Class 10 Physics Formula

Reflection of Light

Reflection of Light

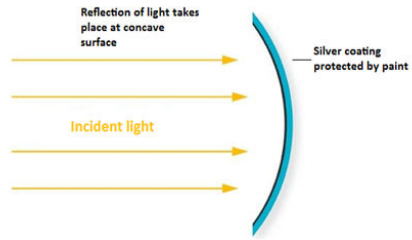
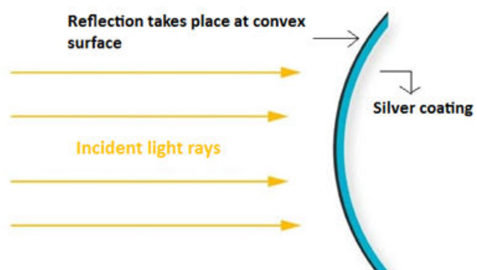
The process of sending back light rays which falls on the surface of an object is called *REFLECTION* of light

Laws of Reflection of light
The angle of incidence is equal to the angle of reflection, and
The incident ray, the reflected ray and the normal to the mirror at the point of incidence all lie in the same plane.

These laws of reflection are applicable to all types of reflecting surfaces including spherical surfaces

Important Terms

S.no	Quantities	Description
1	Real Images	Real images are formed when rays of light that comes from an object (or source) meets at a point after reflection from a mirror (or refraction from a lens). Real images can be formed on a screen and can be seen with the eyes
2	Virtual images	Virtual image is an image in which the outgoing rays from an object do not meet at a point. It will appear to meet at a point in or behind the optical device (i.e., a mirror) but they do not actually meet after reflection from a mirror (or refraction from a lens). A plane mirror always forms virtual images
3	Lateral inversion	If an object is placed in front of the mirror, then the right side of the object appears to be the left side and left side of the object appears to be the right side of this image. This change of sides of an object and its mirror image is called lateral inversion.
4	Characteristics of Plane Mirror	(a) Images formed by mirrors are always virtual and erect (b) Size of image is always equal to the size of the object and the image is laterally inverted. (c) The images formed by the plane mirror are as far behind the mirror as the object in front of the mirror.
5	Spherical Mirror	The reflecting surface of a spherical mirror may be curved inwards or outwards.

6	Concave Mirror	Reflection of light takes place at the concave surface or  bent-in surface Figure 1a :- A concave mirror
7	Convex Mirror	Reflection of light takes place at the convex surface or bent out surface  Figure 1b :- A convex mirror
8	Center of Curvature	The reflecting surface of a spherical mirror forms a part of a sphere. This sphere has a centre. This point is called the centre of curvature of the spherical mirror. It is represented by the letter C
9	Radius of curvature	The radius of the sphere of which the reflecting surface of a spherical mirror forms a part, is called the radius of curvature of the mirror. It is represented by the letter R
10	Pole	The center of a spherical mirror is called its pole and is represented by letter P
11	Principal Axis	Straight line passing through the pole and the centre of curvature of a spherical mirror is called principle axis of the mirror.
12	Principal Focus	The principal focus of the concave mirror is the point on the principal axis from which Light rays that are parallel to the principal axis converge after reflecting from the mirror. The principal focus of a convex mirror is the point on the principal Axis from which all the incident rays parallel to

		principal Axis appear to come after reflection from the convex mirror
13	Focal Length	The distance between the pole and the principal focus of a spherical mirror is called the focal length. It is represented by the letter f.
14	Relationship between f and R	R=2f

Image formation by Concave Mirror

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At focus F	Highly diminished, point sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

Image formation by Convex Mirror

Position of the object	Position of the image	Size of the image	Nature of the image
Anywhere between P and infinity	Behind the mirror between P and F	Diminished	Virtual and erect
At infinity	Behind the mirror at focus	Highly Diminished	Virtual and erect

Formula Used in Spherical Mirror

Mirror formula

It gives the relationship between image distance *(v)* , object distance *(u)* and the focal length *(f)* of the mirror and is written as

$$\frac{1}{u}+\frac{1}{f}=\frac{1}{f}$$

Where *v* is the distance of image from the mirror, *u* is the distance of object from the mirror and *f* is the focal length of the mirror. This formula is valid in all situations for all spherical mirrors for all positions of the object.

Magnification

Magnification produced by a spherical mirror gives the relative extent to which the image of an object is magnified with respect to the object size. It is expressed as the ratio of the height of the image to the height of the object. It is usually represented by the letter *m*.

So,

$$magnification\ m=\frac{hight\ of\ image(h_1)}{hight\ of\ object(h_2)}$$

or,

$$m=\frac{h_1}{h_2}$$

The magnification *m* is also related to the object distance *(u)* and image distance *(v)* and is given as

$$m=\frac{h_1}{h_2}=\frac{-v}{u}$$

Sign Convention

Reflection of light by spherical mirrors follow a set of sign conventions called the New Cartesian Sign Convention. In this convention, the pole (P) of the mirror is taken as the origin. The principal axis of the mirror is taken as the x-axis of the coordinate system. The conventions are as follows

- The object is always placed to the left of the mirror. This implies that the light from the object falls on the mirror from the left-hand side.
- All distances parallel to the principal axis are measured from the pole of the mirror.
- All the distances measured to the right of the origin (along + x-axis) are taken as positive while those measured to the left of the origin (along - x-axis) are taken as negative.
- Distances measured perpendicular to and above the principal axis (along + y-axis) are taken as positive.
- Distances measured perpendicular to and below the principal axis (along -y-axis) are taken as negative.

Refraction of Light

Refraction of Light

When light ray is made to travel from one medium to another say from air to glass medium then light rays bend at the boundary between the two mediums. This bending of light when it passes from one medium to another is called *Refraction of light*.

The refraction of light takes place on going from one medium to another because the speed of light is different in two media.

Medium in which speed of light is more is called *optically rarer medium* and medium in which speed of light is less is known as *optically denser medium. For example, glass is an optically denser medium* than air and water.

When light goes from rarer medium to denser medium it bends towards the normal and when it goes from denser medium to rarer medium it bends away from the normal.

Laws of Refraction of Light

Laws of refraction of light are

1) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.

2) The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given color and for the given pair of media. This law is also known as *Snell's law of refraction*.

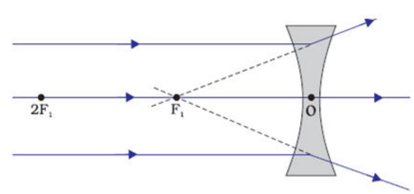
3) If i is the angle of incidence and r is the angle of refraction then

$$\frac{\sin i}{\sin r} = n = constant$$

This constant value is called the refractive index of the second medium with respect to the first.

Important Terms

S.no	Quantities	Description
1	Refractive Index	The refractive index is related to an important physical quantity that is relative speed of propagation of light in different media as light propagates with different speeds in different media

		The refractive index of medium 1 with respect to medium 2 is represented as n12. It is given by $$n_{12} = \frac{speed\ of\ light\ in\ medium\ 2}{speed\ of\ light\ in\ medium\ 1} = \frac{v_2}{v_1}$$
2	Absolute Refractive Index	If medium 1 is vacuum or air, then the refractive index of medium 2 is considered with respect to vacuum. This is called the *absolute refractive index* of the medium. If c is the speed of light in the air and v is the speed of light in any medium, then refractive index n_m of the medium $$n_m = \frac{speed\ of\ light\ in\ air}{speed\ of\ light\ in\ medium} = \frac{c}{v}$$ would
3	Characteristics of Plane Slab	1) Angle of incidence and angle of emergence are equal as emergent ray and incident ray are parallel to each other. 2) When a light ray is incident normally to the interface of two media then there is no bending of light ray and it goes straight through the medium.
4	Spherical Lens	A lens is a piece of transparent glass bound by two spherical surfaces.
5	Concave Lens	A concave lens bulges inward and is thinner in the middle and thicker at the edges. Such lenses diverge light rays  **Figure 1(b) Diverging action of concave lens** Concave lenses are called diverging lenses.
6	Convex Lens	A convex lens bulges outward and is thick at the center and thinner at the edges. Convex lens converges the light rays

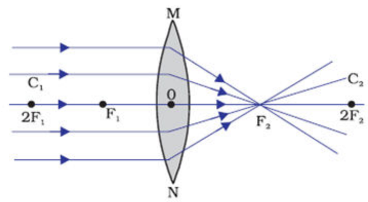
		 Figure 1(a) Converging action of convex lens convex lenses are called converging lenses.
7	Center of Curvature	A lens, whether it is a convex lens or a concave lens, has two spherical surfaces which form a part of a sphere. The centers of these spheres are called centers of curvature of the lens usually represented by the letter C. Since there are two centers of curvature, we may represent them as C_1 and C_2
8	Optical Center	The central point of a lens is its optical centre. It is usually represented by the letter O.
9	Principal Axis	An imaginary straight line passing through the two centers of curvature of a lens is called its principal axis
10	Principal Focus	When several rays of light parallel to the principal axis are falling on a convex lens. These rays, after refraction from the lens, are converging to a point on the principal axis. This point on the principal axis is called the principal focus of the lens. When several rays of light parallel to the principal axis are falling on a concave lens. These rays, after refraction from the lens, are appearing to diverge from a point on the principal axis. This point on the principal axis is called the principal focus of the concave lens
11	Focal Length	The distance of the principal focus from the optical centre of a lens is called its focal length represented by letter f

Image formation by Concave Lens

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F	Highly diminished, point-sized	Virtual and erect

Between infinity and optical center O of the lens	Between F_1 and optical center O	Diminished	Virtual and erect

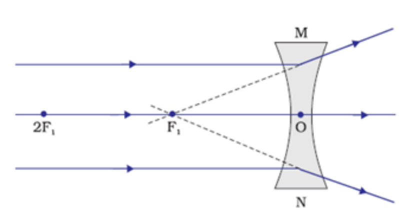
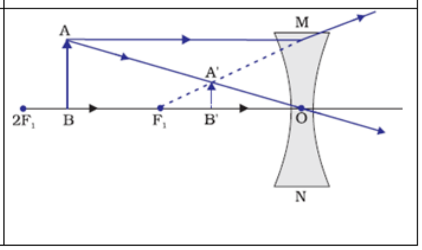
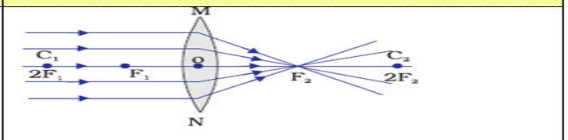
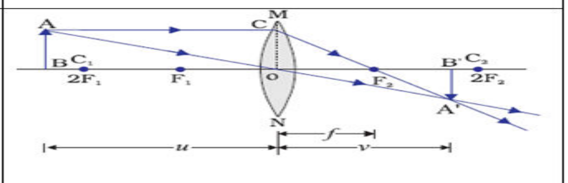
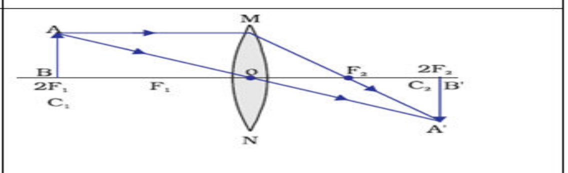
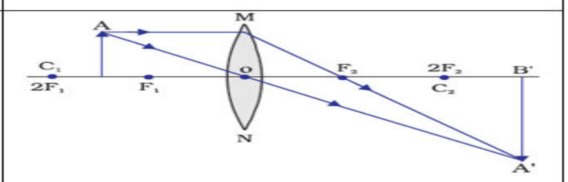
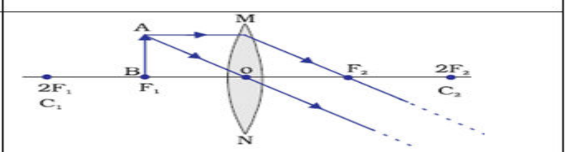
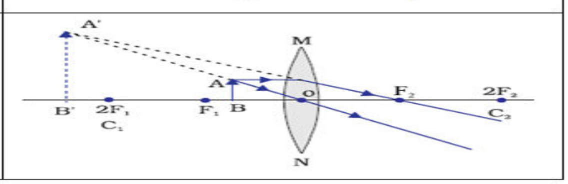
Position of the object	Ray Diagram
Infinity	
Between infinity and optical center O of the lens	

Image formation by Convex Lens

Position of the object	Position of the image	Relative size of the image	Nature of the image
Infinity	At focus F_2	Highly diminished, point sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At 2F2	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At focus $2F_1$	At infinity	Infinitely large or highly enlarged	Real and inverted
Between F_1 and optical center O	On the same side of the lens as the object	Enlarged	Virtual and erect

Position of the object	Ray Diagram
Infinity	
Beyond $2F_1$	
At $2F_1$	
Between F_1 and $2F_1$	
At focus $2F_1$	
Between F_1 and optical center O	

Formula Used in Spherical Lens

Lens Formula

Its gives the relationship between object distance (u), image image-distance (v) and the focal length (f) and is expressed as

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

This formula is valid in all situations for any spherical lens.

Magnification Formula

The magnification produced by a lens is defined as the ratio of the height of the image and the height of the object.

$$m = \frac{Height\ of\ Image(h')}{height\ of\ object(h)}$$

Magnification produced by a lens is also related to the object-distance u, and the image-distance v and is given by

$$m = \frac{v}{u}$$

Power Of lens

The power of a lens is defined as the reciprocal of its focal length. It is represented by the letter P. The power P of a lens of focal length f is given by

$$P = \frac{1}{f}$$

Power of a convex lens is positive and that of a concave lens is negative.
The SI unit of power of a lens is 'dioptre'. It is denoted by the letter D.
1 dioptre is the power of a lens whose focal length is 1 meter so, $1D=1m^{-1}$

Sign Convention for Spherical Lenses

1. All the distances are measured from the optical center of the lens.
2. The distances measured in the same direction as that of incident light are taken as positive.
3. The distances measured against the direction of incident light are taken as negative.
4. The distances measured upward and perpendicular to the principle axis are taken as positive.
5. The distances measured downwards and perpendicular to principle axis is taken as negative.

Some Important things

Reflection of Light	Refraction of light
The reverting of light in the same medium, when it falls on the plane, is called reflection	When light ray is made to travel from one medium to another say from air to glass medium then light rays bend at the boundary between the two mediums. This bending of light when it passes from one medium to another is called Refraction of light.
light ray falling on the plane returns to the same medium	the ray falling on the plane travels from one medium to another.
the angle of incidence is same as the angle of reflection	the angle of incidence is not like the angle of refraction.
Reflection takes place in Mirrors	Refraction takes place in Lens

Mirror	Lens
Reflection happens in mirror	Refraction happens in Lens
Concave and convex mirror	Concave and convex lens
Convex mirrors produce virtual, erect and diminished image	Convex lens produces a real, inverted image below the principal axis when the object distance is greater than the focal length
Concave mirror produces real and inverted images (except when the object is placed between pole and focus. When the object is placed between F and P, concave mirror produces	Concave lenses are curved inward and when light goes through it diverges or spreads out

virtual and erect image). But the convex mirror always produces virtual and erect images.

Interesting facts about Reflection and Refraction

S.no	Points
1	Convex mirrors are used as rearview and side-view mirror in vehicles as they cover a wider area of view. Through these mirrors objects appear smaller and upright
2	A magnifying glass is a convex lens which produces a magnified (larger) image of an object.
3	Concave mirrors are used by dentists, shaving mirrors, headlights of car, solar furnace
4	Light travels in vacuum with an enormous speed of 3×10 m/s. The speed of light is different in different media.
5	Many optical instruments consist of several lenses. They are combined to increase the magnification and sharpness of the image. The net power (P) of the lenses placed in contact is given by the algebraic sum of the individual powers P1, P2, P3, … as P = P1 + P2 + P3 + …

Human eye and Colorful World

Human eye

- It is a natural optical instrument which is used to see the objects by human beings. It is like a camera which has lens and screen system.
- the human eye is the most significant one as it enables us to see the beautiful, colorful world around us

Important Parts in Human eye

S.no	Quantities	Description
1	Retina	It is a light sensitive screen inside the eye on which image is formed. It contains rods and cones.
2	Cornea	It is a thin membrane which covers the eye ball. It acts like a lens which refracts the light entering the eye.
3	Eye lens	It is a Convex lens made of transparent and flexible jelly like material. Its curvature can be adjusted with the help of ciliary muscles.
4	Aqueous humour	It is fluid which fills the space between cornea and eye lens.
5	Pupil	It is a hole in the middle of iris through which light enters the eye. It appears black because light falling on it goes into the eye and does not come back.
6	Ciliary muscles	These are the muscles which are attached to eye lens and can modify the shape of eye lens which leads to the variation in focal lengths
7	Iris	Iris is a dark muscular diaphragm that controls the size of the pupil. It controls the amount of light entering the eye by changing the size of pupil
8	Optical nerve	These are the nerves which take the image to the brain in the form of electrical signals.

Some Important concepts

Concept	Description

Accommodation power	The ability of eye to change the focal length of eye lens with the help of ciliary muscles to get the clear view of nearby objects (about 25 cm) and far distant objects (at infinity) To see an object comfortably and distinctly, you must hold it at about 25 cm from the eyes. The minimum distance, at which objects can be seen most distinctly without strain, is called the least distance of distinct vision. It is also called the near point of the eye. For a young adult with normal vision, the near point is about 25 cm. The farthest point up to which the eye can see objects clearly is called the far point of the eye. It is infinity for a normal eye. You may note here a normal eye can see objects clearly that are between 25 cm and infinity.
Colour blindness	Some people do not possess some cone cells that respond to certain specific colors due to genetic disorder
Cataract	Due to the membrane growth over eye lens, the eye lens becomes hazy or even opaque. This leads to decrease or loss of vision. The problem is called cataract. It can be corrected only by surgery

DEFECTS OF VISION AND THEIR CORRECTION

Sometimes the eye may gradually lose its power of accommodation. In such conditions, the person cannot see the objects distinctly and comfortably. The vision becomes blurred due to the refractive defects of the eye. There are mainly three common refractive defects of vision. These are (i) myopia or near-sightedness, (ii) Hypermetropia or farsightedness, and (iii) Presbyopia

Some Important concepts

Concept	Description
Myopia (Short sightedness)	It is a kind of defect in human eye due to which a person can see near objects clearly but he cannot see the distant objects clearly. Myopia is due to (i) excessive curvature of cornea.

	(ii) elongation of eye ball. You may note here a normal eye can see objects clearly that are between 25 cm and infinity. **Corrective Measure** This defect can be corrected by using a concave lens of suitable power. A concave lens of suitable power will bring the image back on to the retina and thus the defect is corrected.
Hypermetropia (Long sightedness)	It is a kind of defect in human eye due to which a person can see distant objects properly but cannot see the nearby objects clearly. It happens due to (i) decrease in power of eye lens i.e., increase in focal length of eye lens. (ii) shortening of eye ball. **Corrective Measure** This defect can be corrected by using a convex lens of appropriate power. Eye-glasses with converging lenses provide the additional focusing power required for forming the image on the retina.
Presbyopia	It is a kind of defect in human eye which occurs due to ageing. It happens due to (i) decrease in flexibility of eye lens. (ii) gradual weakening of ciliary muscles.

Refraction of light through Prism

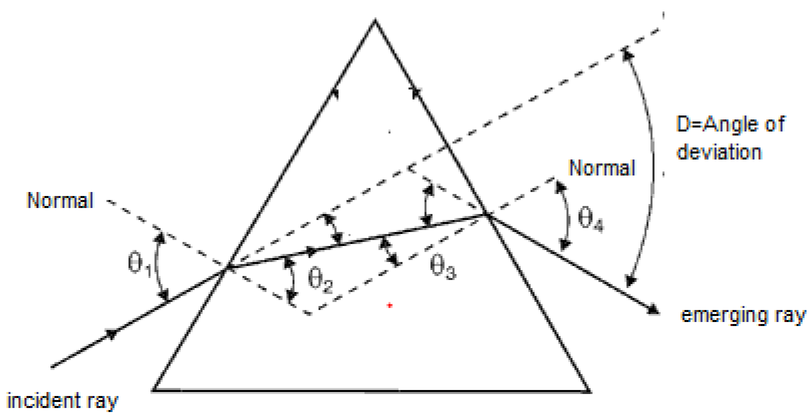
What is Glass Prism

A Glass Prism is a five-sided solid with a triangle cross-section. It has two triangular bases and three rectangular lateral surfaces. These surfaces are inclined to each other. The angle between its two lateral faces is called the angle of the prism

Refraction of Light through Prism

We know that when a light pass through transparent rectangular slab with parallel faces, the emergent rays gets displaced parallel to itself.

Now when light rays fall on the prism, there is net deviation in the path of the ray of a light. The total angle through which ray's deviates is called the angle of deviation. Higher the refractive index of the prism, higher the is the angle of deviation



Some Important concepts

Concept	Description
White light	It is mixture of light of different colour (violet, indigo, blue, green, yellow, orange and red.) present in a definite Proportion
Monochromatic light	Light consisting of single colour or wavelength is called monochromatic light, e.g., sodium light
Polychromatic light	Light consisting of more than two colors or wavelengths is called polychromatic light
Dispersion of white light by a glass prism	The phenomenon of splitting of white light into its seven constituent colors when it passes through a glass prism is called dispersion of white light. The various colors seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red.

	The sequence of colors remembers as VIBGYOR. The band of seven colors is called spectrum. <u>Why do we get these colors?</u> Different colors of light bend through different angles with respect to the incident ray, as they pass through a prism. The red light bends the least while the violet the most. Thus, the rays of each colour emerge along different paths and thus become distinct. It is the band of distinct colors that we see in a spectrum.
Formation of rainbow	The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colors reach the observer's eye
Recombination of white light	Newton found that when an inverted prism be placed in the path of dispersed light then after passing through prism, they recombine to form white light.
Atmospheric Refraction	Earth is surrounded by a layer of air and Density of air varies in the atmosphere. It is the generally at the greatest at the earth surface and goes on decreasing as we move higher. The refraction of light caused by the earth's atmosphere (having air layers of varying optical densities) is called atmospheric refraction. Since the physical conditions of the refracting medium (air) are not stationary, the apparent position of the object, as seen through the hot air, fluctuates.
Twinkling of stars	The twinkling of a star is due to atmospheric refraction of starlight. The starlight, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth. The atmospheric refraction occurs in a medium of gradually changing refractive index. Since the atmosphere bends starlight towards the normal, the apparent position of the star is slightly different from its actual position. The star appears slightly higher (above) than its actual position when viewed near the horizon (Further, this apparent position of the star is not stationary, but keeps on changing slightly, since the physical conditions of the earth's atmosphere are not

	stationary. Since the stars are very distant, they approximate point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers – the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect
Why, the duration of day becomes approximately 4 minutes shorter if there is no atmosphere on earth	Actual sun rise happens when it is below the horizon in the morning. The rays of light from the sun below the horizon reach our eyes because of refraction of light. Similarly, the sun can be seen about few minutes after the actual sun set. Thus, the duration of, day time will increase by 4 minutes.
Scattering of light	It is the phenomenon in which a part of light incident on the particle is redirect in different directions
Why is the colour of sky blue	This happens because of scattering of light by molecule of air and other particles in the atmosphere. Since blue-light has shorter wavelength, they are scattered in the sky and when this scattered light enters the eye, we see the blue sky. If there is no atmosphere, sky will look dark
Colour of the Sun at sunrise and sunset	At noon, the light of sun travels relatively shorter distance through earth's atmosphere thus appears white as only a little of blue and violet colors are scattered. Near the horizon, most of the blue light and shorter wavelengths are scattered and sun appears red.

Electricity

Electricity

Physical phenomena associated with the presence and flow of electric charge is known as electricity

Static or Fractional Electricity

Static (or fractional) electricity is caused by the buildup of electrical charges on the surface of objects The fractional electricity produced have been found to be of two types i.e., positive electricity (charge) and negative electricity (charge). The two substances rubbed together acquire equal and opposite charges.

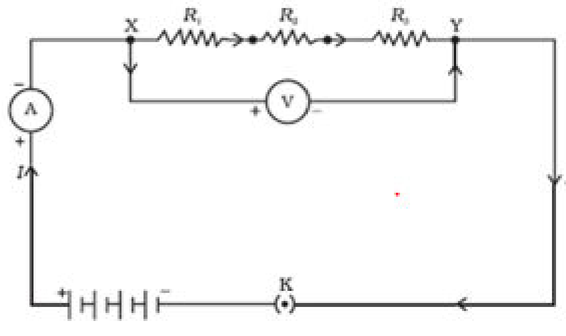
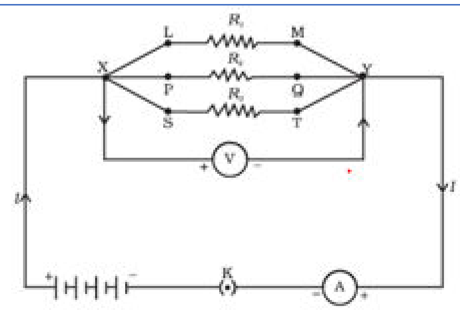
Current Electricity

current electricity is a phenomenon involving the flow of electrons along a conductor.

S.no	Terms	Descriptions
1	Electric Charge	Electric charge is a fundamental property like mass; length etc. associated with elementary particles for example electron, proton and many more Charges are of two kinds 1. negative charge 2. positive charge Electrons are negatively charged particles and protons, of which nucleus is made of, are positively charged particles. All free charges are integral multiples of a unit of charge e, where e = -1.602×10^{-19} C i. e., charge on an electron or proton. Charge q on a body is always denoted by q = ne where n = any integer positive or negative SI unit of charge is Coulomb written as C.

2	Electric Potential and Potential difference	The potential difference between two points in an electric field is defined as the amount of work done in moving a unit positive charge from one point to another point. So, $$potential\ difference = \frac{work\ done}{quantity\ of\ charge\ transfered} = \frac{W}{Q} \quad (1)$$ The SI unit of electric potential difference is volt (V) The potential difference between two points is said to be one Volt if 1 Joule of work is done in moving 1 Coulomb of electric charge from one point to another. Thus $$1\ Volt = \frac{1\ joule}{1\ Coulomb}$$ The potential difference is measured by means of an instrument called the voltmeter. The voltmeter is always connected in parallel across the points between which the potential difference is to be measure
3	Electric current	The flow of charge in metallic wire due to the potential difference between two conductors used is called electric current. Electric current is expressed by the amount of charge flowing through a particular area in unit time. If a net charge Q, flows across any cross-section of a conductor in time t, then the current I, through the cross-section is $$I = \frac{Q}{t}$$ The S.I. unit of electric current is Ampere (A) Current is measured by an instrument called ammeter. It is always connected in series in a circuit through which the current is to be measured.
4	Electric Circuit	Electric circuit is a continuous path consisting of cell (or a battery), a plug key, electrical component(s), and connecting wires.

5	Circuit Diagram	A diagram which indicates how different components in a circuit must be connected by using symbols for different electric components is called a circuit diagram.
6	Ohm's Law	Ohm's law is the relation between the potential difference applied to the ends of the conductor and current flowing through the conductor V=IR where constant of proportionality R is called the electric resistance or simply resistance of the conductor
7	Electric Resistance	Electric resistance of a conductor is the obstruction offered by the conductor to the flow of the current through it. Electric resistance is the ratio of potential difference across the two ends of conductor and amount of current flowing through the conductor. Resistance of a uniform metallic conductor is directly proportional to its length (l) and inversely proportional to the area of cross-section (A) $R = \rho \frac{l}{A}$ Where ρ is the constant of proportionality and is called the electrical resistivity of the material of the conductor. SI unit of resistance is Ohm (Ω) where 1 Ohm=1 volt/1 Ampere or $1\Omega = 1VA^{-1}$. Bigger units of resistance are Kilo-Ohm and Mega-Ohm

8	Resistance of system of resistors in Series	 Resistors in series $R = R_1 + R_2 + R_3$ Current is same across all the resistors $V = V_1 + V_2 + V_3$
9	Resistance of system of resistors in Parallel	 $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ Potential difference is same across all the resistors $I = I_1 + I_2 + I_3$

Heating effect of Electric current

When electric current passes through a high resistance wire, the wire becomes and produces heat. This is called heating effect of current.

Heat Produced

$H = I^2Rt$

This is known as Joule's Law of heating
According to Joule's Law of Heating, Heat produced in a resistor is
(a) Directly proportional to the square of current for a given resistor.
(b) Directly proportional to resistance of a given resistor.
(c) Directly proportional to time for which current flows through the resistor.

Electric Power

The rate at which electric work is done or the rate at which electric energy is consumed is called electric power

$$Power = \frac{Workdone}{Time\ taken} = \frac{W}{t}$$

SI unit of power = SI unit of Work done / SI unit of t
= J / s
= watt, W
1 W = 1 J / 1 s
Definition of SI unit of power – Power of an object or agent is said to be 1 watt when it does 1 joule of work in 1 second.

Electric Power can be expressed as
P=VI
$P=I^2 R$
$P=V^2/R$

Units of Power

1 horse power	**746 W**
1 kilowatt	**1000 W**
1 MW	**106W**

Commercial Unit of Energy KWH (Kilo Watt hour)

Definition of 1 kWh
A kilowatt hour is the amount of electric energy used by 1000 W electric appliance when it operates for 1 hour

Relationship between joule (J) and kilowatt-hour (kWh)
1 kWh =3.6 x 106 J

Forms of energy

Mechanical energy	Sum of kinetic and potential energy.
Thermal energy	Energy possessed by an object due to its temperature.
Chemical energy	Energy released in chemical reactions.
Sound energy	Energy of a vibrating object producing sound
Electrical energy	Energy of moving electrons in a conductor connected with a battery
Solar energy	Energy radiated by the sun.

Interesting Facts about Energy

S.no	Points
1	The word energy comes from the Greek word Energeia.
2	Stretched rubber bands and compressed springs are examples of elastic potential energy.
3	During chemical reactions, chemical energy is often transformed into light or heat
4	The mechanical energy of an object is associated with the objects' position and motion
5	James Joule is the physicist who discovered the relationship between the loss of mechanical energy and the gain of heat.
6	Energy cannot be destroyed or created—only transformed.
7	Albert Einstein defined energy as mass multiplied by the speed of light squared, or $e=mc^2$
8	A “watt” is a unit of power that measures the rate of producing or using energy. The term was named after Scottish engineer James Watt (1736-1819), who developed an improved steam engine. Watt measured his engine’s performance in horsepower. One horsepower equaled 746 watts.

Magnetic effect of Current

Magnetism

what is a magnet
 The substances which have the property of attracting small pieces of iron, nickel and cobalt etc. are called **magnets** and this property of attraction is called **magnetism**

What are magnetic poles?
Magnetic poles refer to the two areas of a magnet where the magnetic effects are the strongest. The poles are generally termed as the north and south poles

What is magnetic Field?
The space around a magnet in which the force of attraction and repulsion due to the magnet can be detected is called the magnetic field**.**

Important Concepts

S.no	Terms	Descriptions
1	Compass	The simplest compass is a magnetized metal needle mounted in such a way that it can spin freely Needle of a compass is a small bar magnet. This is the reason it gets deflected when we place it in the field of another magnet.
2	Earth Magnetism	1) The earth has a magnetic field which we call as the earth's magnetic field. 2) The magnetic field is tilted slightly from the Earth's axis. 3)The core of earth is filled with molten iron (Fe) which give Earth its very own magnetic field. 4)The region surrounding Earth where its magnetic field is located is termed as the Magnetosphere.

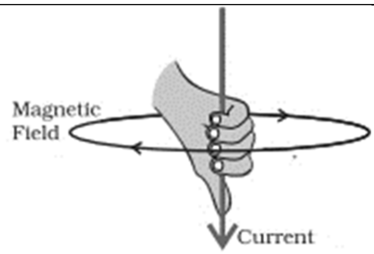
3	Magnetic Field Lines	Magnetic field surrounding the magnet and the force it exerts are depicted using imaginary curved lines with arrow called magnetic field lines.
4	Properties of Magnetic Field Lines	1)All field lines are closed curves. 2)Outside the magnet field lines emerge from North Pole and merge at South Pole. 3) Inside a magnet, the direction of field lines is from South Pole to its north pole. 4) Field lines never intersect each other. 5) The field is stronger where the field lines are more closely spaced. So, the field is stronger near the poles then at other points

Magnetic Effect of Current

what is a magnetic effect of Current?
Electricity and Magnetism are related phenomenon. When an electric current is passed through metallic conductor, it generates a magnetic field around it.

Magnetic Field due to current through straight Conductor
Electric current through a straight Conductor generates magnetic field around it.
Magnetic Field intensity increases on the increasing the current in the conductor
Magnetic field decrease as the distance increase from the conductor
Magnetic Field direction can be find using Right Hand Thumb Rule

What is Right Hand Thumb rule?
When you are holding a current-carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then your fingers will wrap around the conductor in the direction of the field lines of the magnetic field



S.no	Terms	Descriptions
1	Magnetic Field due to a Current through a Circular Loop	a) As with straight conductor, the magnetic field lines would be in the form of concentric circles around every part of the periphery of the conductor. b) The magnetic field would be stronger near the periphery of the loop as magnetic field lines tend to remain closer when near the conductor. c) The magnetic field lines would be distant from each other when we move towards the centre of the current carrying loop. At the centre, the arcs of big circles would appear as straight lines.
2	Magnetic Field due to current through a coil having number of turns	We know that the magnetic field produced by a current-carrying wire at a given point depends directly on the current passing through it and the current in each circular turn has the same direction Therefore, Magnitude of magnetic field gets summed up with increase in the number of turns of coil. If there are 'n' turns of coil, magnitude of magnetic field will be 'n' times of magnetic field in case of a single turn of coil.

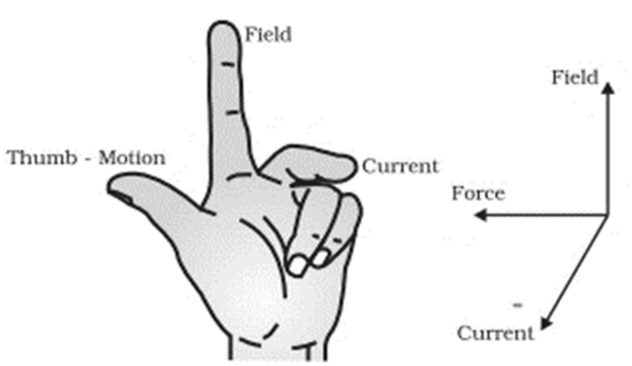
3	Solenoid	A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called a solenoid
4	Magnetic Effect of Current carrying Solenoid	A current carrying solenoid produces similar pattern of magnetic field as a bar magnet. One end of solenoid behaves as the north pole and another end behaves as the south pole. Magnetic field lines are parallel inside the solenoid; like a bar magnet; which shows that magnetic field is same at all points inside the solenoid
5	Electromagnet	When a piece of magnetic material, like soft iron is placed inside a solenoid,the strong magnetic field produced inside a solenoid magnetise the soft iron and it behaves like strong magnet. The magnetism in the soft iron is temporary and it becomes when the current is switched off. This type of magnet is called Electromagnets

Force on a current carrying conductor in a Magnetic Field

When a current carrying, conductor is placed in a magnetic field, it experienced a force. The direction of force depends on the direction of the current and direction of the Magnetic Field. The direction of the force can be found using Fleming Left hand rule

Fleming Left hand rule

Stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If the first finger points in the direction of magnetic field and the second finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor



Electric Motor

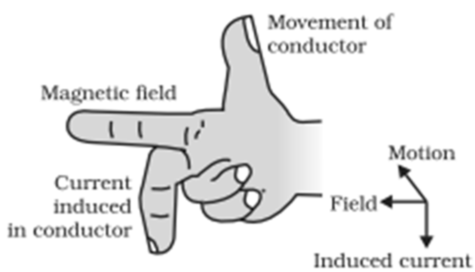
An electric motor is a device which works on the above principle. Here the electrical energy is converted to mechanical energy. Here a current carrying conductor is placed in the magnetic field and force acts on the conductor and it rotates and do the mechanical work.

This is used in electric fans

Electromagnetic Induction

Electromagnetic induction is the production of induced current in a coil placed in a region where the magnetic field changes with time.
The magnetic field may change due
a) relative motion between the coil and a magnet placed near to the coil.
b) If the coil is placed near to a current-carrying conductor, the magnetic field may change either due to a change in the current through the conductor or due to the relative motion between the coil and conductor.
The direction of the induced current is given by the Fleming's right-hand rule.

Fleming's Right Hand rule
Stretch the thumb, forefinger and middle finger of right hand so that they are perpendicular to each other. If the forefinger indicates the direction of the magnetic field and the thumb shows the direction of motion of conductor, then the middle finger will show the direction of induced current



Electric Generator
It is a device which converts mechanical energy into electrical energy. It is based on electromagnetic induction principle as explained above.

AC Current
which current direction changes after equal intervals of time, then the current is called an alternating current (abbreviated as AC).

Direct Current

When the current flows in the same direction and does not change direction, it is called Direct current (DC)

AC generator
Electric Generator can be used to generate both the AC and DC current. When it is designed to produce AC current, it is called AC generator

DC generator
Electric Generator can be used to generate both the AC and DC current. When it is designed to produce DC current, it is called DC generator

Facts about AC and DC currents
a) Most power stations constructed these days produce AC.
b) In India, the AC changes direction after every 1/100 second, that is, the frequency of AC is 50 Hz.
c) An important advantage of AC over DC is that electric power can be transmitted over long distances without much loss of energy

Galvanometer
A galvanometer is an instrument that can detect the presence of a current in a circuit. The pointer remains at zero (the centre of the scale) for zero current flowing through it. It can deflect either to the left or to the right of the zero-mark depending on the direction of current.

Electric Generators	Electric Motors
Device which converts mechanical energy into electrical energy	Device which converts electrical energy into mechanical energy
It is based on Electromagnetic Induction Principle	It is based on moving coil galvanometer
When a closed coil is rotated rapidly in a strong magnetic field, the magnetic flux through the coil changes continuously. Hence an EMF is induced in the coil and current flows in it in a direction by Fleming right hand rule	When a current is passed through a coil in a magnetic field, the coil experiences a torque in the direction given by Fleming left hand rule. This torque gives a continuous rotatory motion in the coil in the magnetic field
Two types AC dynamo and DC dynamo	Back Emf is also generated in motor since it cuts the magnetic flux of the field magnet

Domestic Electric Circuits

S.no	Terms	Descriptions

1	Type of current/Potential Difference and Frequency	AC electric power of 220 V with a frequency of 50 Hz.
2	Live Wire	The wire, usually with red insulation cover, is called live wire (or positive)
3	Neutral Wire	The wire, with black insulation, is called neutral wire (or negative). In our country, the potential difference between the Live wire and Neutral Wire is 220 V.
4	Earth Wire	It has green insulation and this is connected to a metallic body deep inside earth. It is used as a safety measure to ensure that any leakage of current to a metallic body does not give any severe shock to a user.
5	Different Circuit used in the Home Supply	Two separate circuits are used 1) 15 A current rating for appliances with higher power ratings such as geysers, air coolers, etc. 2) 5 A current rating for bulbs, fans, etc.
6	Appliance circuit	a) Each appliance has a separate switch to 'ON'/'OFF' the flow of current through it. b) Each appliance has equal potential difference; they are connected parallel to each other
7	Electric Fuse	a) A fuse in a circuit prevents damage to the appliances and the circuit due to overloading b) electric fuse prevents the electric circuit and the appliance from a possible damage by stopping the flow of unduly high electric current. c) Fuse is based on The Joule heating that takes place in the fuse melts it to break the electric circuit d) Tin-lead alloy is general used to make fuse wire
8	Electric Fuse Current Rating	Electric Fuse current rating defines the maximum value of safe current allowed to flow through fuse without melting it
9	Overloading	If more electrical appliances of high power rating like electric iron box, electric cooker, electric heater, air conditioner etc., are switched on at the same time, they draw an extremely large current from the circuit is called overloading
10	Short-circuiting	Sometimes, the live and neutral wires come in the direct contact due to defective or damaged wiring. When this happens, the resistance of the circuit becomes almost zero

and a very large current flow through it. This is known as Short Circuit

SI units

Physical Quantity	Symbol	Name	Unit
Mass	*m, M*	kilogram	kg
Linear position **Length, Distance** **Radius**	*x, r* *l, d* *R*	meter	m
Time	*t*, τ	second	s
Area	*A*	-	m^2
Volume	*V*	-	m^3
Density	ρ	-	kg/m^3
Linear velocity	*v, u, c*	-	m/s
Linear momentum	*p*	-	kg*m/s
Linear acceleration	*a*	-	m/s^2
Force	*F*	newton	$N=kg*m/s^2$
Impulse	*I*	-	N*s
Work **Energy**	*W* *E*	joule	J=N*m
Power	*P*	watt	W=J/s
Power of lens	*P*	Dioptre	$1\ D= 1\ m^{-1}$
Charge	*Q*	Coulomb	C
Electric Potential	*V*	Volt	1V= 1J/C
Electric Resistance	*R*	Ohm	1 R=1 V/A
Electric Current	*I*	Ampere	1 A=1 C/s

Sources of Energy

Sources of Energy

S.no	Terms	Descriptions
1	Source of energy	Source of energy is anything which supplies us useful energy for carrying out the various activities like cooking, heating
2	Renewable	An energy source which can be replenished in short period. Example Solar energy, hydropower
3	Non-Renewable	An energy source which cannot be recreated in short period. Example Fossil Fuel-oil, natural gas, Coal
6	Good Source of Energy	A good source of energy has following characteristics: (i) It could do a large amount of work per unit volume or mass. (ii) It would be easily accessible. (iii) it would be easy to store and transport. (iv) It would be economical.
7	Fuel	A fuel is a chemical which releases energy when heated with oxygen
8	Conventional Energy Sources	Sources of energy which has been in use from Centuries are called the conventional source of energy. Example Wood,Coal,Petrol,hydropower
9	Non-Conventional Energy Sources	Source of energy which we have started using in recent times is called Non-conventional energy sources Example Nuclear energy, Geothermal energy, Solar energy, Ocean tides

Conventional Sources of Energy

S.no	Terms	Descriptions
1	Fossil Fuels	Fossils fuel are the remains of the pre-historic animal and plants buried under the earth millions of years ago. They are non-renewable sources of energy

		Since fossils fuels from plants and animals and they get energy from Sun, so their ultimate source of energy is Sun Example Coal, Petroleum products
2	Disadvantage of Fossils fuels	1) Burning of fossil fuels causes air pollution. The oxides of carbon, nitrogen and sulphur that are released on burning fossil fuels cause acid rain and other respiratory problems for human beings. 2) green-house effect of gases like carbon dioxide
3	Turbine	A turbine is device that rotates when steam, water or wind false on its blades. The turbine turns the shaft of the electric generator and then electricity is produced
6	Thermal Power plants	Thermal power plants burn fossils fuel like coal which heat up the water to produce steam and Steam is used in Turbine to generate electricity. The term thermal power plant is used since fuel is burnt to produce heat energy which is converted into electrical energy
7	Hydropower Plants	Here the kinetic energy of the flowing water or the potential energy of the water at height is used to turn the turbine and generate electricity. To produce hydel electricity, high-rise dams are constructed on the river to obstruct the flow of water and thereby collect water in larger reservoirs. The water level rises and in this process the kinetic energy of flowing water gets transformed into potential energy. The water from the high level in the dam is carried through pipes, to the turbine, at the bottom of the dam
8	Biomass	Biomass is any organic matter from which we get energy on the renewable basis. It includes wood, Agricultural residues, animal excreta, wastes from food processing
9	Charcoal	Charcoal is produced by burning wood in an insufficient supply of water. This method is called destructive distillation of wood. Charcoal burns without flames, is comparatively smokeless and has a higher heat generation efficiency

10	Biogas	Cow-dung, various plant materials like the residue after harvesting the crops, vegetable waste and sewage are decomposed in the absence of oxygen to give bio-gas. Anaerobic micro-organisms that do not require oxygen decompose or break down complex compounds of the cow-dung slurry. The process is called anaerobic digestion Since the starting material is mainly cow-dung, it is popularly known as 'gobar-gas' Bio-gas contains up to 75% methane,23% Carbon dioxide and 2% other gases. It burns without smoke, leaves no residue like ash in wood, charcoal and coal burning. It is an excellent fuel
11	Wind Energy and Wind mill	Unequal heating of the landmass and water bodies by solar radiation generates air movement and causes winds to blow. The wind contains the kinetic energy. This kinetic energy is used the windmill to do some mechanical work. A windmill is a device in which kinetic energy of the wind is used to rotates a set of blades and rotational energy of the blades is used to do some mechanical work and power the turbine to generate electricity

Non-Conventional Sources of Energy

S.no	Terms	Descriptions
1	Solar Energy	Solar energy is the energy of Sun. The earth receives a huge amount of energy from the sun. Traditionally We have been solar energy for drying clothes and grains, make salt from sea water
2	Solar cooker	Solar cooker is a device which is used to cook food by using solar energy. Solar cookers and solar water heaters are based on the facts that A black surface absorbs more heat as compared to a white or a reflecting surface under identical conditions Solar cooker is having box type structure and its internal surfaces are coloured with black colour. Solar cookers are covered with a glass plate. Which traps heats to go out from

		box and shows greenhouse effect. A plane mirror is also used to focus the rays of the light. The food which need to be cooked ins kept inside the box and temperature around 140^{o} C in summer in 2-3 hour and cooked the food
3	Solar cells	A device which converts solar energy into electric energy is called solar cell. A solar cell can convert only 0.7% of the solar energy into electricity. Silicon is used in in creating the solar cells
6	Solar cell panels	Many solar cells combined in an arrangement is called Solar cell panels. The solar cells in the solar panel are connected in such a that total potential difference and total capacity to provide electric current becomes large
7	Tidal energy	Gravitational pull of the moon on the spinning earth produces tides in the ocean This phenomenon is called high and low tides and the difference in sea-levels gives us tidal energy. Tidal energy is harnessed by constructing a dam across a narrow opening to the sea. A turbine fixed at the opening of the dam converts tidal energy to electricity
8	Wave energy	When the wind passes on the water surface, it leads to the pressure difference between upper and bottom wind which results in the generation of waves. This wave energy can be harnessed to power electric generator
9	Ocean Thermal energy	The water at the surface of the sea or ocean is heated by the Sun while the water in deeper sections is relatively cold. Ocean-thermal-energy conversion plants Exploits this difference in temperature. The warm surface-water is used to boil a volatile liquid like ammonia. The vapors of the liquid are then used to run the turbine of generator. The cold water from the depth of the ocean is pumped up and condense vapour again to liquid
10	Geothermal Energy	Geo means earth and thermal means heat. So, Geothermal energy is the energy which is obtained from heat inside the earth. Sometimes molten rocks formed in the deeper hot regions of earth's crust are pushed upward and trapped in certain regions called 'hot spots' and when underground comes in it contact, steam is generated and that steam can be used to power turbine

		Since the starting material is mainly cow-dung, it is popularly known as 'gobar-gas' Bio-gas contains up to 75% methane,23% Carbon dioxide and 2% other gases. It burns without smoke, leaves no residue like ash in wood, charcoal and coal burning. It is an excellent fuel
11	Nuclear energy	Nuclear energy is generated through the process of Nuclear Fission. In Nuclear fission, A heavy nucleus is bombarded with a low energy neutron. In this process, it splits into two lighter nuclei with a tremendous release of energy which can be utilized to boil water to run turbines. Nuclear energy is generated in a controlled manner in the Nuclear reactor The major hazard of nuclear power generation is the storage and disposal of nucleus wastes because they are radioactive
12	Nuclear Fusion	Nuclear Fusion means joining lighter nuclei to make a heavier nucleus, most commonly hydrogen or hydrogen isotopes to create helium 2H + 2H → 3He (+ n) It releases a tremendous amount of energy, The source of energy in the Sun and other stars is also because of Nuclear fusion reaction.
13	hydrogen bomb	The hydrogen bomb is based on thermonuclear fusion reaction. A nuclear bomb based on the fission of uranium or plutonium is placed at the core of the hydrogen bomb. This nuclear bomb is embedded in a substance which contains deuterium and lithium. When the nuclear bomb (based on fission) is detonated, the temperature of this substance is raised to 107 K in a few microseconds. The high temperature generates sufficient energy for the light nuclei to fuse and a devastating amount of energy is released.