



# MP Patwari General Science

## Physics

## PHYSICS

### WORK

- Work is said to be done, if force acting on a body is able to actually move it through some distance in the direction of the force. Its SI unit is a **joule**.

### ENERGY

- Energy is a scalar quantity and its unit is **Joule**.
- The sum of all kinds of energies in an isolated system remains constant at all times. This is the law of conservation of energy.

### POWER

Its unit is **watt**.

- **1 watt hour** = 3600 Joule
- **1 kilowatt hour** =  $3.6 \times 10^6$  joule
- **1HP** = 746 watt

### GRAVITATION

- Everybody in the universe attracts other body by a force called force of gravitation.
- The gravitational force of the earth is called **gravity**.
- The acceleration produced in a body due to force of gravity is called **acceleration** due to gravity ( $g$ ) and its value is  **$9.8 \text{ m/s}^2$**
- Acceleration due to gravity is independent of shape, size and mass of the body.
- Escape velocity is the minimum velocity with, which an object just crosses the Earth's gravitational field and never returns. Escape velocity at the Earth's surface is  **$11.2 \text{ km/s}$** .
- Escape velocity at the **Moon's** surface is  **$2.4 \text{ km/s}$** . Due to low escape velocity there is no atmosphere on the moon.
- Value of  $g$  decreases with height or depth from Earth surface.
  - $g$  is maximum at **poles**.
  - $g$  is minimum at **equator**.
  - $g$  decreases due to **rotation of Earth**.
  - $g$  decreases if angular speed of Earth increases and increases if angular speed of Earth decreases.
- The acceleration due to gravity at the moon is **one-sixth** that of the Earth. So, the weight of a person on the surface of the moon will be  **$1/6$**  of his actual weight on the Earth.

### SATELLITE

- Satellites are natural or artificial bodies revolving around a planet under its gravitational force of attraction.
- **Moon** is a **natural satellite**, while **INSAT-B** is an artificial satellite of Earth.
- The period of revolution of satellite revolving near the surface of earth is 1 hour 24 minutes (34 minutes).
- Geo-stationary satellite revolves around the Earth at a height 36000 km (approx).
- Time period of rotation of geo-stationary satellite is 24 hours.
- The Earth rotates on its axis from **West to East**. This rotation makes the Sun and the stars appear to be moving across the sky from **East to West**.
- A **geosynchronous satellite** is a satellite in geosynchronous orbit, with an orbital period the same as the Earth's rotation period.
- A special case of geosynchronous satellite is the **geostationary satellite**, which has a geostationary orbit – a circular geosynchronous orbit directly above the Earth's equator.
- **Geo-stationary satellite is used** to telecast. TV programmes from one part of the world to another, in weather forecasting, in predictions of floods and droughts.
- Polar Satellite Revolves around the earth in polar orbit at a height of **800km** (app.) Time periods of these satellites is **84 min**.

ATOMIC AND NUCLEAR PHYSICSCathode Rays

Cathode rays, discovered by Sir William Crooke and its properties are

- travel in **straight lines**.
- Produce fluorescence.
- can penetrate through thin foils of metal and deflected by both electric and magnetic fields.
- have velocity ranging **1/30th** to **1/10th** of the velocity of light.

Positive or Canal Rays

- These rays were discovered by **Goldstein**.
- The positive ray consists of **positively charged particles**.
- These rays travel in **straight line**.
- These rays are deflected by **electric and magnetic fields**.
- These rays can produce ionization in gases.

X-Rays

- X-rays are electromagnetic waves with wavelength **range 0.1 A-100 A**.
- X-rays were discovered by **Roentgen**.
- X-rays travels in **straight line**.
- Long exposures of X – rays in injurious for human body.
- X – rays shows **photoelectric effect**.

Uses of X-Rays

- **In medical sciences** X-rays are used in surgery for the detection of fracture, diseased organs, foreign matter like bullet, stones etc. They are used in treatment of cancer and in skin diseases.
- **In Engineering**, X-rays are used in detecting faults, cracks, flaws and gas pockets in the finished metal products and in heavy metal sheets.
- **In Scientific Work**, X-rays are used in studying crystal structure and complex molecules.
- **In Custom Department** X-rays are used in custom department for detection of banned materials kept hidden.

Radioactivity

- Radioactivity was discovered by **Henry Becquerel, Madame Curie** and **Pierre Curie** for which they jointly won Nobel Prize.

Nuclear Fission

- Atom Bomb is based on nuclear fission.  $U^{235}$  and  $Pu^{239}$  are used as fissionable material.
- Nuclear fission was first demonstrated by Halin and Fritz Strassmann.

Nuclear Fusion

- When two or more light nuclei combined together to form a heavier nucleus is called as **nuclear fusion**.
- For the nuclear fusion, a temperature of the order of  **$10^8$  K** is required.
- **Hydrogen Bomb** was made by the American Scientist in **1952**. This is based on **nuclear fusion**. It is **1000** times more powerful than atom bomb.

Nuclear Reactor or Atomic Pile

- Nuclear reactor is an arrangement, in which controlled nuclear fission reaction takes place.
- **First nuclear reactor** was established in Chicago University under the supervision of **Prof Enrico Fermi**.
- Heavy water, graphite and beryllium oxide are used to slow down the fast moving neutrons. They are called moderate.

Uses of Nuclear Reactor

- To produce electrical energy from the energy released during fission.
- To produce different isotopes, this can be used medical, physical and agriculture science.



There are several components of nuclear reactor which are as follows

- Fissionable Fuel  $U^{235}$  or  $U^{239}$  is used.
- Moderator decreases the energy of neutrons, so that they can be further used for fission reaction.
- **Heavy water** and graphite are used as moderator.
- **Control Rod rods of cadmium** or boron are used to absorb the excess neutrons produced in fission of uranium nucleus, so that the chain reaction.

### NEWTON'S LAWS OF MOTION

- **First Law:** Everybody maintains its initial state of rest or motion with uniform speed on a straight line unless an external force acts on it. It is also called Galileo's law or law of inertia.

**Example:** While jumping from a slowly moving train/bus one must run for short distance, in the direction of motion.

- **Second Law:** The force acting on an object is directly proportioned to the product of the mass of the object and the acceleration produced on it.
- **Third Law:** To every action, there is an equal and opposite reaction.

**Example :** Bogies of the trains are provided with buffers to avoid severe jerks during shunting of trains. Rocket moves up due to reaction of downward ejection of gas.

### CIRCULAR MOTION

- When an object moves along a circular path, its motion is called circular motion.
- The external force required to act radially inward over the circular motion of the body is called **Centripetal force**.
- **Centrifugal force** is such a pseudo force that is equal and opposite to **Centripetal force**.
- Cream separator, centrifugal dryer work on the principle of centrifugal force.

### FRICTION

- In the opposing force that is set-up between the surfaces of contact, when one body slides or rolls or tends to do so on the surface of another body.
- Due to friction, we are able to move on the surface of Earth.
- While applying brakes in automobiles, it stops only due to friction.

### Pascal's Law of Pressure

- Hydraulic lift, hydraulic press and hydraulic brakes are based on the **Pascal's law of pressure**.

### Archimedes Principle

- When a body is immersed partly or wholly in a liquid, there is an apparent loss in the weight of the body, which is equal to the weight of liquid displaced by the body.
- The weight of water displaced by an iron ball is less than its own weight. Whereas water displaced by the immersed portion of a ship is equal to its weight. So, small ball of iron ball sink in water, but large ship float.
- A fat person will quickly learn the swimming as compared to a slim person because he will displace more water. So, it will be more balanced.
- Hydrogen filled balloon float in air because hydrogen is lighter than air. A person can lift more weight in water.

### WAVE

A wave is a disturbance, which propagates energy from one place to the other without the transportation of matter.

**Waves are broadly of two types:**

- Mechanical wave (longitudinal wave and transverse wave)
- Electromagnetic wave
- Following are the electromagnetic (Non-mechanical) waves-
  - a. Gamma rays (**Highest frequency**)
  - b. X-rays
  - c. UV rays
  - d. Visible radiation
  - e. infra-red rays
  - f. short radio waves

g. Long radio waves (**Lowest frequency**)

All are in decreasing order of the frequency

Following waves are not electromagnetic.

- Cathode rays
- Canal rays
- alpha rays
- beta rays
- sound wave
- ultrasonic wave

### Longitudinal Waves

- In this wave the particles of the medium vibrate in the direction of propagation of wave.
- Waves on springs or sound waves in air are examples of longitudinal waves.

### Transverse Waves

- In this wave, the particles of the medium vibrate perpendicular to the direction of propagation of wave.
- Waves on strings under tension, waves on the surface of water are the examples of transverse waves.

### Electromagnetic Waves

- The waves, which do not require medium for their propagation i.e., which can propagate even through the vacuum are called electromagnetic waves.
- Light radio waves, X-rays etc are the examples of electromagnetic wave. These waves propagate with the velocity of light in vacuum.

### Sound Waves

Sound waves are longitudinal mechanical waves. Eased on their frequency range sound waves are divided into following categories.

- The sound waves which lie in the frequency range 20 Hz to 20000 Hz are called audible waves.
- The sound waves having frequencies less than 20 Hz are called infrasonic
- The sound waves having frequencies greater than 20000 Hz are called ultrasonic waves.
- Ultrasonic waves are used for sending signals, measuring the depth of sea, cleaning clothes and machinery parts, remaining lamp short from chimney of factories and in ultrasonography.

### Speed of Sound

- Speed of sound is **maximum in solids minimum in gases**.
- When sound goes from one medium to another medium, its speed and wave length changes, but frequency remain unchanged. The speed of sound remains unchanged by the increase or decrease of pressure.
- The speed of sound increases with the increase of temperature of the medium.
- The speed of sound is more in humid air than in dry air because the density of humid air is less than the density.

**Echo:** The repetition of sound due to reflection of sound waves is called an echo.

**Intensity:** It is defined as amount of energy passing normally per unit area held around that point per source unit time.

**Pitch:** The sensation of a frequency is commonly referred to as the pitch of a sound.

**Sonar:** It stands for sound navigation and ranging. It is used to measure the depth of a sea, to locate the enemy submarines and shipwrecks.

## LIGHT

- Light is a form of energy, which is propagated as an electromagnetic **wave**.
- It is the radiation which makes our eyes able to 'see' the object. Its speed is **3 x 10<sup>8</sup> m/s**. It is the form of energy. It is a **transverse wave**.
- It takes **8 min 19s** to reach on the earth from the sun and the light reflected from moon takes **1.28s** to reach earth.
- Primary Colours-** Blue, Red, Green
- Secondary Colours-** The coloured produced by mixing any two primary colors
- Complementary Colours-** Any two colours when added produce white light.
- Blue colour of the sky is due to scattering of light.

- The brilliant red colour of rising and setting sun is due to scattering of light.

### Human Eye

- Least distance of distinct vision is 25 cm.
- Myopia or short sightedness- far objects cannot see clear
- Hyperopia or hypermetropia or Long-sightedness- Near objects cannot see clear
- **Presbyopia**- in elder person, both far and near cannot see clear

### Reflection of Light

- When a ray of light falls on a boundary separating two media comes back into the same media, then this phenomenon is called reflection of light.

### Spherical Mirror

Spherical mirrors are of two types

1. **Concave mirror**
2. **Convex mirror**

- Image formed by a convex mirror is always virtual, erect and diminished.
- Image formed by a concave mirror is generally real and inverted.

### Uses of Concave Mirror

- (i) As a shaving mirror
- (ii) As a reflector for the head lights of a vehicle, search light
- (iii) In ophthalmoscope to examine eye, ear, nose by doctors.
- (iv) In solar cookers.

### Uses of Convex Mirror

- (i) As a rear-view mirror in vehicle because it provides the maximum rear field of view and image formed is always erect.
- (ii) In sodium reflector lamp.

### Refraction of Light

- The bending of the ray of light passing from one medium to other medium is called refraction. When a ray of light enters from one medium to other medium, its frequency and phase do not change, but wavelength and velocity change. Due to refraction from Earth's atmosphere, the stars appear to twinkle.

### Total Internal Reflection

- Sparkling of diamond, mirage and looming, shinning of air bubble in water and optical Fiber are examples of total internal reflection.

### Power of a lens

- Power of a lens is its capacity to deviate a ray. It is measured as the reciprocal of the focal length in meters.
- SI Unit of Power is diopter.

## ELECTRICITY AND MAGNETISM

### Charge

Charge is the basic property associated with matter due to which it produces and experiences electrical and magnetic effects. Similar charges repel each other and opposite charges attract each other. The SI unit of charge is **coulomb**.

**Conductor:** Conductors are those materials, which allow electricity to pass through them. Metals like silver, iron, copper and earth acts like a conductor. Silver is the best conductor.

**Insulator:** Insulators are those materials which do not allow electricity to flow through them. Metals like wood, paper, mica, glass, ebonite are insulators.

### Electric Current

- Its unit is Ampere. It is a scalar quantity.
- **An electric bulb makes a bang when it is broken** because there is a vacuum inside the electric bulb, when the bulb is broken air rushes at great speed from all sides to fill the vacuum. The rushing of air produces a noise generally referred to as the bang.
- A Galvanometer can be converted into an ammeter by connecting a shunt parallel to it.
- The sodium and mercury street lamps light up due to atomic emission.
- The purpose of choke coil in fluorescent is to produce high voltage to ionize the gas in the tube required for high current to flow through filament.

### Magnetism

- Diamagnetic substance- when placed in magnetic field, acquire feeble magnetism opposite to the direction of the magnetic field.
- Examples- Gold, Diamond, Copper, Water, Mercury etc.
- Paramagnetic substance- when placed in magnetic field, acquire feeble magnetism in the direction of the magnetic field.
- Example- Al, Na, Mn etc.
- Ferromagnetic substance-when placed in magnetic field, are strongly magnetized in the direction of the magnetic field.
- Examples- Iron, Cobalt, Nickel
- Curie temp- the Curie temperature (TC), or Curie point, is the temperature at which certain materials lose their permanent magnetic properties, to be replaced by induced magnetism.
- **Isogonic lines** are lines on the Earth's surface along which the declination has the same constant value, and lines along which the declination is zero are called **agonic lines**.
- **Isoclinic lines** are imaginary lines on the earth's surface connecting points where the earth's magnetic field has the same angle.
- **The aclinic line** is the magnetic equator, where the magnetic field is inclined neither north or south, so it's a special case of an isoclinic line.
- **Isodynamic line-** A line on a map connecting points of equal strength of the earth's magnetic field.

### Surface Tension and capillary

- Lubricating oil spread easily on all parts because of their low surface tension.
- Dirt get removed when detergents are added while washing clothes because surface tension of water is reduced.
- The absorption of ink by a blotting paper is due to capillary action
- The supply of water to the leaves at the top of even a tall tree is through capillary rise.

### Heat

- Unit of heat-  
C.G.S- Calorie  
F.P.S- British Thermal Unit (B. Th. U)
- Absolute Zero Temp- minus 273 K (-273 K)
- 1 calorie= 4.2 J
- The specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius.
- **Newton's Law of Cooling** states that the rate of change of the temperature of an object is proportional to the difference between its own temperature and the ambient temperature (i.e. the temperature of its surroundings).
- **Hoar Frost**-is the reverse process of sublimation.

### MEASUREMENT UNITS

- **Angstrom** : For measuring length of light waves
- **Barrel** : For measuring liquids. One barrel is equal to 31½ gallons or 7,326.5 cubic inches
- **Cable**: For measuring length of cables. It is about 183m. in length
- **Carat** : Used for measuring precious stones. It is also a measure for the purity of gold alloy



- **Fathom** : It is used for measuring depth of water. One fathom is equal to 4 inches
- **Knot**: For measuring speed of ships

**SOME CONVERSION FACTORS****Mass and Density**

- 1 Kg = 1000 g = 6.02 u
- 1 Slug = 14.6 kg
- 1 u = 1.66 kg

**Length and Volume**

- 1 m = 100 cm = 39.4 inch = 3.28 ft
- 1 mile = 1.61 km = 5280 ft
- 1 inch = 2.54 cm
- 1 nm = m = 10 A
- 1 pm = m = 1000 fm
- 1 light year = 9.46 m
- 1 = 1000 L = 35.3 = 264 gal

**Angular Measure**

- 1 m/s = 3.28 ft/ s = 2.24 mi / h
- 1 km / h = 0.621 mi / h = 0.278 m/s

**Force and Pressure**

- 1 lb = 4.45 N
- 1 ton = 2000 lb
- 1 Pa = 1 N/ = 10 dyne/ = 1.45 lb/
- 1 atm = 1.01 x 10<sup>5</sup> Pa = 14.7 lb/ = 76 cm – Hg

**SOME IMPORTANT SCIENTIFIC INSTRUMENTS**

- **Accumulator**: Electrical energy is stored
- **Altimeter**: Used in aircraft for measuring altitudes
- **Ammeter**: Measuring the electrical current in amperes
- **Anemometer**: Measuring the strength of winds
- **Audiometer**: Measuring intensity of wind
- **Audiophone**: It is used for improving imperfect sense of hearing.
- **Barometer**: Measuring atmospheric pressure
- **Binocular**: An optical instrument designed for magnified view of distant objects by both eyes simultaneously
- **Bolometer**: To measure heat radiation
- **Cardiogram**: For recording the heart movements
- **Calorimeter**: Measuring of quantities of heat
- **Chronometer**: A clock that keeps very accurate time as the one that is used to determine longitude at sea.
- **Colorimeter**: An instrument for comparing intensities of colour.
- **Commutator**: An instrument to change or remove the direction of an electric current, in dynamo used to convert alternating current into direct current.
- **Cyclotron**: Studying the properties of atoms by smashing them.
- **Dynamo**: A device for converting mechanical energy into electrical energy
- **Dynamometer**: An instrument for measuring the electrical power
- **Electroscope**: An instrument for detecting the presence of electric charge.
- **Endoscope**: To examine internal parts of the body
- **Fathometer**: Measure depth of the ocean
- **Galvanometer**: For detecting and measuring electric current
- **Hygrometer**: Measure level of humidity
- **Phonograph**: For reproducing sound



- **Pyrometer:** Measure very high temperature
- **Quartz Clock:** A highly accurate clock used in astronomical observations and other precision work
- **Radiometer:** An instrument for measuring the emission of radiant energy
- **Radio Micrometer:** An instrument for measuring heat radiations
- **Rain Gauge:** An instrument for measuring rainfall
- **Rectifier:** An instrument used for the conversion of AC into DC.
- **Refractometer:** An instrument used to measure the refractive index of a substance
- **Resistance Thermometer:** Used for determining the electrical resistance of conductors
- **Salinometer:** A type of hydrometer used to determine the concentration of salt solutions by measuring their densities
- **Seismometer (Seismograph):** An Apparatus for measuring and recording earthquake shock
- **Sextant:** For guiding ships or surveying land.
- **Spectroscope:** An instrument used for spectrum analysis
- **Speedometer:** It registers the speed at which the vehicle is moving
- **Spherometer:** For measuring curvature of surfaces
- **Sphygmomanometer:** An instrument used to detect blood pressure in a human body. It is also called B.P.Apparatus
- **Sphygmophone:** Instrument with the help of which, a pulse beat makes a sound
- **Spring Balance:** Useful for measuring weight
- **Stereoscope:** It is used to view two dimensional pictures.
- **Stethoscope:** An instrument which is used by the doctors to hear and analyze heart and lung sounds.
- **Stroboscope:** It is used to view rapidly moving objects.
- **Tachometer:** An instrument used in measuring speeds of aero planes and motor boats.
- **Teleprinter:** This instrument receives and sends typed messages from one place to another.
- **Telescope:** It views distant objects in space.
- **Theodolite:** It measures horizontal and vertical angles.
- **Transistor:** A small device which may be used to amplify currents and perform other functions usually performed by a thermionic valve
- **Viscometer:** For measuring viscosity
- **Voltmeter:** To measure potential difference between two points
- **Udometer:** Rain gauge