MPPSC Mains Notes -2021

Paper -3 Science and technology

Unit I

Physics

SAMPLE NOTES

Topics covered in the booklet

- Work, Power and Energy:- Gravitational Force, Friction, Atmospheric pressure and Work.
- Units and measurement, Example from daily life.
- Speed, Velocity, acceleration.
- **Sound:-**Definition, Medium of propogation, Auidble and Inaudible Sound, Noise and music.

  Terminology related with Sound:- Amplitude,Wave length, Frequency of Vibration.
- **Electricity:-**Different types of cell, circuit.
- Magnet:-Properties, preparation and uses of artificial magnets.
- Light:- Reflection , Refraction, Mirrors and Lenses ,Image formation.
- Heat :-Measuring temperature, Thermometers, Transformation of heat.

1. Work, power and energy:- Gravitational force, friction, Atmospheric Pressure

Whenever a **force** makes a body move, then work is said to be done. But for doing work, energy is required. When work is done by human beings, machines or animals they get energy from the food which they eat and if work is done via machines, then energy is supplied by fuels or by electricity. So, we can say that when work is done an equal amount of energy is used up. This article deals with the **summary of Work, Power and Energy**, its mechanism, formulas and how they are related to each other in a crux form which not only clear your concepts but also help in your preparation and in solving problems.

Work

Work can be done when a force produces a motion. *For e.g.* when a person climbs the stairs of an office or a house, work is said to be done as he is moving against the force of gravity.

Basically, Work done by a force depends upon two factors:

(i) Magnitude of the force

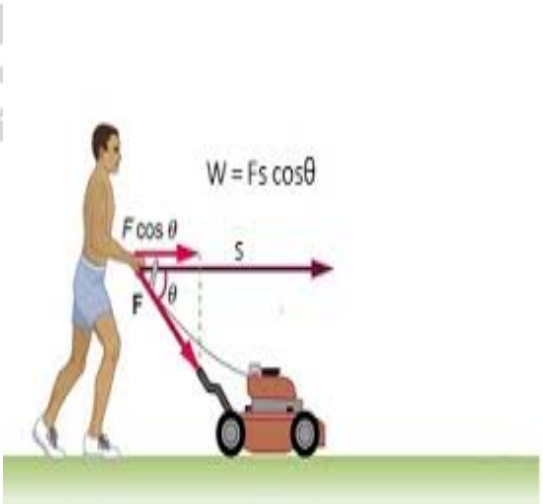
(ii) Distance through which the body moves in the direction of force.

Therefore, **Work is measured** by the product of force and displacement of the body along the direction of force. It is a *scalar quantity* and its **SI** unit is **joule.**

Work = Force X Distance (S) moved in the direction of force

Or **Work = F X S**

- If a body gets displaced by S when a force F acts on it, then



Work **W = F S Cos θ**

Where θ = angle between force and displacement

Note: The condition for a force to do work is that it should produce motion in an object, i.e. if the distance moved is zero, and then the work done on an object is also zero. **For example,** if a man pushes a wall, but there is no displacement that is wall is stationary it does not move, then, the work done by the man on the wall is zero. But

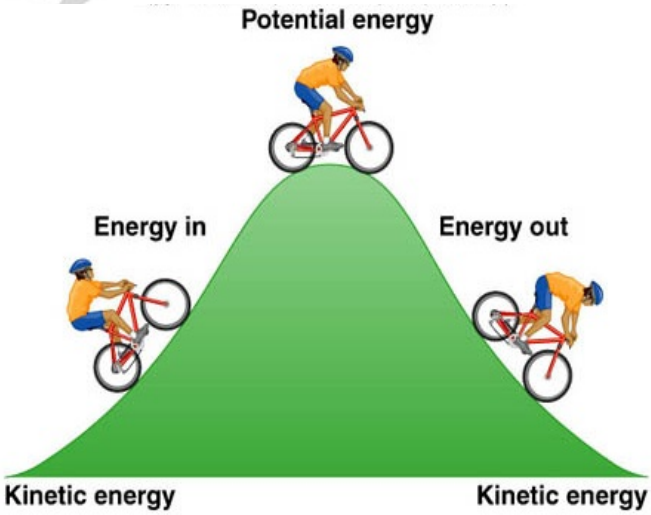
the work done on the body of the man himself is not zero. Because while pushing the wall man consumes energy, his muscles are stretched and he feels tired.
Also, we can take another **example** that if a man stands still at a bus stop with heavy suitcase in his hand, he may get tired soon but he does no work in this situation because suitcase held by the man do not move at all.
So, it is clear now that whenever a force is applied to an object it is not necessary that work is done. Work is done when force able to move the object.

What happens when work is done against gravity?

Whenever work is done against gravity, the amount of work done is equal to the product of weight of the body and the vertical distance through which the body is lifted.
Work done in lifting a body = Weight of body x Vertical distance
W = m x g x h
Where W = work done
m = mass of the body
g = acceleration due to gravity
h = height through which the body is lifted

Energy

Capacity of doing work by a body is called energy. *Energy is a scalar quantity* i.e. it has only magnitude but no direction and its unit is joule. The energy required to do 1 joule of work is called *1 joule energy.*
1 Kilojoules (KJ) = 1000 joules (J)
The unit joule is named after a British physicist *James Prescott Joule.*
- Energy developed by a body due to work done on it is called *mechanical energy*. It is of two types:
(i) Potential Energy
(ii) Kinetic Energy



Potential Energy: The capacity of doing work developed in a body due to its position or configuration or we can say that the energy of a body due to its position or change

in shape. For e.g. Energy of compressed string, energy of water collected at a height, energy of spring in a watch etc.
- The energy of a body due to its position above the ground is called *gravitational potential energy.*
- The energy of a body due to change its shape and size is called *elastic potential energy.*
- Potential energy of a body in the gravitational field of earth is mgh. where m = mass, g = acceleration due to gravity, h = height of the body from surface of the earth.

Kinetic Energy: The energy of a body due to its motion. If a body of mass m is moving with speed v, then Kinetic Energy of the body is $1/2mv^2$.
From the above formula it is clear that:
- If the mass of the body is doubled, its kinetic energy also gets doubled.
- If the mass of the body is halved, its kinetic energy also gets halved.
- If the velocity of a body is doubled, its kinetic energy becomes four times.
- If the velocity of a body is halved, then its kinetic energy becomes one-fourth.

Relation between Momentum and Kinetic Energy
$K.E = p^2/2m$ where p = momentum = mv
So, it is clear from above formula that when momentum is doubled, kinetic energy becomes four times.

Power

Power is defined as the rate of doing work. It is scalar quantity.
Power = Work done/ time taken
Or P = W/t
where P = Power
W = work done
t = time taken
Also, when work is done, an equal amount of energy is consumed. Thus, power is also defined as the rate at which energy is consumed or utilised.
Power = Energy consumed / Time taken
Or P = E/t
where P = Power
E = energy consumed
t = time taken

The S.I unit of power is watt (W). One watt is the power of an appliance which does work at the rate of 1 joule per second.
1 watt = 1 joule/ 1 second
Or 1W = 1 J/ 1 s
1 watt = 1 joule per second
1 KW = 10^3 watt
1 MW = 10^6 watt

- **Horse power** is another unit of power which is equal to 746 watt i.e. 1 horse power is equal to about 0.75 kilowatt (0.75 KW).

1 watt second = 1 watt x 1 second

1 watt hour (Wh) = 3600 joule

1 kilowatt hour (kWh) = 3.6×10^6 joule

Principle of Conservation of Energy

Energy can neither be created nor destroyed. Only energy can be transformed from one form to another. Whenever energy is utilised in one form, equal amount of energy is produced in other form. Hence, total energy of the universe remains same.

Some equipments used to transform energy are:

S.No.	Equipment	Energy transformed
1.	Dynamo	Mechanical energy in to electrical energy
2.	Candle	Chemical energy in to light and heat energy
3.	Microphone	Sound energy in to electrical energy
4.	Loud Speaker	Electrical energy in to sound energy
5.	Solar Cell	Solar energy in to electrical energy
6.	Tube light	Electrical energy in to light energy
7.	Electric bulb	Electrical energy in to light and heat energy
8.	Battery	Chemical energy in to electrical energy
9.	Electric motor	Electric energy in to motor energy
10.	Sitar	Mechanical energy in to sound energy

Hence, we can say that many physical situations can be greatly simplifies by understanding about the **work**. As, it enables us to evaluate force over distance and time. Also, it gives a broader understanding not just the forces acting on a given object, but about what happens to that object over the course of a given journey.

Gravitational Force

- Newton's law of universal gravitation states that any two objects with mass will experience a gravitational force that is…
  - universal (acts on all objects)
  - attractive (there is no such thing as antigravity)
  - directly proportional to the mass of each object (mass makes gravity)
  - inversely proportional to the square of the separation between their centers (inverse square rule)
- Equations

$$F_g = -\frac{Gm_1m_2}{r^2}$$

<u>magnitude notation</u>

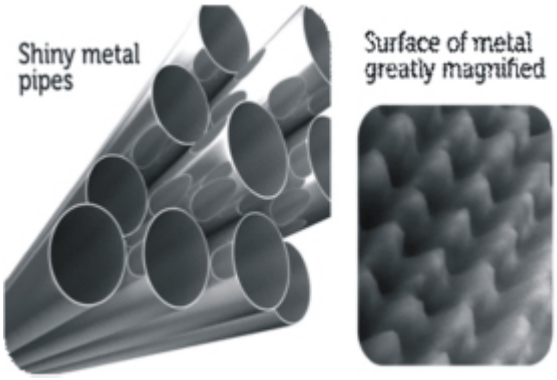
F_g = magnitude of the gravitational force between two objects (Note: A minus sign is often added to the equation to show that the force

- Use vector addition to find the net gravitational field when more than one massive object is present.

Friction

- **Friction** is a force that opposes motion between any surfaces that are touching. Friction can work for or against us. For example, putting sand on an icy sidewalk increases friction so you are less likely to slip. On the other hand, too much friction between moving parts in a car engine can cause the parts to wear out. Other examples of friction are illustrated in the two **Figures** below
  - Friction between the graphite in a pencil and a sheet of paper leaves a mark on the paper.
- Friction between a bicycle brake pad and the rim of a wheel causes the wheel to stop turning.

Why Friction Occurs

- Friction occurs because no surface is perfectly smooth. Even surfaces that look smooth to the unaided eye make look rough or bumpy when viewed under a microscope. Look at the metal surfaces in the **Figure** below. The aluminum foil is so smooth that it's shiny. However, when highly magnified, the surface of metal appears to be very bumpy. All those mountains and valleys catch and grab the mountains and valleys of any other surface that contacts the metal. This creates friction.
- 

Factors that Affect Friction

- Rougher surfaces have more friction between them than smoother surfaces. That's why we put sand on icy sidewalks and roads. Increasing the area of surfaces that are touching also increases the friction between them. That's why you can't slide as far across ice with shoes as you can on the thin blades of skates. The greater surface area of the soles of the shoes cause more friction and slow you down.
- Heavier objects also have more friction. Can you explain why?
- Heavier objects press together with greater force, and this causes greater friction between them.

Friction Produces Heat

- You know that friction produces heat. That's why rubbing your hands together makes them warmer. But do you know why? Friction causes the molecules on rubbing surfaces to move faster, so they have more energy. This gives them a higher temperature, and they feel warmer. Heat from friction can be useful. It not only warms your hands. It also lets you light a match as shown in the **Figure** below. On the other hand, heat from friction between moving parts inside a car engine can be a big problem. It can cause the car to overheat.

An atmosphere (atm) is a unit of measurement equal to the average air pressure at sea level at a temperature of 15 degrees Celsius (59 degrees Fahrenheit). One atmosphere is 1,013 millibars, or 760 millimeters (29.92 inches) of mercury.

Atmospheric pressure drops as altitude increases. The atmospheric pressure on Denali, Alaska, is about half that of Honolulu, Hawai'i. Honolulu is a city at sea level. Denali, also known as Mount McKinley, is the highest peak in North America.

As the pressure decreases, the amount of oxygen available to breathe also decreases. At very high altitudes, atmospheric pressure and available oxygen get so low that people can become sick and even die.

Mountain climbers use bottled oxygen when they ascend very high peaks. They also take time to get used to the altitude because quickly moving from higher pressure to lower pressure can cause decompression sickness. Decompression sickness, also called "the bends", is also a problem for scuba divers who come to the surface too quickly.

Aircraft create artificial pressure in the cabin so passengers remain comfortable while flying.

Atmospheric pressure is an indicator of weather. When a low-pressure system moves into an area, it usually leads to cloudiness, wind, and precipitation. High-pressure systems usually lead to fair, calm weather.

Very short questions (3 Markers)

Que. Define force.

Ans. Force: " The external physical factor which changes or tries to change the state of motion or state of rest of a body is called force."

Que.What do you mean by a force of 1 N (one newton force)?

Ans. One nowton force: The anountofforce required to create an acceleration of 1 ms^{-2} in a body of mass 1 kg is called one newton of force or force of 1N.

Que. What are balanced forces ?

Ans. Balanced forces: The forces which are applied on a body, do not change the state of motion or the state of rest of the body are called balanced forces.

Que.What are unbalanced forces ?

Ans. Unbalanced forces: The forces which are applied on a body, change its state of motion or the state of rest are called unbalanced forces.

Que.What is inertia?

Ans. The inertia: The tendency of the bodies to oppose any change in the state of motion or the state of rest of the bodies is called inertia.

Que. What do you mean by Galileo's law of inertia or Newton's first law of motion ?

Ans. Galileo's law of inertia or Newton's first law of motion: The body which is in the state of rest will remain in rest and dthe body which is in the state of motion will remain in the motion until and unless an external force is applied upon it.

Que.What do you mean by momentum ?

Ans. The momentum: The product of the mass of a body and its velocity is called momentum of the body i.e.

Momentum (P) = mass (m) x velocity (v)

Que.Write Newton's second law of motion in terms of momentum.

Ans.Newton's second law of motion in terms of momentum in a time interval i.e.

$$Force(F) = \frac{Change\ in\ momentum(\Delta p)}{Time\ interval(t)}$$

Que. Write the Newton's second law of motion.

Ans. Newton's second law of motion: "The amount of force applied on a body is equal to the product of the mass of the body and acceleration created in it due to the force applied."i.e.,

Force (F) = mass (m) x acceleration (a)

Que.What is law of conservation of momentum ?

Ans. Ans. Law oi conservation of momentum:Thetotal momentum of a System remains constant until and unless an external force is applied on the system. i.e.,

$M_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$

Que.What is impulse of the force?

Short questions (5 Markers)

Que. Mention any four phenomena that the universal law of gravitation was able to explain.

Ans.The universal law of gravitation was able to explain successfully

- the force that binds us to the earth.
- the motion of the moon around the earth.
- the motion of planets around the sun.
- the tides due to the moon and the sun.

Que. Write the methods of reducing friction.

Ans. Methods of reducing friction : The following are the methods used to reduce the friction:

(1) By use of lubricants : The use of oil and grease can reduce the friction.

(**2) By polishing**: By polishing the contact surfaces can be made smooth due to which the friction will be reduced.

(3) By use of ball bearing: Use of ball bearings reduces the area of contacting surfaces resulting reduction in friction.

(4) Streamline Shape streamlined:- In the specific shape of fish which reduces the friction of air or water.

Que.Why does a body reach the ground quicker at poles than at the equator when dropped from the same height?

Ans. The acceleration due to gravity is more at the poles than at the equator. The time taken for a body is less if the acceleration due to gravity is more when the initial velocities and the distance travelled are the same. So, when dropped from the same height a body reaches the ground quicker at the poles than at the equator.

Que. Write down the methods to increase friction.

Ans. The methods of increasing friction: The following are the main methods to increase friction

(1) By making grooves and grips on the slope of houses, the friction is increased.

(2) By dropping sand on the oily or smooth surfaces, the friction is increased.

(3) By making soles of shoes and sandles rough by grooves and lines the friction can be increased.

(4) By making heavy grips on the tyres of the automobiles the friction is increased.

Que.What are the disadvantages of friction ?

Ans. Disadvantages of friction: The following are the disadvantages of friction

(1)Heat is produced due to friction therefore the parts of machinery damage soon due to rise in temperature.

(2) There is wear and tear of machine parts due to friction. e

The chemical energy of a (chemical) substance can be converted to other forms of energy by a chemical reaction. E.g., green plants convert solar energy to chemical energy (commonly of oxygen) by the process of photosynthesis.

Que. Explain electrical energy .

Ans.The energy, derived from electric potential energy or kinetic energy, is known as electrical energy.Electricity is normally produced by electromechanical generators at a power station.Theelectromechanical generators primarily are driven by heat engines fueled by the kinetic energy of flowing water and wind.The electromechanical generators are also driven by heat engines fueled by chemical combustion or nuclear fission.

Que. What is law of conservation of energy?

Ans. Law of conservation of energy states that energy can neither be created nor be destroyed; however, it can be only transformed from one form to another.According to the law of conservation of energy, the total energy before and after the transformation remains the same.The law of conservation of energy remains valid in all conditions and locations and for all kinds of transformations.

Long questions (11 Markers).

Que. Explain increasing and decreasing friction with suitable examples.

Ans.**Increasing friction:**

- Soles of our shoes are grooved to provide the shoes better grip on the floor so that we can move safely. Similarly tyres of vehicles are treaded to increase friction to provide better grip.
- We increase friction by using brake pads in the brake system of bicycles and automobiles.
- Gymnasts apply some coarse substance on their hands to increase friction for better grip.
- Kabaddi players rub their hands with soil for a better grip of their opponents.
- Roads are made rough to prevent from slipping.

Decreasing friction:

- A few drops of oil are poured on the hinges of a door, the door moves smoothly.
- A bicycle and motor mechanic uses grease between the parts of these machines to reduce friction.
- By polishing surfaces, sprinkling powder on carrom board, we reduce friction.

Que. Difference between Mass and Weight.

Ans.

Mass	Weight
The mass of an object is the amount of the matter contained in that object.	The weight of an object is the gravitational force exerted upon it by the earth
Mass of an object is always constant everywhere.	The weight of the body varies from place to place.

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2. Units and Measurement, Example from daily life.

The comparison of any physical quantity with its standard unit is known as measurement. Measurement is the basis of all scientific studies and experimentation. It plays an important role in our daily life. Physics is a quantitative science and physicists always deal with numbers which are the measurement of physical quantities.

"When you can measure what you are speaking about and can express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind" - Lord Kelvin

Definition of Physical Quantity

Quantities that can be measured, and in terms of which, laws of physics are described are called physical quantities. Examples are length, mass, time, force, energy, etc.

Types of Physical Quantities

Physical quantities are classified into two types. There are fundamental and derived quantities.

Fundamental or base quantities are quantities which cannot be expressed in terms of any other physical quantities. These are length, mass, time, electric current, temperature, luminous intensity and amount of substance.

Quantities that can be expressed in terms of fundamental quantities are called derived quantities. For example, area, volume, velocity, acceleration, force.

Definition of Unit and its Types

The process of measurement is basically a process of comparison. To measure a quantity, we always compare it with some reference standard. For example, when we state that a rope is 10 meter long, it is to say that it is 10 times as long as an object whose length is defined as 1 metre. Such a standard is known as the unit of the quantity. Here 1 metre is the unit of the quantity 'length'.

An arbitrarily chosen standard of measurement of a quantity, which is accepted internationally is called unit of the quantity.

The units in which the fundamental quantities are measured are called *fundamental or base units* and the units of measurement of all other physical quantities, which can be obtained by a suitable multiplication or division of powers of fundamental units, are called derived *units*.

Different types of Measurement Systems

A complete set of units which is used to measure all kinds of fundamental and derived quantities is called a system of units. Here are the common system of units used in mechanics:

SI unit System

The system of units used by scientists and engineers around the world is commonly called ***the metric system*** but, since 1960, it has been known officially as the International System, or SI (the abbreviation for its French name, Systeme International). The SI with a standard scheme of symbols, units and abbreviations, were developed and recommended by the General Conference on Weights and Measures in 1971 for international usage in scientific, technical, industrial and commercial work. The advantages of the SI system are,

i. This system makes use of only one unit for one physical quantity, which means a rational system of units

ii. In this system, all the derived units can be easily obtained from basic and supplementary units, which means it is a coherent system of units.

iii. It is a metric system which means that multiples and submultiples can be expressed as powers of 10.

THE SEVEN FUNDAMENTAL UNITS

UNIT	QUANTITY	HOW IT IS/WILL BE DEFINED
Meter*	Distance	Based on speed of light
Kilogram**	Mass	To be based on Planck constant
Second*	Time	Based on radiation of caesium-133 atom
Ampere**	Current	To be based on an electron's charge
Kelvin**	Temperature	To be based on Boltzmann constant
Mole**	Amount of substance	To be based on Avogadro constant
Candela*	Luminous intensity	From efficacy of light of specific frequency

*Current definition stands **Being redefined

Very short questions (3 Markers)

Que.Define scalar quantities. Give examples.

Ans. Scalar quantities:The physical quantities which can be represented only by magnitude and there is no need of any direction are called scalar quantities.

Examples: Distance, speed, density etc.

Que. Define vector quantities. Give examples.

Ans. Vector quantities: The physical quantities which require magnitude as well as direction to represent them, are called vector quantities."

Example : Displacement, velocity, acceleration etc.

Que.What is the CGS system of units?

Ans.The CGS (centimeter, gram, second) system

- Length is measured in centimeters, mass is measured in grams and time is measured in seconds.

Que. Who invented verniercalipers ?

Ans. Pierre Vernier (19 August 1580 at Ornans, Franche-Comté, Spanish Habsburgs (now France) – 14 September 1637, same location) was a French mathematician and instrument inventor. He was inventor and eponym of the vernier scale used in measuring devices.

Que. Write the name of device used to measure current ?

Ans.An **ammeter** (from **ampere meter**) is a measuring instrument used to measure the current in a circuit. Electric currents are measured in amperes (A).

Que. When the units redefinition takes place recently?

Ans.On May 20, 2019, the CGPM redefined the kilogram, the ampere, the mole, and the kelvin in terms of fundamental physical constants.

Que. Who is considered as the 'Father of Electrodynamics'?

Ans. Mathematician Andre-Marie Ampere, is considered as "Father of Electrodynamics".

Que. Naming of Ampere.

Ans.It is named after the French Physicist and Mathematician Andre-Marie Ampere

Short questions (5 Markers)

Que. When was the International system of Units implemented ?

Ans. The International System of Units, universally abbreviated SI (from the French Le Système International d'Unités), is the modern metric system of measurement. The SI was established in 1960 by the 11th General Conference on Weights and Measures (CGPM, ConférenceGénérale des PoidsetMesures). The CGPM is the international authority that ensures wide dissemination of the SI and modifies the SI as necessary to reflect the latest advances in science and technology.

Que. What are the advantages of using SI unit of system ?

Ans. Advantages of using system of International System (**SI**)

- SI is coherent system of units i.e. a system based on certain set of fundamental units .
- SI is rational system of units i.e., it assigns only one unit to particular physical unit .
- SI is metric system , i.e., multiples and sub- multiples of the system can be expressed as power of 10.
- SI is internationally accepted system of units.

Que. What is the significance of Unit redefinition ?

Ans.The unit redefinitions represent a profound change of perspective and they are expected to form the foundations of improved measurements for decades to come as science and technology continues to develop in ways scientists cannot currently foresee.

However, the proposed changes have been designed to have no immediate consequences. However, they will matter when it comes to measurements less than a kilogramme for instance, while measuring smaller diamonds.

Que. Does the redefinition of units really helps the science ? Explain.

Ans.

- The change in definition of the second, previously, has helped ease communication across the world via technologies like GPS and the Internet.
- In the same way, the change in the kilogram will be better for technology, retail and health.

parts per million and the ohm changed by even less. Practitioners working at the highest level of accuracy will have adjusted the values of their standards and reviewed their measurement uncertainty budgets.

Que. Give some real life examples of Units and measurements .

Ans.

- When planning a trip, we calculate the mileage (miles per gallon) using the odometer in the car, calculate the distance traveled; determine when to fill up the gas tank again…
- We use measurement skills when planning a garden space, measuring floor covering, painting the interior of your home. The amount of paint to be bought is directly proportional to the surface area of the walls in your home.
- We use measurement when sewing a dress.
- We choose air conditioner based on the volume of the house.
- We buy fruits and vegetables in a grocery store by weight. We weigh them using a balance scale.

Long questions (11 Markers)

Que.What are the impact of changing the units definition ?
Ans.

- For astronomers calculating the movements of stars and galaxies or for pharmacologists trying to define doses of medications sown to the molecule, the new standard of measurement could change the way they work. But for many metrologists, that day to day work is not necessarily what inspired this change. The metric system was intended to be rational, universal set of units “for all people, for all time”.
- This decision has now enabled scientists and researchers to base the SI units entirely on fundamental properties of nature, which will ensure their ongoing refinement and improvement for years to come. The SI unit will finally be truly universal system, free of any human artefacts.

In India, the Council of Scientific & Industrial Research - National Physical Laboratory (CSIR-NPL) has also prepared documents on:

NPL Policy on Metrological Traceability;

- Recommendations on the proposed changes to be incorporated in the National Council of Educational Research and Training (NCERT) textbooks and implement the new changes to impart cotemporary education to its students;
- Recommendations on the proposed changes to be incorporated in syllabi of metrology courses in graduate engineering and academic courses being taught in All India

3. Speed , Velocity and Acceleration.

Speed (s):

- The distance travelled by an object in unit time is referred to as speed.
- It is represented as:

$$\text{Acceleration} = \frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time}}$$

$$\text{Or} \quad a = \frac{v-u}{t}$$

$$\Rightarrow \quad at = v-u$$

$$\Rightarrow \quad \boxed{v = u + at}$$

- Its SI unit is metre/ second (m/s).
- It is a scalar quantity.
- **Average speed:** For non-uniform motion, the average speed of an object is obtained by dividing the total distance travelled by an object by the total time taken.

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

Velocity (v):

- Speed of an object in a particular direction is named as velocity, i.e., it is the displacement of body in unit time.
- It is represented as:

$$v^2 = u^2 + 2as$$

Derivation:

From second equation of motion, we have:

$$s = ut + \frac{1}{2}at^2 \qquad \ldots(i)$$

Also, from first equation of motion, we have:

$$v = u + at$$

Above equation can be rearranged as:

$$at = v - u$$

$$\Rightarrow \quad t = \frac{v-u}{a}$$

Putting this value of t in equation (i), we get:

$$s = u\left(\frac{v-u}{a}\right) + \frac{1}{2}a\left(\frac{v-u}{a}\right)^2$$

Very Short questions (3 Markers)

Que.Define speed and write its unit.

Ans. Speed: "The distance travelled by a moving body in unit time interval in any Uirection is called speed of the body ,

$$speed = \frac{Distance\ travelled(x)}{Time\ taken(t)}$$

Unit of the speed: Metre per second.

Que. What is meant by average speed?

Ans. Average speed: "The ratio of the total distance travelled by a body in a time interval to the time interval is called the average speed i. e,

$$The\ average\ speed = \frac{The\ total\ distance\ travelled}{Total\ time\ taken}$$

Unit of average speed: Metre per second (ms)

Que. Define velocity and write its unit.

Ans. Velocity : "The rate of displacement of a body with time in a detinite direction is called the velocity." i.e

$$Velocity = \frac{Displacement}{Time\ interval}$$

Unit of velocity: Metre per Second (ms)

Que. What is non-uniformm or variable velocity ?

Ans. Non-uniform or variable velocity : If a moving body travels equal distances in equal time intervais but its direction changes or it cOvers unequal distances in equal time interval in a fixed direction, then its velocity is called non-uniform velocity or variable velocity."

Que. Define average velocity.

Ans. The average velocity : The ratio between total displacement of a moving body and the total time taken by the body is called average velocity. i.e.,

$$Average\ Velocity = \frac{Total\ Displacement}{Total\ time\ taken}$$

Que. Define acceleration. Write its unit.

Ans. The acceleration: The rate of change of velocity with time is called acceleration. i.e,

$$Acceleration = \frac{Change\ in\ velocity}{Time\ interval}$$

Que. What do you mean by acceleration due to gravity?

Ans. Acceleration due to gravity:"The acceleration occurring in a falling body due to gravitational force is called acceleration due to gravity." It is denoted by 'g'.

Que. What is retardation ? What is the relation between acceleration

Ans. Yes, e.g. a body in uniform circular motion has constant speed but due to the change in the direction of motion, its velocity changes at every point.

Que. What is uniform acceleration?

Ans. Acceleration of an object is said to be uniform if it travels in a straight line and its velocity increases or decreases by equal amounts in equal intervals of time.For example, motion of a freely falling body.

Que. Which device is used to measure the speed?

Ans. **Speedometer**, instrument that indicates the speed of a vehicle, usually combined with a device known as an odometer that records the distance travelled.

Que. The instrument used to measure the acceleration.

Ans.An accelerometer is a device that measures the vibration, or acceleration of motion of a structure.

Short questions (5 Markers)

Que.How can we describe the location of an object?

Ans. To describe the position of an object we need to specify a reference point called the origin. For example, suppose that a library in a city is 2 km north of the railway station. We have specified the position of the library with respect to the railway station i.e., in this case, the railway station acts as the reference point.

Que. Give an example of a body which may appear to be moving for one person and stationary for the other.

Ans. The passengers in a moving bus observe that the trees, buildings as well as the people on the roadside appear to be moving backwards. Similarly, a person standing on the roadside observes that the bus (along with its passengers) is moving in forward direction. But, at the same time, each passenger in a moving bus or train observes, his fellow passengers sitting and not moving. Thus, we can tell that motion is relative.

Que. What is negative acceleration ?

Ans.If the velocity of a body decreases with time, then its final velocity is less than the initial velocity and thus its acceleration is negative. Negative acceleration is called retardation or deceleration. For example, when brakes are applied to a moving truck, its velocity gradually decreases. In other words, it is under retardation.

Que.Who invented the speedometer?

Ans. Charles Babbage is credited with creating an early type of a speedometer, which was usually fitted to locomotives. The electric speedometer was invented by the Croatian JosipBelušić in 1888 and was originally called a **velocimeter.**

Que. Who invented the accelerometer?

Ans. The first accelerometer, originally known as the Atwood machine, was invented by the English physicist George Atwood (1746-1807) in 1783. There are two types of accelerometers. The instrument constructed by Atwood measures linear acceleration, such as that experienced by a falling object.

Middle Ear: The middle ear is composed of the ear drum or tympanum(it is an elastic membrane, circular in shape) and the bone ossicles. There are three bone ossicles, namely, the hammer, the anvil and the strirrup.

Internal/inner Ear: The internal ear is composed of a cochlea and three semi-circular canals. The cochlea is filled with liquid. The cochlea makes the hearing apparatus and the auditory nerve from it goes to the brain.

Eardrum is the intersection of the outer and middle ear.

Oval window is the intersection of middle and inner ear.

Working of Human Ear: The outer ear called pinna collects the sound waves. The sound waves passes through the ear canal to a thin membrane called eardrum. The eardrum vibrates. The vibrations are amplified by the three bones of the middle ear called hammer, anvil and stirrup. The middle ear then transmits the sound waves to the inner ear. In the inner ear the sound waves are converted into electrical signals by the cochlea and sent to the brain through the auditory nerves. The brain then interprets the signals as sound.

Very Short questions (3 Markers)

Que What is sound and how is it produced ?

Ans. Sound: "The type of form of energy for which our ears are sensitive is calledsound.It is produced due to vibration of sound source**.**

Que.Which characteristics of the sound helps you to identify your friend by his voice while sitting with others in a dark room?

Ans. The quality of sound.

Que. Flash and thunder are produced simultaneously. But thunder is heard a fewseconds after the flash is seen. Why ?

Ans. The speed of flash (light) is very much higher than that of thunder (sound)therefore flash is seen early while thunder takes more time to reach and hence it is heard afew second after the flash is seen.

Que. Does sound follow the same laws of reflection as light does ? Explain.

Ans. Yes, sound waves also follow the same laws of reflection as light waves do. Theseare

(1) Angle of incident = Angle of reflection.

(2) Incident ray, reflected ray and normal lie in the same plane.

Que. Give two practical applications of reflection of sound waves.

Ans. The two practical applications of reflection of sound waves are:-

(1) To send sound waves in the forward direction towards audience by megaphone, loudspeaker etc.

(2) Stethoscope is used for listening the sounds produced within the body.

Que. What is reverberation ? How can it be reduced ?

Ans. **Reverberation of sound**: The perşistance of sound due to repeated reflection,called reverberation.

Que. What is noise and music?

Ans. **Music:** It is the sound that is pleasant to hear. For example: Sound coming out of musical instruments.

Noise: It is the sound that is unpleasant to hear. For example: Sound produced by vehicles.

Que. What is tone and note ?

Ans**..**

Tone: A pure sound of single frequency is called tone.

Note: An impure sound produced by mixture of many frequencies is called a note. For example: A musical note has tones of various frequencies**.**

Short questions (5 Markers)

Que. Describe, how compressions and rarefactions areproduced in air near a source of sound ?

Ans. When a sound source vibrates forward it compresses the nearby particles of themedium (air) and hence a region of high atmospheric pressure is developed. This region iscalled compression. When this vibrating body vibrates backward, then a low pressure regionin air is developed in forward direction which is called rarefaction. In this way compressionsand rarefactions are produced.

Que.**Why is a sound wave called a longitudinal wave ?**

Ans. The propagation of sound waves is carried out through compressions andrarefactions which creates the changes in pressure and density of air (the medium).These are the characteristics of longitudinal waves therefore sound waves are calledlongitudinal waves.

Que. Explain how bats use ultrasound to cateh a prey ?

Ans. Use of Sonar technique by bats to search their prey in darkness: Bats use sonar technology to search their prey in darkness. For this they produce and transmit ultrasound waves while fiying in the sky. These high frequency waves strike the obstacles like insects etc. and reflect back. These reflected waves are received and detected by bats. The nature of refiected pulse gives information about size, shape and position of prey.

Que. How is ultrasound used for clearing of object?

Ans. The use of ultrasound for clearing of objects: Ultrasound can be used to clear inaccessible parts of small objects such as zig-zag tube, complex shaped machine parts, electronic component etc. The object desired to be cleared is placed in a solution. Ultrasound is transmitted through this solution. The high frequency is produced in the particles of solution. These high frequency disturbances in the particles of solution, remove the dirt from the object.

Que.Explain the working and application of a SONAR.

Ans. **Working of Sonar**: In SONAR technique, a transmitter and a detecter are used.The powerful high frequency pulses of ultrasound called signals are send periodically bytransmitter. These waves propagate in water and strike the target and after reflection from

5. Electricity :- Different types of cell, circuit.

Electricity

Electricity is a basic part of our nature and it is one of our most widely used forms of energy. We use electricity virtually every minute of every day for example in lighting, heating, refrigeration, air conditioning, power electromagnets, power computers , power televisions, power pumps, power our vehicles etc.

Charge

Each matter contains some protons, electrons and neutrons. The charge possessed by proton is called positive charge () while the charge possessed by electron is called negative charge (). Neutron has the particle that has no charge.
Like charges repel each other while unlike charges attract each other.
Electric charges are made up of positive charges (protons) and negative charges (electrons).

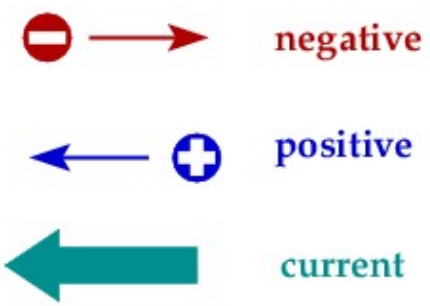
Conductors and Insulators

Conductors are those materials in which electrons are free to move anywhere inside the matter like, aluminium, copper etc. All metals are conductors.
Insulators are those materials in which electrons are not free to move anywhere like, plastic, wood etc.

Electric Current

The flow of electric charge is known as electric current.
Electric current is denoted by letter 'i'. Electric current is expressed by the rate of flow of electric charges. Rate of flow means the amount of charge flowing through a particular area in unit time.
If a net electric charge (Q) flows through a cross section of any matter in time t,
SI unit of electric current is ampere (A).

- If positive charge flows, direction of electric current is same as direction of flow of charge.
- If negative charge flows, direction of electric current is opposite to direction of flow of charge.



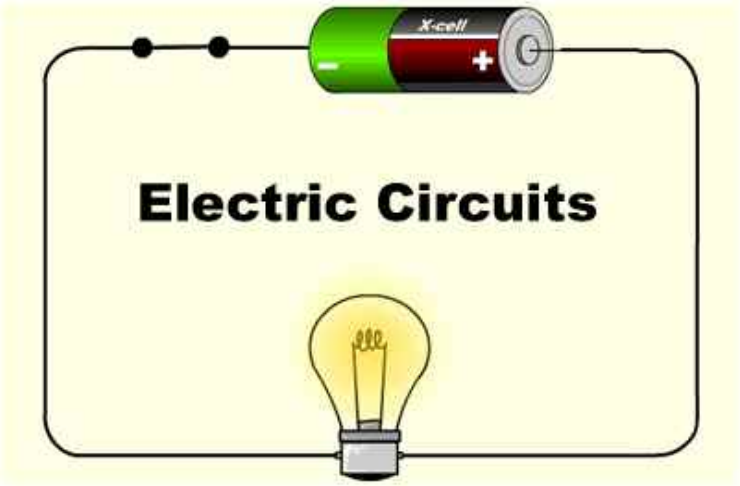
Electric current can't flow through insulator because in insulator, protons and electrons are fixed at their position.

Potential Difference

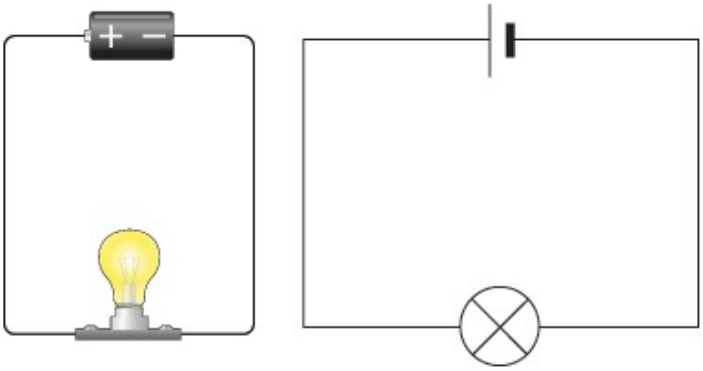
Potential difference between two points is the workdone per unit charge in taking the charge from one point to another.
1 volt is the potential difference between two points if 1 J of work has to be done in taking 1 C charge from one point to another.
As water flows from high level to low level similarly, electric current flows from high potential to low potential.
Cell: The Difference of potential may be produced by a battery, consisting of one or more electric cells.
Potential difference across the terminals of the cell generated due to chemical reaction within the cell. When cell is connected to a conducting wire, current flows from high potential to low potential.

Electric circuit

Electric circuit is a continuous and closed path of electric current. For example figure given below shows a typical electric circuit comprising a cell, an electric bulb and a switch.



Note: Current flows only if electric circuit forms closed loop.
Circuit Diagram
We know that electric circuit is a continuous path consisting of cell, switch (plug key), electric components and connecting wires. Electric circuits can be represented conveniently through a circuit diagram.
A diagram which indicates how different components in a circuit have to be connected by using symbols for different electric components is called a circuit diagram.



At Anode

$$Pb \rightarrow Pb^{2+} + 2e^-$$
$$Pb + SO_4^{2-} \rightarrow PbSO_4(electrode) + 2e^-$$

At Cathode

$$2e^- + PbO_2 + 4H^+ \rightarrow Pb^{2+} + 2H_2O$$
$$2e^- + PbO_2 + 4H^+ + SO_4^{2-} \rightarrow PbSO_4(electrode) + 2H_2O$$

In order to recharge these batteries, the charge is transferred in the opposite direction and the reaction is reversed, thus converting $PbSO_4$ back to Pb and PbO_2.

Another example of the secondary cell is the nickel-cadmium cell. These cells have high storage capacities and their lifespan is relatively long (compared to other secondary cells). However, they are difficult to manufacture and maintain

Very Short questions (3 Markers)

Que- Define Electric Power.

OR

What do you mean by electric power of an electric appliance (instrument)?

Ans. Electric power of an electric appliance : The rate of consumption of electric energy in an electric appliance is called electric power of the appliance.

Que. Define the unit "Watt" of electric power.

OR

What do you mean by "one watt electric power.

Ans. One watt electric power :If there is one joule per second electric energy loss in an electric circuit then the power of the circuit of the circuit is one watt.

Que. What are lightning Conductors ?

Ans. **Lightning Conductors**:-It is a device used to protect buildingsfrom effects of lightning. A metallic rod,is installed on the top of the building. Oneend of the rod is kept out in the air and theother is buried deep in the ground. Therod provides easy route for the transfer ofelectric charge to the ground.

Que. What is electric current?

Ans.Electric Current :-A flow of charge is called an electriccurrent. The direction of current flowis opposite to the direction of flow ofnegative charges.

Current(I)= Charge(Q)/Time(t)

The S.I. unit of current is coulomb/second. This unit is called ampere whose symbol is A.

Que. Define potential difference .

Ans. Potential Difference:- The potential difference between two points is equalto work done in moving a unit positive charge from one point to the other. It is expressed in volts.

Que. Define Electromotive force (EMF).

Ans. Plastics is a bad conductor or insulator of electricity. It prevents us from electric shocks. To complete the circuit, we have to remove the plastic coating to connect wires so that the current may flow through the circuit.

Que. What is includings in a simple circuit ?

Ans. A simple circuit comprises the power source, conductors, switch, and load.

Cell: It is the power source. 

Load: It is also termed as the resistor. It is a light bulb that lights when the circuit is turned on.

Conductors: They are made of copper wires with no insulation. One end of the wire is connected the load to the power source and the other end of the wire connects the power source back to the load.

Switch: It is a small gap in the circuit. There are various types of switches. A switch can be used to open or close a circuit.

Short questions (5 Markers)

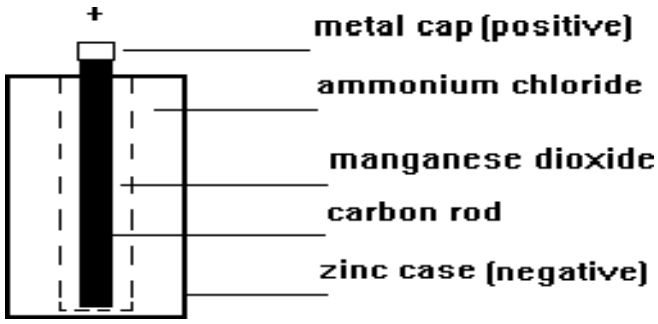
Que. What is electric cell?

Ans. Electric Cell:-In an electric cell, chemical energychanges into the electrical energy whenit sends current in a circuit. Cells havechemicals inside.The positive andnegative charges gather separately in acell, which creates a potential differencebetween the terminals of a cell. Theterminal with higher potential is called thepositive terminal and the one with lowerpotential is called the negative terminal.

Que. Explain the types of cell .

Ans.: The cells are of two kinds- (1) Primary cells, and (2) Secondary cells.

1. Primary Cells:-These cells providecurrent as a result of irreversible chemical reaction. Such cells arediscarded after use and cannot be recharged. Some examples of primary cells are simple voltaic cells, Danielcell, Leclanche cell, dry cell etc.



Dry cell (Leclanche)

2. Secondary Cells or Accumulators:-In these cells, chemical reactions is reversible and so they can berecharged after use. These cells are also calledstorage cells. Examples-lead accumulators,Fe accumulators, Li-H battery. Low Current rechargeable cells are widely used in toys and mobile phones.

Que- What are the types of material ?

Ans. Types of Materials:-

Insulators:-The substances which doesnot allow the current to flow throughthem are called insulators. They do nothave free electrons. Cotton, rubber,plastic, wood, glass, leather, etc. are someexamples of insulators.

After some time, when heater coil becomes hot its resistance increases. As a result, current through the heater coil decreases and the current through the bulb filament increases and thus dimness of the bulb decreases.

Que. Expalin the Ohms Law.

Ans. **Ohm's Law**

At the constant physical conditions of any conductor, the current flowing through the conductor is directly proportional to thepotential difference across it.

I =V/R, where R is the resistance.

- If a wire is stretched, its resistance will change but its specitic resistance will remain unaffected.
- On increasing the temperature of themetal, its resistance increases.
- On increasing thesemiconductor, its resistance decreases.
- On increasing theelectrolytes, its resistance decreases.
- The reciprocal of resistivity of aconductor is called its conductivity. Itsunit is mho m^{-1}.
- The heating effect of electric current isknown as Joule's law of heating.
- Electric bulb, electric kettle, heater, etcdevices work on the bases of heating effect of electric current.

Long questions (11 Markers)

Que. Difference between Series and Parallel circuit.

Ans.

Series Circuit	Parallel Circuit
The same amount of current flows through all the components	The current flowing through each component combines to form the current flow through the source.
In an electrical circuit, components are arranged in a line	In an electrical circuit, components are arranged parallel to each other
When resistors are put in a series circuit, the voltage across each resistor is different even though the current flow is the same through all of them.	When resistors are put in a parallel circuit, the voltage across each of the resistors is the same. And even the polarities are the same
If one component breaks down, the whole circuit will burn out.	Other components will function even if one component breaks down, each has its own independent circuit
If Vt is the total voltage then it is equal to V1+V2+V3	If Vt is the total voltage then it is equal to V1=V2=V3

Que. Difference Between Cell and Battery.

Ans.

Cell	Battery
A cell is a single unit device which converts chemical energy into electric energy.	A battery usually consists of group of cells.
Depending on the types of electrolytes used, a cell is either reserve, wet or dry types. Cell also includes molten salt type	A battery is either a primary battery or a secondary battery meaning it is rechargeable or non-chargeable.

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is twice the size of the object and a magnification of 1 indicates an image size being the same as the object size.

Power of a Lens

The degree of divergence or convergence of ray of light by a lens is expressed in terms of the power of lens. Degree of convergence and divergence depends upon the focal length of a lens. The power of a lens is denoted by 'P'. The power of a lens is reciprocal of the focal length.
P=1/f
The SI unit of Power of lens is dioptre and it is denoted by 'D'.
Power of a lens is expressed in dioptre when the focal length is expressed in metre. Thus, a lens having 1 metre of focal length has power equal to 1 dipotre.

$$Therefore, 1D = 1m^{-1}$$

A convex lens has power in positive and a concave lens has power in negative.

Very Short Answer (3 marker)

Que. Define Ray of light.
Ans. A line drawn in the direction of propogation of light is called a Ray of light.
Que. Define reflection of light.
Ans. Reflection of light: "The process of returning back of thelight in a particular direction, when it falls on a polished surface, is called the reflection of light."
Que. What is mirror ?
Ans. Mirror: "The polished surface which reflects the maximum part of the light that falls upon the surface, is called mirror."
Que. What is point of incidence related to reflection of light?
Ans. Point of incidence related to reflection of light: "The point on the mirror (reflecting surface) where an incident ray strikes, is called point of incidence.
Que. What is incident ray related to reflection of light ?
Ans. Incident ray related to reflection of light: The ray of light which strikes the mirror, is called incident ray"
Que. What is 'normal' related to reflection of light ?
Ans. 'Normall related to reflection of light: "The perpendicular drawn at the point of incidence to the surface of the mirror is called normal".
Que.What is reflected ray ?
Ans. Reflected ray: A ray of light which bounces off the surface of a mirror, is called reflected ray
Que.What is angle of incidence ?
Ans. Angle of incidence: "The angle betwcen incident ray and normal is,called angle of incidence.
Que. What is angle of reflection ?
Ans. Angle of reflection: "The angle between reflected ray and normal is called angle of reflection."
Que.. What happens when a ray of light falls normally on thesurface of a mirror ?
Ans. When a ray of light falls normally on the surface of a mirror,it reflects back on the same path of its arrival.
Que. What is a "plane mirror"?
Ans. The plane mirror: "The mirror whose reflecting surface is plane, is called plane mirror.

Ans. Range of vision of an eye: The distance between near point and far point of an eye is called the range of vision of the eye."

It is 25 cm to infinity for normal eye.

Que. What is least distance of clear vision ?

Ans. The least distance of clear vision : "Within the range of vision, there is a certain distance from the eye where the object is most clearly seen. This distance is called the least distance of clear vision."

The least distance of clear vision for a normal eye is 25 cm.

Que. What is presbyopia ?

Ans. Presbyopia: "In old age the ciliarymuscles become weak so unable to accommodate the eye lens properly, therefore the man neither can see distinct object nor near object clearly. This type of eye defect is called presbyopia."