon
Stethoscope	Reflection of sound
Remote Control	Infrared Radiation
Microwave oven	Electromagnetic Waves
Refrigerator	Thermodynamics
Washing Machine	Centrifugal Force
Electric Fan	Electromagnetic induction
Light Bulb	Incandescence
Smartphone	Radio Waves, Touch sensitivity
Television	Electromagnetic Waves
Air Conditioner	Refrigeration Cycle
Electric Kettle	Electrical Resistance Heating
Camera	Optics (Lens Focusing)
Speaker	Electromagnetic Induction
Hair Dryer	Convection Heating
Computer	Semiconductor Electronics
Photovoltaic cell	Solar energy (Photoelectric Effect)

Motion

- **An object** is said to be **in motion if** it **changes** its **position with time**.
- A **body which does not move** is said to be at **rest**, **motionless**, or **stationary**.
- An **object's state of motion** or rest cannot **change unless** it is **acted upon** by a **force**.
- **Described in** terms of **displacement**, **velocity**, and **displacement**.

Displacement



- **Shortest distance from** the **initial to** the **final position** of the object.
- **Represents** the **length** and **direction of** the **straight path**.
- **Vector quantity** as it has **both magnitude** and **direction**

Distance

- **Scalar quantity** measuring only the length of path.

Velocity

- **Speed in a given direction.**
- **Describes** only **how fast** an **object** is **moving** and **direction** of object's **motion**
- A **vector quantity**.
- **Unit** - meter per second (m/s).

Acceleration

- **Rate of change of velocity with time.**
- **Rate** at which an **object speeds up** or **slows down**.
- **Positive Acceleration:** If the object speeds up.
- **Negative Acceleration:** If the object slows down.
- A **vector quantity**.
- **SI unit:** meter per second squares (m/s2).

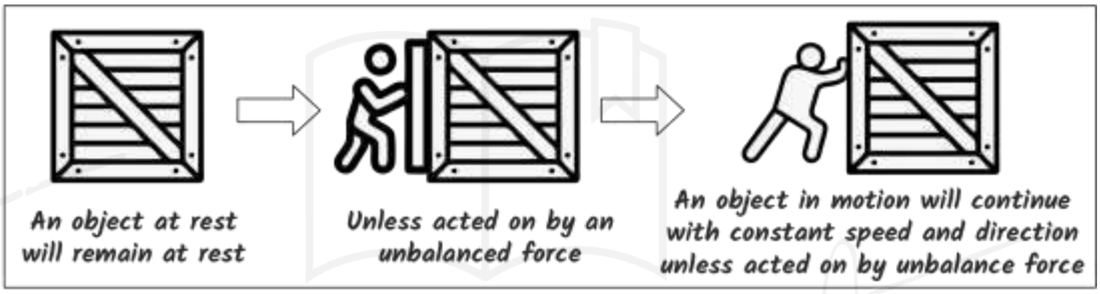
Types of Motion

Oscillating Motion	➢ **Back** and **forth oscillation** causes this motion ➢ If a **thing repeats** the **motion cycle** after a certain period is considered to be oscillating. ➢ **Example:** sprinkler system, the pendulum of a clock ,sound waves.
Linear Motion (Uniform + Non Uniform)	➢ **Straight Line Path**: The motion occurs along a straight line (either uniform or non-uniform). ➢ **Velocity**: In uniform linear motion, velocity remains constant, while in non-uniform motion, velocity changes. ➢ **Acceleration**: In uniform motion, acceleration is zero, while in non-uniform motion, acceleration may be constant or variable.
Uniform motion:	➢ **Constant Speed**: The object moves at a constant speed along a straight path. ➢ **Equal Distance in Equal Time**: The object covers equal distances in equal intervals of time. ➢ **No Acceleration**: There is no change in the velocity or direction of motion.

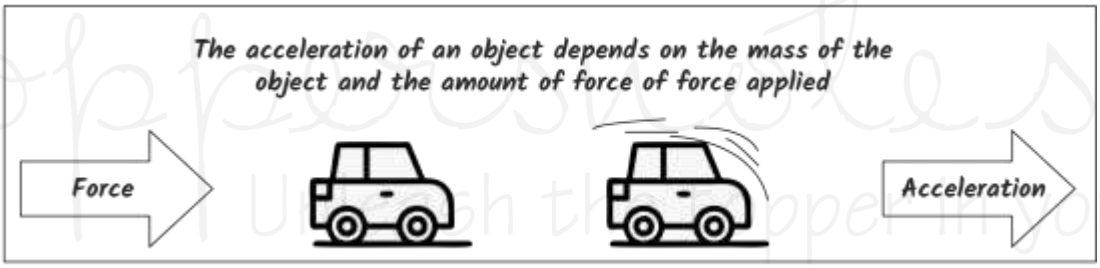
Non-uniform motion:	➢ ***Varying Speed***: *The speed of the object changes continuously over time.* ➢ ***Unequal Distance in Equal Time***: *The object covers unequal distances in equal intervals of time.* ➢ ***Acceleration/Deceleration***: *The object may speed up (acceleration) or slow down (deceleration) during its motion.*
Circular Motion	➢ ***Motion along a Circular Path:*** *The object moves along a circle, maintaining a constant distance from a fixed point (center).* ➢ ***Centripetal Force:*** *A force acts towards the center of the circle to keep the object in its circular path.* ➢ *Constant Speed, Changing Velocity: The object may move at a constant speed, but its direction constantly changes, so velocity is not constant.*

Laws of Motion

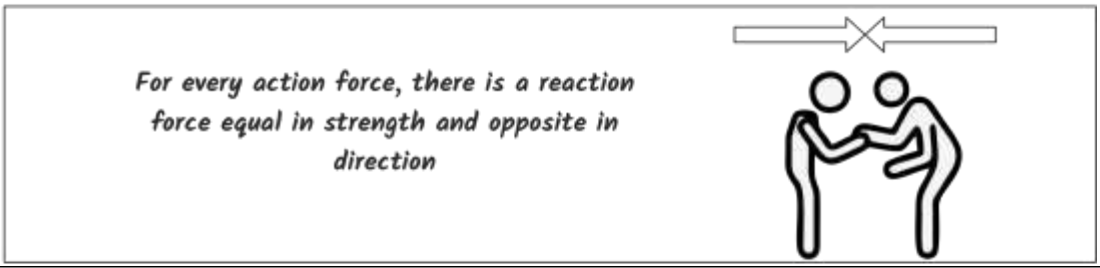
Newton's First Law of Motion



Newton's Second law of Motion



Newton's Third law of Motion



Inertia:

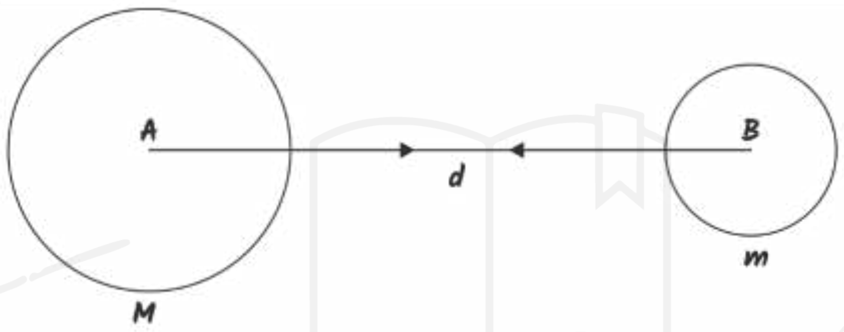
- ➢ ***Resistance*** *of any physical object* ***to any change in its velocity.***
- ➢ ***Includes changes*** *to the* ***object's speed****, or* ***direction*** *of* ***motion****.*
- ➢ ***Tendency of objects*** *to* ***keep moving*** *in a* ***straight line*** *at a* ***constant speed*** *or to* ***remain*** *in state of* ***rest*** *when* ***no forces act*** *upon them, according to the first law of motion.*

Gravity

- **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:

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

- Here M and m = masses of the objects interacting
- d- distance between the center of the masses
- G -gravitational constant (6.674×10^−11 m3⋅kg−1⋅s−2)

Free Fall due to Gravity

Free fall: Motion of an object under the influence of gravity alone, with no air resistance.

Acceleration due to gravity (g): Constant at 9.8 m/s29.8 \, \text{m/s}^29.8m/s2 near Earth's surface, independent of mass.

Mass: The acceleration in free fall does not depend on the mass of the object.

Dropped object: Initial velocity (uuu) is zero when dropped from a height.

Thrown upwards: Final velocity (vvv) becomes zero at the highest point of the upward motion.

Same acceleration: All objects near Earth's surface experience the same acceleration due to gravity.

Energy

- **Capacity** of a body **to do work.**
- **SI unit:** Joule (J).

Forms of Energy

Kinetic Energy: Energy possessed by an object due to its motion.

Potential Energy: Energy stored in an object due to its position or state.

Thermal Energy: Energy related to the temperature of an object, due to the motion of its particles.

Chemical Energy: Energy stored in chemical bonds, released during chemical reactions.

Electrical Energy: Energy from the movement of electrons through a conductor.

Nuclear Energy: Energy stored in the nucleus of atoms, released during nuclear reactions.

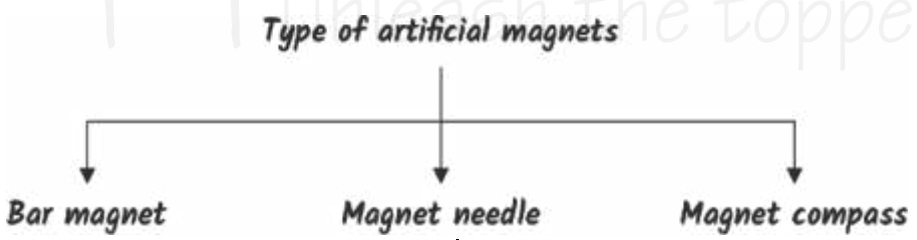
Radiant (Light) Energy: Energy carried by electromagnetic waves, including light.

Conversion from one form to another

Energy Conversion	Instrument	Energy Form Converted
Kinetic → Potential	Elevators, Waterfalls	Kinetic to Potential Energy
Potential → Kinetic	Falling Object, Pendulum	Potential to Kinetic Energy
Chemical → Thermal	Stove, Combustion Engine	Chemical to Thermal Energy
Electrical → Thermal	Electric Heater, Toaster	Electrical to Thermal Energy
Electrical → Mechanical	Electric Motor, Fan	Electrical to Mechanical Energy
Mechanical → Electrical	Generator, Dynamo	Mechanical to Electrical Energy
Radiant → Chemical	Photosynthesis (in plants)	Radiant to Chemical Energy
Mechanical → Sound	Loudspeaker, Bell	Mechanical to Sound Energy

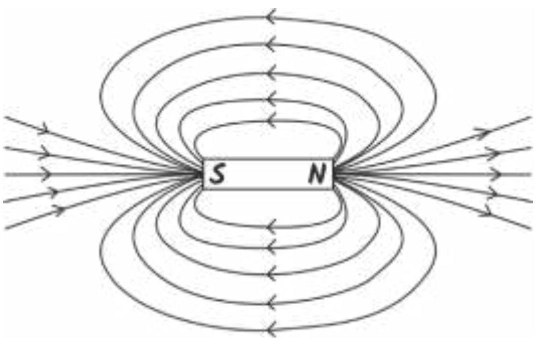
Magnetism

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.

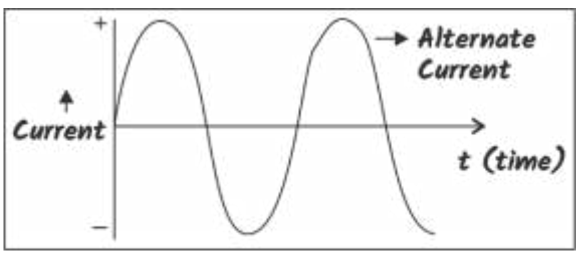
Magnetic field



- ***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.*

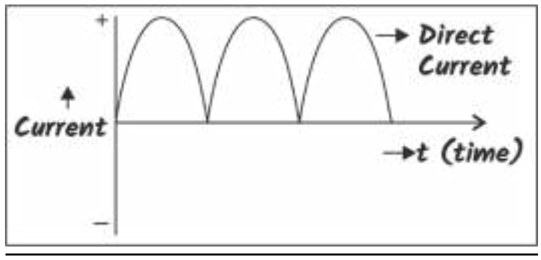
Electric Current

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**.*

Electromagnetic Spectrum

*The **electromagnetic spectrum** encompasses all types of electromagnetic radiation, ranging from low-energy radio waves to high-energy gamma rays. It includes various wave types, such as radio, microwave, infrared, visible light, ultraviolet, X-rays, and gamma rays, classified by wavelength and frequency. These waves travel at the speed of light and differ in their energy, penetration ability, and practical applications.*

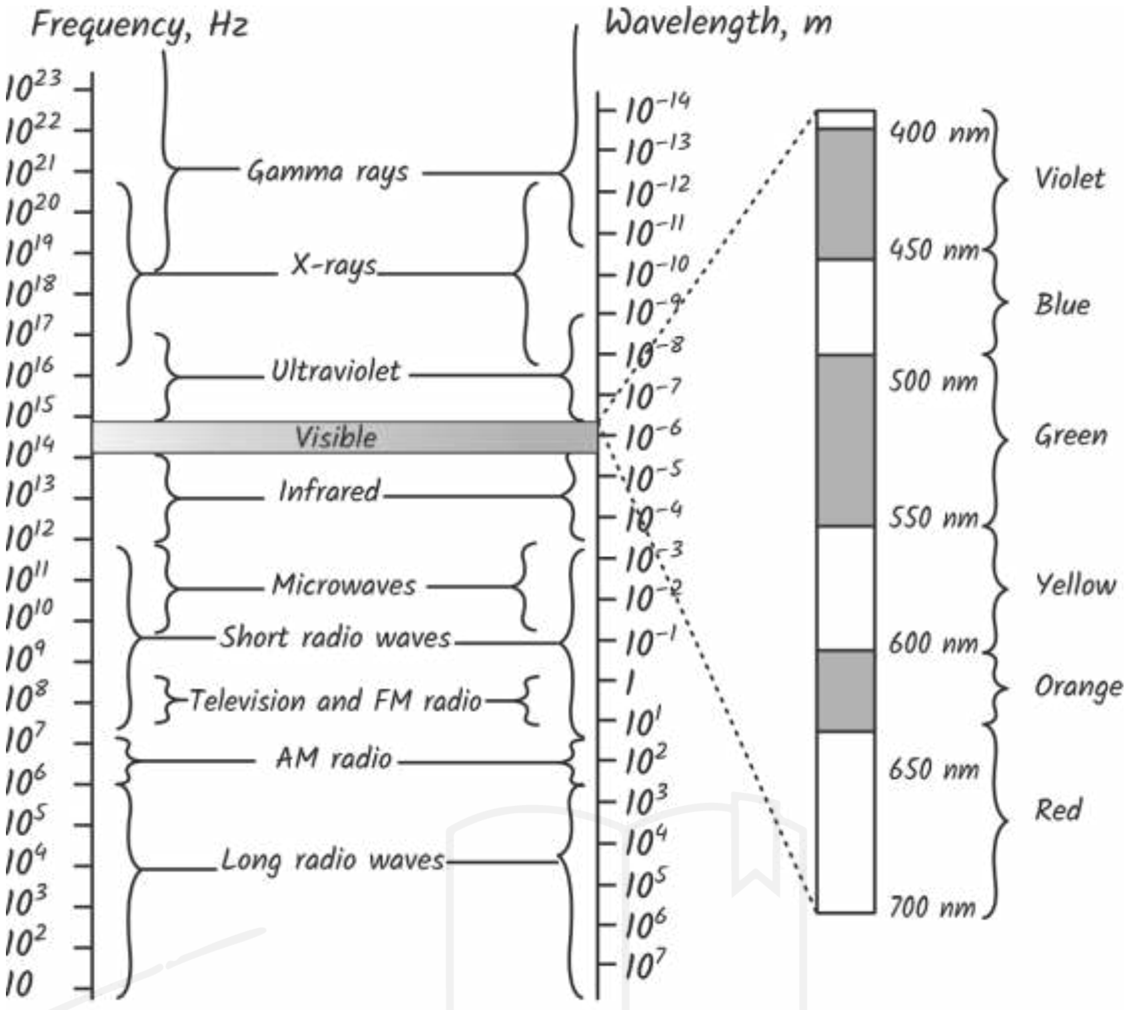


Figure: The electromagnetic spectrum, with common names for various part of it. The various regions do not have sharply defined boundaries.

Radio Waves	➢ Used in radio (AM and FM bands) and television communications systems. ➢ Cellular phones use them to transmit voice communication in UHF band.
Microwaves	➢ Suitable for radar systems used for aircraft navigation, speed guns used to time fast balls, tennis-serves and automobiles. ➢ Microwave oven use selective frequency of microwaves to match the resonant frequency of water molecules to efficiently transfer wave energy to kinetic energy of molecules. It raises the temperature of food containing water.
Infrared Waves	➢ Infrared lamps used in physical therapy ➢ Maintains earth's average temperature through Greenhouse effect ➢ Infrared detectors are used in Earth Satellites ➢ Semiconductor light emitting diodes, emitting infrared lights are used in TV/AC remotes, video recorders and hi-fi systems. ➢ Snakes can detect infrared waves

Visible rays	➢ Helps us see different objects and different colours
Ultraviolet rays	➢ Sun is an important source of UV-rays and most of it gets absorbed by the Ozone Layer in the atmosphere ➢ Exposure to UV radiations induces production of more melanin, causing skin tanning (Ordinary glass absorbs UV-rays thus, protect from tanning) ➢ UV is produced by welding arcs thus; welders wear special glass goggles or face masks for protection ➢ Used in LASIK eye surgery ➢ UV lamps used to kill germs in water purifiers
X-rays	➢ Used as a diagnostic tool in medicine and treatment of cancer
Gamma rays	➢ Used in medicine to destroy cancer cells

Utility of electro-magnetic waves based on their frequency

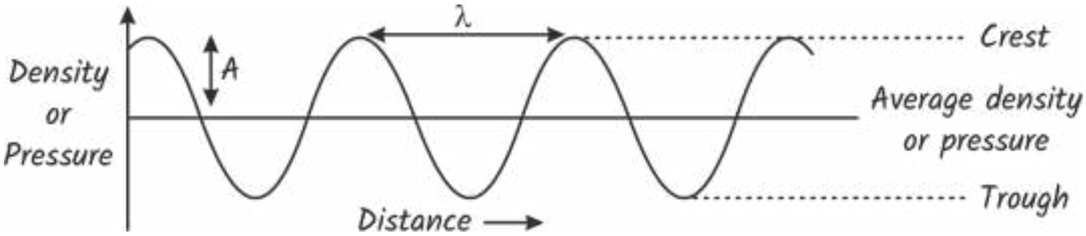
Frequency Band	Frequency Range	Mode of Travel	Examples
Low Frequency (LF)	30 KHz-300 KHz	Ground Waves	Am Radio
Medium Frequency (MF)	300 KHz-3 MHz	Ground and sky Waves	Am radio broadcasting
High frequency (Hf)	3 MHz-30 MHz	Sky Waves	Shortwave radio
Very high Frequency (VHF)	30 MHz-300s MHz	Space waves	Fm radio, television broadcasts
Ultra High Frequency (UHF)	300 Mhz-3 GHz	Space waves	Television Broadcasts, Mobile phones
Super High Frequency (SHF)	3 GHz-30 GHz	Space waves	Satellite communications, radar
Extremely High Frequency (EHF)	30 GHz-300 GHz	Space waves	Advanced radar Systems, experimental communications

Sound

➢ Sound is a form of energy which produces a sensation of hearing in our ears. Sound is a mechanical wave and needs a material medium like air, water, steel etc. for its propagation. It cannot travel through vacuum.

Important terms related to sound-

1. **Wavelength (Lemda)**-The distance between two consecutive compressions (C) or two consecutive rarefactions (R).
2. **Frequency**-The number of oscillations per unit time is the frequency of the sound wave



Propagation of Sound Waves

1. **Medium Requirement**: Sound requires a medium (solid, liquid, or gas) to propagate. It cannot travel through a vacuum, as there are no particles to transmit the vibrations.
2. **Mechanism of Propagation**: Sound waves propagate through the vibration of particles in the medium. These vibrations create compressions (high-pressure regions) and rarefactions (low-pressure regions) that move in the direction of the wave.
3. **Speed of Sound**: The speed of sound varies depending on the medium's density and elasticity. It travels faster in denser mediums like solids and slower in gases.
4. **Wavelength and Frequency**: The **wavelength** of sound depends on its frequency and the speed of propagation in the medium. As the frequency increases, the wavelength decreases (inverse relationship).
5. **Effect of Medium Change**:
   - ✓ **Speed and Wavelength**: When sound passes from one medium to another (e.g., from air to water), its speed and wavelength change because of the different properties of the media, like density and elasticity.
   - ✓ **Frequency**: The **frequency** of the sound wave typically **remains constant** when transitioning between media. It does not change because the source of the sound remains the same.

Types of Sound Waves:

1. **Infrasound**:
   - ✓ **Frequency**: Below 20 Hz.
   - ✓ **Features**: Cannot be heard by humans; used for detecting natural events like earthquakes.
2. **Audible Sound**:
   - ✓ **Frequency**: 20 Hz to 20,000 Hz.
   - ✓ **Features**: The range of sound audible to the human ear.
3. **Ultrasound**:
   - ✓ **Frequency**: Above 20,000 Hz.
   - ✓ **Features**: Used in medical imaging, cleaning, and industrial applications.
4. **Hypersound**:
   - ✓ **Frequency**: Above 1 GHz.
   - ✓ **Features**: Used in scientific research and high-frequency applications.

3. **Sonic boom -** When a sound, producing source(Bullets, Jets) moves with a speed higher than that of sound, it produces shock waves in air. These shock waves carry a large amount of energy. The air pressure variation associated with this type of shock waves produces a very sharp and loud sound called the "sonic boom". The shock waves produced by a supersonic aircraft have enough energy to shatter glass and even damage buildings.
4. **Reverberation-** The repeated reflection that results in the persistence of sound is called reverberation. Stethoscope works on this principle.
5. **Refraction of Sound Waves -** When a sound wave bends due to changes in its speed as it passes through a medium. The density of a gas decreases with the rise in temperature, inversely proportional.
6. **Diffraction of Sound Waves -** Ability of the sound waves to bend around obstacles is known as diffraction. For example, sound waves diffract around walls and door openings to carry sound from one room to another.

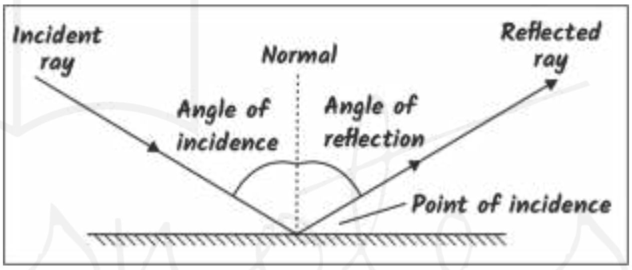
Optics

- **Branch of physics concerned with light** and it's **behavioural pattern** and **properties**.
- Used to **describe behaviour of visible light**, **infrared light**, and **ultraviolet**.

Light

- **Form of energy** in form of an electromagnetic wave that **helps us to see objects**.
- **Wavelength**: 400–700 nanometres.
- **Primary source of light:** Sun
- **Properties:**
  - ✓ **Does not require** any material **medium** to **travel**.
  - ✓ **Travels** in a **straight line**.
  - ✓ **Dual nature-** travels as a wave as well as particle.
  - ✓ **Casts shadow**.

Reflection



- one of the **primary properties** of light.
- **Bouncing back of light** when it strikes a polished surface.
- **Incident light:** Light which falls on the surface.
- **Reflected light**: Light which bounces back after reflection.
- **Angle of incidence**: Angle between incident ray and normal.
- **Angle of reflection**: Angle between the reflected ray and the normal.

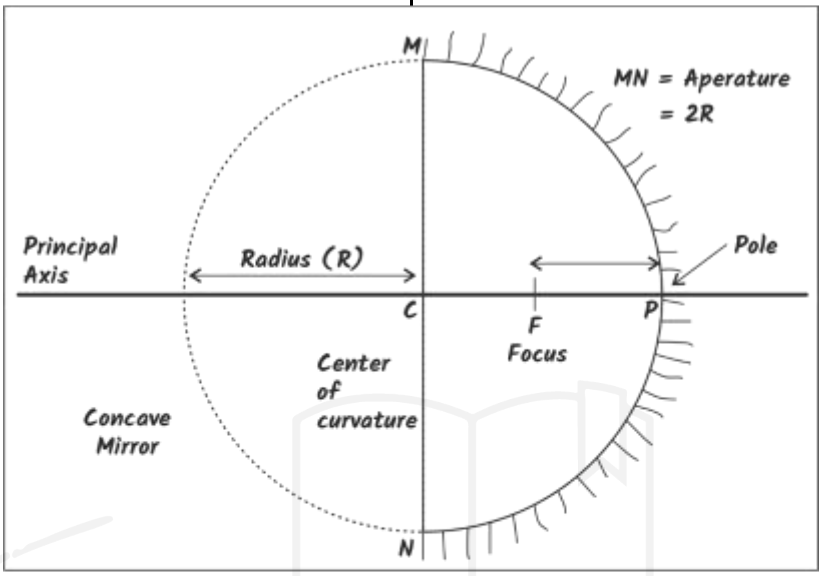
Mirror

- **Surface** which can **reflect the light**.

- **Types:**
  1. **Plane Mirror:**
     - **Reflecting surface** is a **plane**.
  2. **Spherical Mirror:**
     - **Reflecting surface** is **part** of the **hollow sphere**.
     - 2 **types:**

       A. **Convex mirror:**
       - **Reflecting** surface is **convex**.
       - **Diverges** light.

       B. **Concave mirror:**
       - **Reflecting** surface is **concave**.
       - **Converges** the light.
- **Parameters of Mirror:**



- ✓ **Center of Curvature:**
  - Centre of hollow sphere of which mirror is a part.
- ✓ **Radius of curvature:**
  - Radius of hollow sphere of which mirror is a part.
- ✓ **Pole:**
  - Centre of mirror (middle point).
- ✓ **Principal axis:**
  - Line joining pole and center of curvature.
- ✓ **Aperture:**
  - Size of mirror.
- ✓ **Principal Focus:**
  - Point on principal axis, where all incident rays parallel to principal axis converge or diverge after reflection through mirror.
- ✓ **Focal Length:**
  - Distance between pole and focus point.

- **Use of Concave Mirror:** Makeup mirror, reflector in torches, in headlights of cars and searchlights, doctor's head-mirrors, solar furnace, etc.
- **Use of Convex Mirror:** Rear view mirror in vehicles, as shop security mirrors, etc.

Refraction

- **Bending of light** at the **interface** of **two** different **mediums**.
- **If** the **velocity** of light in medium **is more**, then **medium** is called **optical rarer**.
  - ✓ **Eg**, air or vacuum is more optical rarer.
- **If** the **velocity** of **light** in medium is **less**, then **medium** is called **optical denser**.
  - ✓ **Eg**, glass is more denser than air.
- **Refractive Index:**

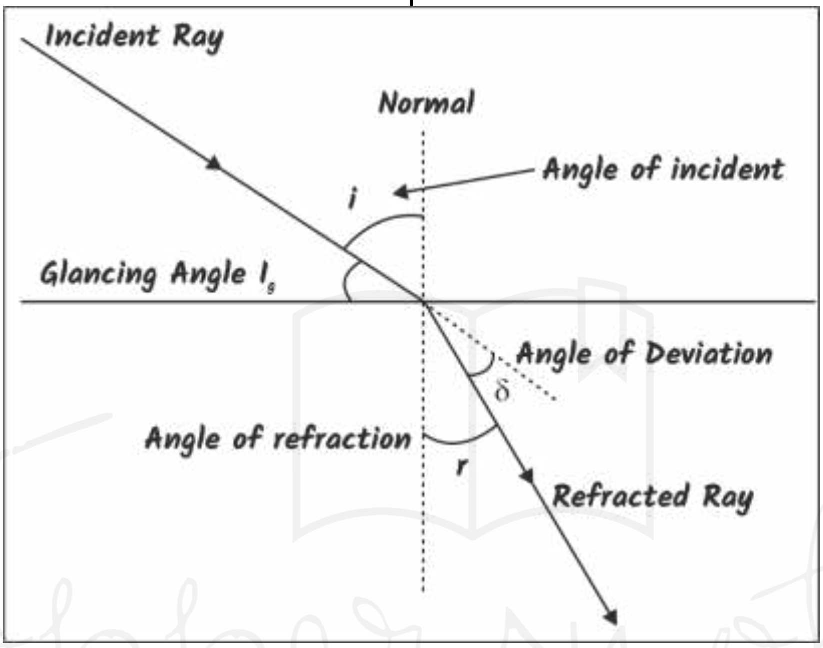
- ***Represents amount*** *or extent* ***of bending of light*** *when it* ***passes from one medium*** *to* ***another***.
- ***2 types:***
  - ✓ ***Relative refractive index***
    - ■ ***Refractive index*** *of* ***medium with respect to other medium***
  - ■ *Refractive index of medium 1 wrt medium 2*

    = ***Speed of light in medium 1***

    Speed of light in medium 2
  - ✓ ***Absolute refractive index***
    - ■ ***Refractive index*** *of* ***medium with respect to air*** *or* ***vacuum***.
    - ■ *Absolute refractive index of medium (m)*

      = ***Speed of light in air***

      Speed of light in medium



- ***Incident ray:*** ***Incoming ray*** *on the refracting surface.*
- ***Refracted ray:*** *An* ***outgoing ray*** *from the refracting surface.*
- ***Angle of incidence*** *(i):* ***Angle between incident rays*** *and* ***perpendicular line*** *(normal) at the* ***point*** *of* ***incidence***.
- ***Angle of refraction (r): Angle between refracted rays*** *and* ***perpendicular*** *line (normal) at the* ***point of incidence***.

Lens

- ***Transparent refracting medium bounded by two surfaces*** *in which* ***at least one*** *surface is* ***curved***.
- ***2 types:***
  - ✓ ***Convex lens/ converging lenses***
    - ■ ***Thicker*** *at the* ***centre*** *than at the edges.*
  - ✓ ***Concave lens/ Diverging lenses***
    - ■ ***Thinner*** *at the* ***centre*** *than at the edges.*

Total Internal Reflection (TIR)

- ***When*** *a* ***beam of*** *light* ***strikes water***, *a* ***part*** *of the light is* ***reflected***, *and some* ***part*** *of the light is* ***refracted***.

Image formation by Concave Mirror

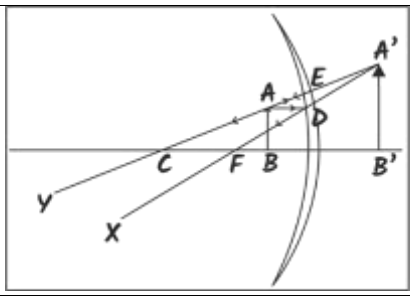
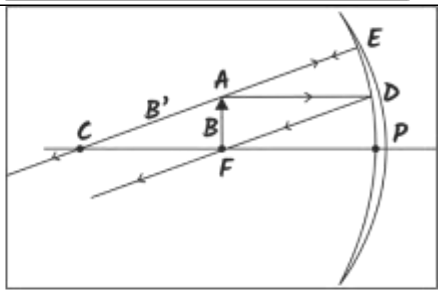
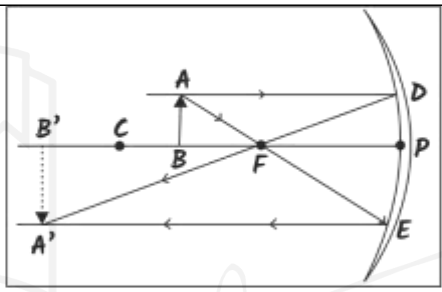
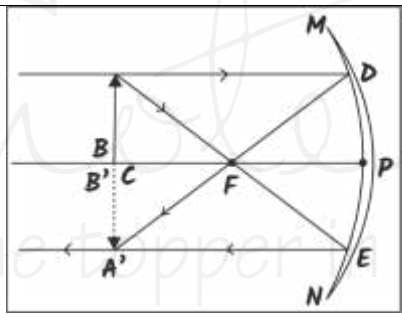
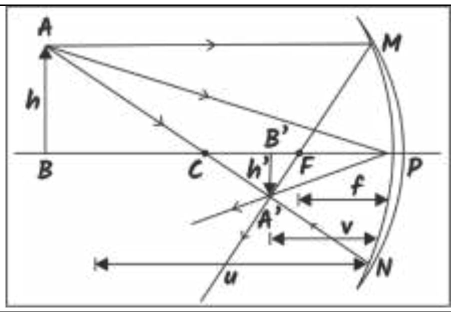
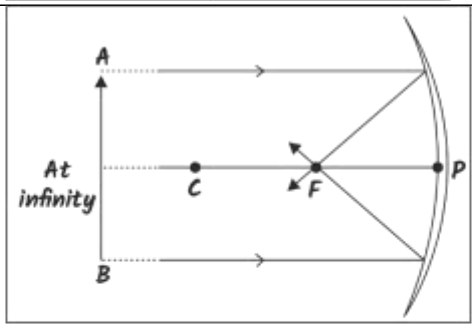
Position of Object	Position of Image	Image Size	Nature of Image	Ray Diagram
Within focus (Between P and F)	Behind the mirror	Enlarged	Virtual and erect	
At focus	At infinity	Highly Enlarged	Real and Inverted	
Between F and C	Beyond C	Enlarged	Real and Inverted	
At C	At C	Equal to object	Real and Inverted	
Between Infinity and C	Between F and C	Diminished	Real and Inverted	
At Infinity	At focus (F)	Highly Diminished	Real and Inverted	

Image formed by Convex Mirror

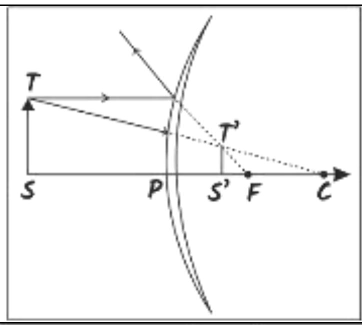
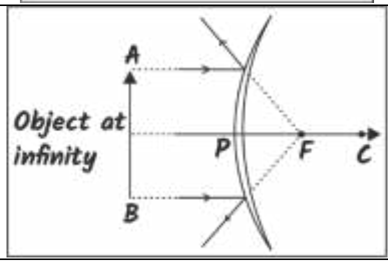
Position of Object	Position of Image	Image of Size	Nature of Image	Ray Diagram
Anywhere between pole P and Infinity	Behind the mirror between P and F	Diminished	Virtual and erect	
At infinity	Behind the mirror at Focus (F)	Highly Diminished	Virtual and erect	

Image formation by Concave Lens

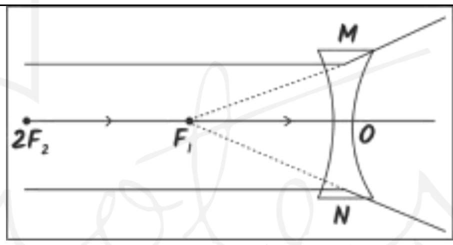
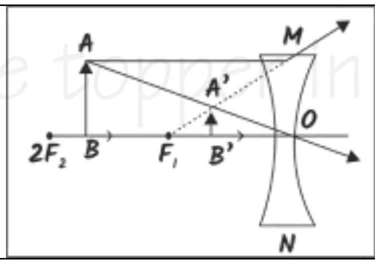
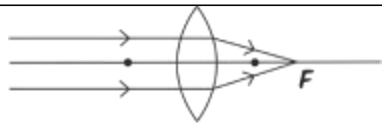
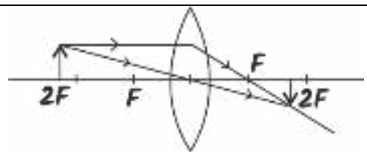
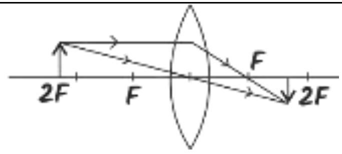
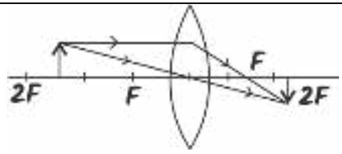
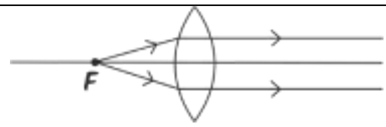
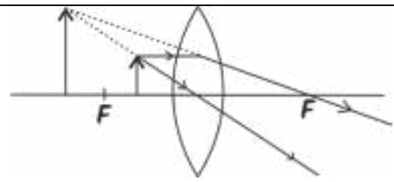
Object Position	Image Position	Nature and Size of Image	Ray Diagram
At Infinity	At Focus (F)	Highly diminished, Virtual, Upright	
finite distance	Between Focus (F) and Optical Centre	Diminished, Virtual Upright	

Image formation by Convex Lens

Object Position	**Image Position**	**Nature of the Image**	**Ray Diagram**
Infinity	On Focus F2	Real and Inverted, Highly Diminished	
Beyond 2FI	Between FI and F2	Real and Inverted, Diminished	

At 2F1	At 2F2	Real and Inverted, of same size	
Between F1 and 2F1	Beyond 2F2	Real and Inverted, enlarged	
At Focus F1	At infinity	Real and Inverted	
Between F1 and Optical Centre O	On the same side of the lens as the object	Real and Inverted, enlarges	

Nuclear Physics

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