CHAPTER#1

INTRODUCTION

PHYSICS:

"It is the branch of science which deals with the study of matter and energy along with their mutual interaction."

BRANCHES OF PHYSICS:

Main branches of physics are given below:

MECHANICS:

It deals with motion of objects with or without reference of force.

ELECTRICITY:

It is concerned with the phenomena and effects related to electric charges.

ELECTROMAGNETISM:

It deals with observations, principles, laws and methods that relate electricity and magnetism.

SOLID-STATE PHYSICS:

It is concerned with the structure and properties of solid materials.

ATOMIC PHYSICS:

It is concerned with the structure and properties of atom.

NUCLEAR PHYSICS:

This branch is concerned with the structure, properties and reactions of the nuclei of atoms.

PLASMA PHYSICS:

It is concerned with the properties of highly ionized atoms forming a mixture of the nuclei and electrons.

CONTRIBUTION OF MUSLIM SCIENTISTS:

ALI HASSAN IBN-AL-HAITHAM (965-1039 A.D.):

Ibn-al-Haitham was a great scholar of Physics, Mathematics, Engineering, Astronomy and medicine. He wrote many books but the most famous is "KITAB-UL-MANAZIR" which deals with 'optics' a branch of physics. He gave the true concept of light and declared it as a form of energy. He gave the definition of the ray, constructed a pinhole camera and managed to obtain the image of 'SOLAR ECLIPSE'. He also gave the two laws of reflection and described luminous, non-luminous, opaque and transparent objects. He researched on the formation of image using spherical mirrors.

ABU REHAN AL-BERUNI:

Al-Beruni wrote more than one hundred and fifty books on Mathematics, Cosmology, Physics, Geography, History, Culture and Civilization, Archeology, Comparative Religions, Geology, Chemistry and Biology. He discussed shape of earth, the movement of sun, moon

and planets in his famous book 'QANOON AL MASOODI'. He also gave the concept of longitudes and latitudes. He also determined the densities of metals.

YAQUB IBNE ISHAQ AL KINDI (800-873 A.D.):

He produced several research monographs on Meteorology, specific gravity and on tides. His most important work was in sound and optics. He explained musical notes on scientific ground and discovered the method to express them in terms of frequency. He discussed nature of sound and worked in geometrical physics which was translated in Latin. He also worked in the field of medicine.

CHAPTER#2

MEASUREMENTS

MEASUREMENT:

It is the result of the value of unknown against the known standard.

FUNDAMENTAL UNITS:

The international system of units is based on seven independent units known as fundamental or basic units, they are used to express fundamental units.

DERIVED UNITS:

The units of other physical quantities which are obtained by multiplication, division or both of the fundamental units are called derived units.

SIGNIFICANT FIGURES:

Significant figures are the accurately known digits and first doubtful digit in any measurement.

VERNIER CALLIPERS:

It is an instrument which can measure length correct up to 0.1mm and even up to 0.05mm which depends on the number of division of Vernier scale.

SCREW GUAGE:

It is an instrument that can measure small length correctly up to 0.001 cm or up to three places of decimal.

PITCH OF THE SCREW:

It is the distance between the two consecutive threads of linear screw. It is measured by the distance travelled on the main scale by the circular scale during one complete rotation or 100 division of circular scale.

ERROR AND ITS CLASSIFICATION:

The difference between the measured and the actual value of a physical quantity is called an error. A person may come across with the following errors:

PERSONAL ERROR:

This kind of error is due to a faulty procedure followed by an observer. It arises while reading the scale with an inappropriate method.

SYSTEMATIC ERROR:

This kid of error is due to a fault in the measuring instrument. This is usually called zero error. It may be avoided by mathematical calculations.

RANDOM ERROR:

It is also called an accidental error which arises due to changes in the experimental conditions, like temperature, humidity, voltage etc. it can be reduced by maintaining certain conditions in the laboratory.

ACCURACY:

Accuracy means to find the measurement of the quantities involved in a phenomenon as close to the factual value as possible.

CHAPTER#3

KINEMATICS OF LINEAR MOTION

STATE OF REST:

If a body doesn't change its position with respect to its surroundings then it is in state of rest.

STATE OF MOTION:

A body is said to be in the state of motion if it changes its position with respect to its surroundings.

TYPES OF MOTION:

1. TRANSLATORY MOTION:

   The motion of a body in which every particle of the body is displaced by the same amount is called translatory motion. For example, moving car on a road, train moving on tracks, falling bodies etc.

2. ROTATIONAL MOTION:

   When an object spins or rotates about a fixed point or axis, its motion is called rotational motion. For example the rotation of earth about its own axis, the rotating wheels of a cycle, blades of a moving fan etc.

3. OSCILLATORY (VIBRATORY) MOTION:

   The to and fro motion of an object about a mean position executed at regular intervals of time is called oscillatory motion. For example, moving pendulum, motion of strings of guitar, vibrating skin of a drum etc.

KINEMATICS:

The branch of physics which deals with the description of motion of objects without reference to force agents causing motion is called 'kinematics'.

SCALAR QUANTITIES:

The physical quantities which are completely specified by their magnitude only are called scalar quantities. For example: length, mass, time, speed, work and temperature.

TYPES OF ACCELERATION:

POSITIVE ACCELERATION:

It is positive when the velocity of body increases and its direction is in the direction of motion.

NEGATIVE ACCELERATION:

Acceleration is negative if the velocity decreases and the direction of acceleration is against the motion of body. It is called retardation or deceleration.

UNIFORM ACCELERATION:

If the velocity of a body changes by equal amount in equal interval of time then its acceleration is uniform.

VARIABLE ACCELERATION:

If the velocity of a body doesn't change by equal amount in equal interval of time then its acceleration is variable.

AVEREGE ACCELERATION:

It is the ratio between the total velocity change and time interval.

FIRST EQUATION OF MOTION:

Consider an object moving with uniform acceleration 'a'. Let its initial velocity be 'Vi' which changes to 'Vf' in time interval't'. Hence change in velocity, ΔV = Vf –Vi

According to definition of acceleration,

Acceleration = Change in velocity / time
a = $\Delta V/t$
a = (Vf – Vi) / t >> at = Vf – Vi
Vf = Vi + at hence derived

SECOND EQUATION: ($s = Vit + 1/2\ at^2$)

Consider an object moving with uniform acceleration 'a'. let its initial velocity be 'Vi' which changes to 'Vf' in time interval 't' during which the body covers displacement 's'. The average velocity of the body is given as:

Vav = (Vi+Vf)/2

By the definition of average velocity,

Vav = s/t
>> S = Vav x t, on substituting Vav in above equation
S = [(Vi+Vf)/2] x t →**eq 1**

According to definition of acceleration, a = $\Delta V/t$
OR
a = (Vf – Vi) / t
>> Vf = Vi + at

On substituting 'Vf' in equation 1

S = [(Vi+Vi+at)/2] x t
S = [(2Vi+at)/2] x t
S = [(2Vi/2) + (at/2)] x t

>> **$S = Vit + 1/2\ at^2$** Hence derived

THIRD EQUATION OF MOTION: ($2as = Vf^2 – Vi^2$)

Consider an object moving with uniform acceleration 'a'. Let its initial velocity be 'Vi' which changes to 'Vf' in time interval 't' during which the body displace 's'.The average velocity of the body is given as:

Vav = (Vi+Vf)/2

Also according to definition of average velocity:

Vav = s/t
>> S = Vav x t, on substituting Vav in above equation
S = [(Vi+Vf)/2] x t →**eq 1**

According to definition of acceleration, $a = \Delta V/t$
$a = (Vf - Vi) / t$
OR $t = (Vf - Vi) / a$

Substituting the value of 't' in equation:

$S = [(Vi+Vf)/2] [(Vf-Vi)/2]$
>> $S = (Vf^2 - Vi^2)/2a$ $[(a+b) (a-b) = a^2 - b^2]$
OR
$2as = Vf^2 - Vi^2$ Hence derived

MOTION UNDER GRAVITY:

If a body is dropped from a certain height, it falls to the ground and its velocity continues to increase till it strikes the ground. This example shows that a free falling body has acceleration. It is experimentally proved that all bodies falling freely towards the ground have constant acceleration. No matter how heavy or light they are, they reach the ground at the same time with the same acceleration called acceleration due to gravity. Its value is found to be 9.8 m/s^2 on earth.

All these equations of rectilinear motion are also true for bodies falling under gravity.

CHAPTER#4

FORCE AND MOTION

FORCE:

Force is an agent which changes or tends to change the state of rest or the motion of a body.

OR

It is an agent which produces or tends to produce acceleration in body.

NEWTON'S LAWS OF MOTION:

NEWTON'S FIRST LAW OF MOTION:

Everybody continues its sate of rest or of uniform motion in a straight line unless it is acted upon by an unbalanced external force.

It is a common observation that an object lying at a place will remain there and moving body will continue its motion unless acted upon by external force. For example a mobile phone will remain on the table unless some force is applied to changes its state. Similarly a boy on a bicycle will keep riding until he applies brakes and provides external force to stop.

Apart from the definition of force we conclude that all material objects possess the property of resisting any change in their state of rest or of uniform motion. This property is called INERTIA. Hence this law is also called the 'law of inertia'.

LAW OF INERTIA:

The inability of matter to change its state of rest or of uniform motion is called inertia. Mass is the direct measure of inertia i.e. the greater the mass of an object, the greater will be the inertia as relatively greater force is needed to change its state.

NEWTON'S SECOND LAW OF MOTION:

When a force acts on an object it produces acceleration in that object in its own direction. The acceleration is directly proportional to the magnitude of applied force. Mathematically,

If a force 'F' is applied on an object of mass 'm' which produces acceleration 'a' in the direction of the applied force then the relationship between acceleration and force can be expressed as:

$$a \propto F \quad \text{.....(i)}$$

$$\text{also } a \propto 1/m \quad \text{.....(ii)}$$

Combining (i) and (ii)

$$a \propto 1/m \text{ or } a = k\,(f/m)$$

where 'k' is constant of proportionality

Or ma = kf

if k = I then F = ma

Hence force acting on a body is said to be 1 Newton if it produces an acceleration of 1 m/s^2 in the body of mass 1kg in the direction of force.

NEWTON'S THIRD LAW OF MOTION:

"To every action there is always an equal and opposite reaction"

For Example: if a body is placed on a table then its weight acts downward (as an action) and equal but opposite force (normal) wo;; act perpendicularly upwards which ensures the body in rest. Similarly when a ball is thrown upward at a wall, the ball bounces back. This is

due to the fact that when the ball exerts force on the wall (action) the wall also exerts a force of same magnitude on the ball in opposite direction (reaction).

MASS:

The quantity of matter present in a body is mass. It is a scalar quantity and its S.I unit is kg. It can be measure using physical balance.

WEIGHT:

The force by which earth attracts a body towards its Centre is called weight of the body. It is a vector quantity and its S.I unit is newton (N). It can be measured using a spring balance

mathematically, $W = mg$

TENSION IN STRING:

It is a reactionary force which will act on a body connected to string whenever it is subjected to pull.

MOTION OF BODIES CONNECTED BY STRING OVER A FRICTIONLESS PULLEY:

Case – 1 (when both the bodies move vertically)

Consider two bodies A and B having unequal masses m1 and m2 connected by a string which passes over a pulley in such a way that the two bodies hang vertically as shown in figure.

Let m1 be greater than m2, hence body A moves down and B moves up with same acceleration 'a'. Let 'T' be the tension in string.

MOTION OF BODY A:

Since two forces are acting on the body, its weight 'W1' and tension 'T' in the string. As the body moves down, therefore W>T. Hence, the net force acting vertically downwards on body A is given by,

$$F_1 = W_1 - T$$

Or $m_1a = m1g - T$ …….. (i) (: F = ma, W = mg)

MOTION OF BODY B:

Again, there are two faces acting on the body, its weight 'W2' and tension in string 'T'. As the body moves up, therefore W2 < T or T > W2. Hence, the net force acting vertically upwards is given by,

$$F_2 = W_2 - T$$

Or $m_2a = T - m_2g$ …… (ii)

EXPRESSION FOR ACCELERATION 'a':

To find expression for acceleration. We add equation 1 and 2.

$$m_1a = m_1g - T$$
$$\underline{m_2a = -m_2g + T}$$
$$m_1a + m_2a = m_1g - m_2g$$
$$a\,(m_1 + m_2) = (m_1 - m_2)\,g$$

Or $a = (m_1 - m_2)g/(m_1 + m_2)$

EXPRESSION FOR TENSION 'T':

To find expression for tension divide 1 by 2

$$m_1a / m_2a = (m_1g - T) / (T - m_2g)$$

$m_1 / m_2 = (m_1g - T) / (T - m_2g)$
$m_1 (T - m_2g) = m_2 (m_1g - T)$
$m_1T - m_1m_2g = m_1m_2g - m_2T$
$m_1T + m_2T = m_1m_2g + m_1m_2g$
$T = 2m_1m_2g / (m_1 + m_2)$

Case – 2

(WHEN ONE OF THE BODY MOVES HORIZONTALLY WHILE THE OTHER HANGS VETICALLY):

Two bodies A and B of unequal masses m_1 and m_2 are connected to the string. Which passes over a frictionless pulley as shown in figure.

Body A moves downward while body B moves on a frictionless horizontal surface with the same acceleration 'a'.

MOTION OF BODY 'A':

Since two forces are acting on the body, its weight 'W1' and tension 'T' in the string. As the body moves down, therefore W1 > T. Hence, the net force acting vertically downward on body A is given by,

$F_1 = W_1 - T$
Or $m_1a = m1g - T$ …… (i)

MOTION OF BODY 'B':

There are three forces acting on the body 'B' in the absence of fractional force. Its weight W2 and normal reaction 'R' act; vertically down and upwards and play no role in the movement of body 'B' on horizontal. Therefore the net force which moves body 'B' on horizontal is tension 'T' in string.

$F_2 = T$
Or $m_2a = T$ …. (ii)

EXRESSION FOR ACCELERATION 'A':

In order to find expression for acceleration we add equation 1 and 2.

$m_1a = m_1g - T$
$m_2a = \quad T$
$m_1a + m_2a = m_1g$
$a(m_1 + m_2) = m_1g$
$a = m_1g / (m_1 + m_2)$

EXPRESSION FOR TENSION 'T':

To find expression for 'T' substitute 'a' in equation 2

$T = m_2 a$
$T = m_2 m_1g / (m_1 + m_2)$

MOMENTUM:

It is defined as the quantity of motion contained by a body.
Mathematically, it is a product of mass and velocity. i.e. $P = mv$
Its S.I. unit is Kg – m/s or N-s. It is a vector quantity.

LAW OF CONSERVATION OF MOMENTUM:

The total momentum of an isolated system always remains constant.

Consider a system consisting of two balls of masses m_1 and m_2 moving in a straight line with velocities U_1 and U_2 respectively. ($U_1 > U_2$)

After collision, they continue to move with velocities V_1 and V_2 respectively.
The total momentum of system before collision = $m_1U_1 + m_2U_2$
The total momentum of system after collision = $m_1V_1 + m_2V_2$
According to the law of conservation of momentum,

Total initial momentum = Total final momentum

$$m_1U_1 + m_2U_2 = m_1V_1 + m_2V_2$$

FRICTION:

It is an opposing force which resists motion or whenever two bodies / surfaces move over each other then the opposing force which resists motion is called friction.

CAUSES OF FRICTION:

Friction is due to the roughness of two surfaces when they are in contact with each other. Even the most polished surfaces I contact develop inter locking between their elevation and depressions causing friction, preventing them to move freely. Friction increases with the roughness of surface.

SELF ADJUSTING FORCE:

The force of friction has the ability to increase its value with the increase of applied force till it reaches a maximum value. Due to this strange nature we call friction as self-adjusting force.

SLIDING FRICTION:

When two solid surfaces slide over each other then the friction between them is called sliding friction.

ROLLING FRICTION:

When one solid object rolls on other surface then the opposing force is called rolling friction.

LIMITING FRICTION:

The maximum force of friction which just stops the body from sliding or moving is called limiting friction. Consider a wooden block placed on the table. The two forces acting on the block are its weight downward and normal reaction, upward. (By the table on the block). It is found experimentally that limiting frictional force 'Fs' is directly proportional to the total weight pressing the block against the table or normal reaction 'R'

$$Fs \propto R \quad \text{or} \quad Fs = \mu R$$

$$\text{Or} \quad \mu = Fs/R$$

Where 'μ' is constant of surface of block and table. It is called co-efficient of friction.

ADVANTAGES OF FRICTION:

Friction is very useful in daily life. Some of the advantages of friction are listed below.

1. When a person walks, the ground is pushed in the backward direction and the ground gives a reaction in the forward direction because of friction.
2. A nail stays in the wood because of friction.
3. Nut and bolt can hold a body due to friction.
4. When a knot is tied, it is the frictional force which keeps it strong.
5. It is because of friction between the tyre and the road that a car can be brought to rest.

DISADVANTAGES OF FRICTION:

1. The main disadvantage of friction is the production of heat as some useful energy is wasted when the parts of machines slide or roll over each other.
2. It leads to wear and tear on moving parts of machine.
3. Due to friction, 100% efficiency is not achievable.
4. Machines catch fire due to friction between their moving parts.

METHODS TO REDUCE FRICTION:

Friction can be reduced by adopting the following methods.

1. Various parts of the machine which move over each other are properly lubricated.
2. In machines, the sliding part are replaced by rolling parts using ball bearings.
3. Where sliding is unavoidable, a thick layer of grease is applied between the sliding parts to reduce friction.
4. The front of fast moving objects like cards, trains, aero planes are made oblong and pointed to reduce air friction

CHAPTER#6

STATICS

Q1. Define the following terms:

a) Statics
b) Equilibrium
c) Static and dynamic equilibrium
d) Centre of gravity
e) Torque

a) Statics:

It is the branch of physics which deals with the study of objects in equilibrium.

b) Equilibrium:

When a body is under the influence of balanced forces. It is said to be in equilibrium.

c) Static equilibrium:

If a body is at rest, it is said to be static equilibrium

For e.g. A box kept on floor

The weight of the box acts downward, whereas the reaction of rack acts upward, both being equal and opposite, unable to move the pot.

Dynamic equilibrium:

If a body is moving with uniform velocity, then the body is said to be in dynamic equilibrium.

For e.g. A train moving with uniform velocity.

When a train moves with uniform velocity, the force of engine pushes the rain forward and the friction between wheels and track tend to move it backward, Since both are equal and opposite, the train runs with uniform velocity.

d) Centre of Gravity:

The Centre of gravity of a body is the point where the whole height of the body appears to act. The Centre of gravity of a body might be lying inside or outside the object. In some condition it can be located by changing the shape of the object.

e) Torque:

Torque is turning effect of force

Whenever any object moves about a fixed point, there produced either cock wise or anti clockwise movement or rotation, which is read as the turning effect of the concerned force.

E.g. opening of a door or window and rotating the key in the lock.

Whenever a door or a window is opened or closed and the key is rotated, there, produced a turning effect about the fixed point. In other words torque is produced.

$$T = F \times d$$

Q2. How the Centre of gravity of geometrical shapes can be determined? And give a method to find out the Centre of gravity of an irregular metallic plate of uniform thickness.

Ans. The Centre of gravity o geometrical shaped objects can be located as under:

Objects	Centre of gravity
Square/Rectangle	Where two diagonals intersect each other.
Sphere	Centre of sphere
Cylinder	Midpoint of axis
Triangle	Intersection of the medians

Centre of gravity of an irregular plate:
Drill a few holes at the edges of the plate keeping appropriate distance between them. Name the holes like A, B and C. Then, first with hole A suspend the plate in a wall so that it could rotate. Then suspend a plumb line from hole A and draw a line coinciding the thread of the plumb line. Repeat this for B and C also. Now the point of intersection of three lines is then Centre of gravity of the plate.

Q3. Describe the two conditions of equilibrium.
Ans. **Conditions of equilibrium:**
Conditions of equilibrium depends upon the type of motion of a body like translator and rotatory motion.

1st condition of equilibrium:
It says that "if the sum of all the forces acting along x-axis is zero and sum of all the forces acing along y-axis is also zero, then the body is said to be in equilibrium"
$\Sigma Fx=0$ & $\Sigma Fy=0$

E.g. Along x-axis:
If two equal forces are applied along rightward and leftward, then, it satisfies first condition of equilibrium i.e. $\Sigma Fx=0$

Along y-axis:
Upward force is equal to the downward force then it satisfies first condition of equilibrium i.e. $\Sigma Fy=0$

2nd condition of equilibrium
If the net force produced by an object is zero, then, the object is in equilibrium. If a weight is hanged on the right hand side of the scale, then the distance of this weight from the point of rotation and the weight produces clockwise torque. And by the same way anti clock wise torque will be produced on the left hand side of the scale. If the scale is balanced, then, the scale is under equilibrium.

Q4. Describe three states of equilibrium also describe their relationship with the Centre of gravity of an object.

Ans. **Three states of equilibrium**:

Three states of equilibrium define the position of the body with respect to its tendency of maintaining the state of equilibrium.

1. Stable equilibrium:

   If the Centre of gravity of a body is raised after lifting from one edge, then the body is said to be in stable equilibrium.

It means that the object in stable equilibrium have the tendency to come back to original position, if they are disturbed from their original position.
E.g. any object lying more horizontally and less vertically, like a book, slab, etc.
If we raise the book from its one side and release, then, it come back to its original position.

2. Unstable equilibrium:

   If the Centre of gravity of a body is lowered after it is disturbed from its position then the object is said to be in un-stable equilibrium.

   It means the object in un-stable equilibrium do not have the tendency to come back to their original position if they are disturbed from their original position.
   E.g. any object lying more vertically and less horizontally, like a pencil or cylinder when kept vertically upward.
   If a pencil kept vertically upward, is disturbed from its original position, it topples down and does not come back to its original position.

3. Neutral equilibrium:

   If the Centre of gravity of a body lies at the point of support or suspension, then the object is said to be in neutral equilibrium.

   It means that he objects in neutral equilibrium do neither have tendency of coming back to its original position nor have the tendency of toppling down.
   E.g. any sphere, like a cricket ball etc.
   If a ball kept on ground is hit slightly, it moves forward and comes to rest at a certain position.

CHAPTER# 7

CIRCULAR MOTION AND GRAVITATION

Q1. Define circulation and gravitation.

CIRCULAR MOTION:

When a body covers certain distance along a circular path, this type of motion is called a circular motion.
E.g. an athlete running on a circular path.

GRAVITATION:

The force of attraction between two masses is called as gravitation. This force depends upon the quantity of masses, more mass will have greater force.

Q2. What do u mean by uniform circular motion?
Ans. **UNIFORM CIRCULAR MOTION:**
If a body covers distance along a circular path with constant speed, this type of motion is called as uniform circular motion.

Q3. Differentiate between centripetal force and centrifugal force.
Ans.

CENTRIPETAL FORCE	CENTRIFUGAL FORCE
1. When a force is directed towards the Centre of the circular path, it is known as centripetal force. 2. e.g.:- when a stone is tied with a string is whirled in air, moves under the influence of centripetal force. 3. This force produces acceleration which is directed towards the Centre of the circular path.	1. When a force is directed away from the Centre of a circular path, it is known as centrifugal force. 2. E.g.:- when the centrifugal force is withdraw, the stone is tied with a string moves away from the Centre of the circular path, it is under the influence of centrifugal force. 3. This force produces acceleration which is directed away from the Centre of the circular path.

Q4. Define centripetal acceleration and also find out its dimension
Ans. **CENTRIPETAL ACCELERATION**:
When a body is accelerated by the centripetal force, the acceleration so produced directed towards the Centre of the circular path is called as centripetal acceleration.

Dimension:
We know that according to the Newton's 2nd law of motion, a = f/m or f = ma
Therefore, the dimension of centripetal force is:

$$F_{centripetal} = mv^2/r \quad \text{or} \quad a = v^2/r$$

Q5. a) State Newton's law of universal gravitation.
b) Find out the mass of earth with the help of Newton's law of gravitation.

Ans. **NEWTON'S LAW OF UNIVERSAL GRAVITATION**:
This law states "Between every two masses in the universe there is a force of attraction (i.e. gravitation) which is directly proportional to the product of masses and inversely proportional to the square of the distance between them."

Mathematically,

$$F \propto m_1 m_2$$

Force of gravitation is directly proportional to the product of masses.

$$F \propto 1/r^2$$

Force of gravitation is inversely proportional to the square of the distance between them.
Combining both relations we get:

$$F = G [(M_1 M_2)/R^2)]$$

The sign of proportionality is replaced by universal gravitation constant of proportionality: This known as the equation of Newton's law of universal gravitation.

Where, F = Force of Gravitation.
M = First mass.
M_2 = Second mass.
R = Distance between the Centre of gravity of both bodies.
G = Gravitational constant.

Mass of Earth:
Mass of earth can be calculated with the help of the above equation, if the following condition is supposed:
Let,
M = Mass of a body of the surface of earth.
M_2 = Mass of Earth.
R = Radius of Earth (i.e. the distance between earth and the body)
G = Gravitational constant.
F = Force of Gravitation (i.e. the weight of the person) OR
F = mg.

Therefore, according to Newton's law of universal gravitation:

$$mg = G [(M M_2)/R^2)]$$

Dividing 'm' from both sides, we get:

$$g = G M_2/R^2$$

Hence, after putting the values of r, G and g, mass of earth was found to be 6×10^{24} kg.

Q6. Describe the effect of altitude on the value of 'g'.
Ans. Variation of 'g':
As we know that according to Newton's law of universal gravitation,

$$g = (m\ e) / r^2$$

Therefore g varies inversely with r^2 using G as constant of proportionality when r is the distance of any object from the Centre of the earth. Hence, the value of g will become one fourth if we go higher from the surface of earth a distance equal to the radius of earth. And it will decrease to one-ninth to a height equal to the twice of the radius of earth.

CHAPTER#8

WORK, POWER & ENERGY

Q1. Define Work, Power & Enegry.
Ans. **Work:**

When a force displaces an object work is said to be done.

Mathematically. $W = F \times S$

Where W = work done
F = Force
S = Displacement produced

Power:

The rate of doing work is known as power

Mathematically $P = W/t$

Where W = work done
P = Power
t = time taken for the work done

Energy:

Energy is the ability to do work, therefore it is always equal to the work done

$E = W$

Q2. Differentiate between Kinetic Energy & Potential Energy.
Ans.

KINETIC ENERGY	POTENTIAL ENERGY
1. Energy possesses by virtue of motion of a body is known as kinetic energy. 2. When a body is at rest its kinetic energy is always zero. 3. The dimensions for kinetic energy is K.E. = ½ mv^2	1. The energy possessed by virtue of position of a body is known as Potential Energy. 2. When the body is at rest its potential energy is not always zero. 3. The dimension for potential energy is P.E = mgh.

Q3. Derive a relation for the Potential Energy possessed by a body.
Ans. Supposition:

Let a body is being displaced by raising it upward
We know that the work done will be $W = F \times S$ -- (i)

Where W = Work done
F = Force (equal to the weight)
S = Displacement produced (height gained)

Since, "F" is equal to the weight of the body and we know that w=mg or f=mg
And "S" is equal to the height gained by the body i.e. "h".
Therefore we can replace the values in equation (i) as.

$W = m\ g\ h$ --- (ii)

We always know that work done is always equal to energy and here it is equal to the potential energy possessed by the body since it was raised.
Therefore we can replace "W" by P.E

$$P.E. = m\ g\ h$$

This is the relation which could be used to obtain potential energy of a body.

Q4. Derive a relation for the kinetic energy possessed by a body.
Ans. Let a body is being displaced and possessed some velocity.
We know that the work done will be

$$W = F \times S \text{ --- (i)}$$

Where W = work done
F = force producing velocity
S = displacement produced

We know that F = m a
Also we know that $2aS = Vf^2 - Vi^2$
And if we consider instantaneous velocity, then $2aS = V^2$

OR $S = V^2/2a$

Now replacing the values of "F" and "S" in equation (i), we get,

$$W = m\ a \times V^2/2a$$

OR $W = \frac{1}{2}\ mv^2$

Since, this is the type of work done where the body gains velocity. Therefore, it will be equal to kinetic energy. Therefore we can replace "W" by K.E

$$K.E = \frac{1}{2}\ mv^2$$

With the help of this equation, we can calculate the kinetic energy of a body.

Q5. State law of conservation of energy ad prove it with the help of kinetic energy and potential energy.

a) Taking example of a body from certain height.
b) Taking example of a simple pendulum.

Ans.

Law of Conservation of Energy:

"Energy can neither be created nor can it be destroyed by any method"
A body falling from a certain height. According to the diagram (book), the ball was resting on position "A" (the origin) from where it started to fall towards the ground at "C" (the destination). "B" is any point between the origin and destination of the ball.
"h_2" is the maximum height of the ball at "A". "h_1" is the height of ball at "B". $h_2 - h_1$ is the loss of height when the ball reached at "B". "Vi" is the initial velocity of the ball when it was at rest "A (vi = 0). "Vf" is the final velocity of the ball when it reached at "B". "Vf – Vi" is the gain in velocity of the ball when it reached at "B".

Kinetic Energy of the ball at "B":
We know that $K.E = \frac{1}{2}\ mv^2$ --- (i)

From third equation of motion we also know that $2aS = vf^2 - vi^2$
And the instantaneous velocity $2aS = V^2$
Replacing the value of "v^2" in equation (i) we get:

$$K.E = \frac{1}{2}\ m \times 2aS$$

OR $K.E = m\ a\ S$ --- (ii)

Since the ball is falling freely from a certain height, therefore, "a" will be equal to "g" and "S" will be equal to "h". Therefore, replacing these values in equation (ii) we get

$$K.E = m\ g\ h$$

But we also know that P.E = m g h, therefore, it is clear that any position between the origin and the destination of the free falling body. Total loss in potential energy is always equal to total gain in kinetic energy.

$$K.E = P.E \text{ (at any point in air)}$$

Hence, the Law of Conservation of energy has been proved.

CHAPTER# 9

MACHINES

Q1. Define: Machine, Effort, Load, Mechanical Advantage and Efficiency.
Ans.

Machine:
Machine is a device which helps us in doing work, an inclined plane, a pair of scissors and pulley are the examples of simple machines which have great importance in doing work.

Effort (P):
Effort is the force applied on the machine to make the machine help us in doing some work.

Load (W):
Load is the force applied by the machine in response of effort to do some work.

Mechanical Advantage (M.A):
It is the ratio of the load raise by the machine to the effort applied on the machine. Mechanical Advantage tells us how useful the machine is for doing some work.

$$M.A = W/P$$

Efficiency (E):
Efficiency is the percentage of the ratio of the work done by the machine to the work done on the machine.

$$E = \text{output/input} \times 100$$

Q2. Define lever and describe the types of Lever.
Ans.

Lever:
It is one of the most simple machines. It is used to raise heavy loads conveniently.

Types of Lever:

a) First kind of Lever:
In first kind of lever, fulcrum is located in the Centrewhereas the load and effort are on the extremes.
E.g. a pair of scissors, sea saw etc.

b) Second kind of Lever:
In second kind of lever, fulcrum is located at one extreme and effort is on the other extreme, while load lies in the Centre.
E.g. door, punching machine etc.

c) Third kind of lever:
In third kind of lever, fulcrum is located at one extreme and load is on the other extreme, while effort second kind of lever.
E.g. for up, human arm etc.

Q3. Find out the Mechanical Advantage of lever.
Ans.

Mechanical Advantage of Lever:
Let,

Work done by the machine = Work done on the machine
Output = input
Load x load arm = effort x effort arm
(Torque produced by Load = Torque produced by effort)
OR Load/Effort = Effort Arm / Load Arm (i)

Since, mechanical advantage of a machine is the ratio of Loaf to effort i.e.
M.A = Load/Effort OR M.A = W/P
Replacing values in eqn (i) we get, M.A = Effort Arm / Load Arm

Q4. Define fixed pulley and derive a relations for the mechanical advantage for fixed pulley.
Ans.

Fixed pulley:

It is a simple machine used to raise heavy load conveniently by applying effort downward. I consists of a grooved wheel with a rope passing through it. The wheel runs into a hollow block which is hung from fixed point on a frame.

Mechanical Advantage of Fixed Pulley:

Let, work done by the machine = work done on the machine
output = input
Load x Load Arm (OB) = Effort x Effort Arm (OA)
(Torque produced by Load = Torque produced by Effort)
Load/Effort = Effort arm / Load arm (i)

Since mechanical advantage of a machine is ratio of Load to effort
i.e. M.A = Load/effort or W/P
W/P = OA / OB (OA and OB are equal being the radii of the same circle.)
Mechanical Advantage of Fixed pulley = 1

Q5. Define moveable pulley and derive a relations for the mechanical advantage of moveable pulley.
Ans.

Moveable pulley:

It is a simple machine used to raise heavy load conveniently by applying effort downward. It consists of two grooved wheels with a rope passing through it. Both wheels run in to hollow blocks, the block of the first wheel is hung from a fixed point on a frame while the other block is attached to the Load.

Mechanical Advantage of Moveable pulley:

Let work done by the machine = work done in the machine
Output = input
Load x load arm (OB) = Effort x effort arm (OA)
(Torque produced by Load = Torque produced by effort)
Load/effort = Effort arm / load arm

Since mechanical advantage of a machine is ratio of load to effort
i.e. M.A = Load/effort or W/P

In moveable pulley the effort is applied twice through two segments of rope, therefore
W/2P = OA /OB or M.A = 2

Q6. Define inclined plane and derive a relation to find out the mechanical advantage of inclined plane with the help of trigonometry.
Ans.

Inclined Plane:

An inclined Plane is a surface which is raised from ground making an angle (theta) with the ground. It is a simple machine and used to move objects easily upward or downward.

Mechanical Advantage of Inclined Plane:

Let, work done by the machine = work done on the machine

Output = input

Load x height of inclined plane (h) = effort x length of the inclined plane (I)

Load/effort = length of the inclined plane / height of the inclined plane

W/P = I/h

Since mechanical advantage of a machine is the ratio of load to effort

i.e. M.A = length of inclined plane / height of inclined plane

According to trigonometry, from the above diagram, sine (theta) = h/I, therefore, Mechanical Advantage of the inclined plane according to trigonometry is: M.A = 1/sin (theta).

Q7. Define Wheel and axle and derive a relation to find out the mechanical advantage of wheel and axle.
Ans.

Wheel and axle:

It is a simple machine used to raise heavy loads conveniently; it works more or less like a pulley. It has a big grooved wheel through which a rope is passed over. There is a cylinder fixed with the Centre of the big wheel which acts as an axle of the wheel. Effort is applied on the big wheel and load is raised by the axle.

Mechanical advantage of wheel and Axle:

Where,

W = load raised
P = effort applied
R = radius of the axle
R = radius of the big wheel

2 pi r = one complete circumference of axle (distance covered by the load)
2 pi R = one complete circumference of big wheel (distance covered by effort)

Output = work done by the machine
Input = work done on the machine

Let work done by the machine = work done on the machine

Output = input

Load x distance covered by the load = effort x distance covered by effort

W x 2 pi r = P x 2 pi R

W / P = 2 pi R / 2 pi r

Therefore, mechanical advantage of wheel and axle = R/r

Q8. Define screw jack and derive the equation for the mechanical advantage of screw jack.
Ans.

Screw jack:

It is a simple machine which is used to raise heavy loads up to short height e.g. raising a car to change the flat tire etc. it consists of a long screw which is rotated by the help of a

handle. When one complete rotation is given to the handle, the screw moves up to a height equal to the pitch of the screw.

Mechanical advantage of screw jack:

Where, W = load raised
P = effort applied
H = pitch of screw (distance covered by the load)
2 pi R = one complete rotation of the handle (distance covered by the effort)

Output = work done by the machine
Input = work done on the machine

Let, output = input
W x pitch of the screw = p x one complete rotation of the handle
W x h = P x 2 pi R
W / P = 2 pi R / h

Mechanical advantage of screw jack = 2 pi R / h

Q9. Define a screw and derive the equation of the mechanical advantage of screw.
Ans. **Screw**:
Screw is a simple machine which is used to hold different parts of a machine or hold a frame etc. It has a long cylindrical shape with threads on it which help the screw to penetrate into some surface and that's how the screw hold different parts.

Mechanical advantage of screw:

Where, W = load raise
P = effort applied
h = pitch of screw (distance covered by the load)
2 pi R = one complete rotation of head of screw (distance covered by the effort)

Output = work done by the machine
Input = work done on the machine

Let, output = input
W x pitch of the screw = p x one complete rotation of the head of screw
W x h = P x 2 pi R
W / P = 2 pi R / h

Mechanical advantage of screw jack = 2 pi R / h

Q9. Define wedge and derive a relation for the mechanical advantage of wedge.
Ans.
Wedge:
It is a simple machine used to split wood or some other thing conveniently by hammering a wedge on the surface which needs to be split. Maximum work can be done by increasing the inclined surface of the wedge as well as the thickness of the wedge.
Where, P = effort applied on the thickness of the wedge
R = length of the inclined surface of the wedge
(Length of the inclined surface is equal on both sides)
Output = work done by the machine
Input = work done on the machine

Mechanical advantage of wedge:

Let, output = input

Work done by the wedge = work done on the wedge

W x distance covered by the load = P x distance covered by effort

$$W \times R = P \times T$$

$$W / P = T / R$$

Mechanical advantage of wedge = thickness of the wedge / length of the inclined surface

CHAPTER# 10

MATTER

Matter is everything which possesses mass and volume. Everything around us is made up of matter.

States of matter:

Matter exists on three fundamental states:

Solid:

Solid have the following properties:

- Solids have definite shape and volume.
- Molecules of solid are closely packed so that they cannot be displaced. Only they can vibrate about a mean position.
- The average kinetic energy of solids is comparatively lower than that of liquids and gases.

Liquids:

Liquids have the following properties:

- Liquid have definite volume but no definite shape, it adopts the shape of its container.
- Molecules of liquid are not closely packed they have small gaps between them.
- The average kinetic energy of liquids is comparatively higher than that of liquid and lower than that of gases.

Gases:

Gases have the following properties:

- Gases have no definite shape or volume.
- Molecules of gases tend to move away as much the shape is available.
- The average kinetic energy of gases is higher than that of solids and liquids.

Elasticity:

When a body change its shape temporarily under the influence of an external force and come back to its original shape after withdraw of that force, this ability of substance is known as elasticity.

Elastic limit:

If a substance does not change its shape permanently under the influence of an external force and come back to its original shape after withdraw of that force, the substance is said to be in elastic limit.

Stress:

Stress is the force per area which produces a temporary change in the shape of a substance.

$$\text{Stress} = F / A$$

Where: F = force of stress
A = area on which stress is applied

The unit of stress in S.I system is N/m^2

Strain:

Strain is the ratio of the temporary change in length to the original length of the body under stress.

Stress = ΔL / L

Where

ΔL = Change in the length

L = original length

It has no unit.

Young's modulus:

The ratio of the stress applied on a substance to the strain produced is known as young's modulus.

Y = stress/strain OR (F/A)/ ΔL/L

Different substances have different values for young's modulus. Its unit is N/m^2

Hooke's law:

It states:

"Under elastic limit, stress is directly proportional to strain.

Stress α Strain

E.g. if weight is hanged on a helical spring, then:

F α x where F = the applied force on the spring

x = the extension produced in the spring

F = - K x where k = the constant of proportionality and the negative sign shows that the extension produced in the spring is because of the tension which is opposite in direction as compared to the force applied on the spring.

PRESSURE:

- The effect of a force which depends upon the surface are where the force is applied is called as pressure.
- The pressure applied by the high heels of a woman will be greater on the floor as compare to that of by the flat shoes of a man.

ATMOSPHERIC PRESSURE:

- The blanket of air around us is called as our atmosphere. It has almost 1000 km thick layer around our earth. The total weight of air corresponds to its mass about 4.5×10^{18} kg. The pressure applied because of this much force of atmospheric pressure.
- The device which measure atmospheric pressure us known as barometer. There are different types of barometers used for finding the atmospheric pressure.
- The atmospheric pressure can be measured in different units like Pa, mm of Hg. At sea level it is measured as 10^5 Pa or 1 atm or 750 mm of Hg.

DEMONSTRATION OF ATMOSPHERIC PRESSURE:

Atmospheric pressure can be demonstrated with the help of the following examples:

Collapsing can:

The air pressure inside a can is equal to the atmospheric pressure applied on the walls of the can outside. If the air inside the can is pumped out by the help of vacuum pump, as soon as the air is taken out the can, the pressure outside is greater than the pressure inside and can collapse.

Magdeburg hemispheres:

Two hollow metallic spheres were placed in contact with each other tightly. Then, the air inside them was pumped out by the help of a vacuum pump. As soon as the air is removed from inside, the pressure inside is lesser than that of outside (atmospheric pressure). And as a result the hemispheres were almost impossible to get separate. They were pressed by atmospheric pressure.

PASCAL's LAW:

It is stated as under:
When a pressure is applied to a liquid, it transmit the pressure in all direction inside the liquid.

Experimental verification of the law:

Pascal's law can be verified experimentally by taking a glass sphere with four cylinders on it. Each cylinder is fixed with a piston on it, so that the piston could move inside and outside into the cylinder tightly. Now fill the sphere with a liquid and apply pressure on piston 01. As soon as the piston 01 moves inside, equally move the other three piston outside. It proves Pascal's law.

Hydraulic lift:

There are two cylinders with pistons on them, one smaller and the other is bigger in diameter. Force is applied on the smaller cylinder and heavy load is raised easily by the bigger piston. According to Pascal's law, the pressure applied on the smaller cylinder will be transmitted in to the bigger cylinder equally while the force increases.

Hydraulic press:

A hydraulic press works like a hydraulic lift. It has also got two cylinders. Force is applied on the smaller cylinder and heavy load is raised easily by the bigger piston. According to Pascal's law, the pressure applied on the smaller cylinder will be transmitted into the bigger cylinder equally while the force increases. But it is used to compress the load between platforms.

Hydraulic break:

Hydraulic breaks are commonly used in automobiles. Just behind the brake pedal, there is a cylinder which is connected with other cylinders hidden behind the wheels. As soon as the pressure is applied on this cylinders, according to Pascal's law the pressure is transmitted equally in all directions. Hence, the break is applied on all the wheels of the automobile.

Archimedes principle:

Archimedes presented the following theory:

- Whenever a body is immersed in to a fluid, and up thrust is applied on the body opposite to the weight of the body.
- This up thrust produced an apparent loss in the weight of the body immersing into fluid.

- E.g. if a diver dives into water, he will experience an apparent loss in weight but as soon he comes out of the water the effect of up thrust will be no more and he will gain his original weight again.

PRACTICAL APPLICATION OF ARCHIMEDES PRINCIPLE:

Following are the practical applications of Archimedes principle:

i. Relative density OR specific gravity:

- The ratio of the density of a body to that of water is called as the relative density of that substance.

Mathematically:
Relative density of a substance = density of substance/density of water at $4^{o}C$

ii. Submarines:

The principle of making a submarine has been taken from Archimedes principle. There are empty tanks in a submarines. It can float like a ship and when it need to go down into deep sea, the tanks are filled with water. Hence, up thrust gets weaker that the weight of the submarine and submarine go down.

CHAPTER#11

HEAT

Differences between heat and temperature.

HEAT:

1. Heat is the energy in transit due to the difference in temperature at two places.
2. Heat is the total kinetic energy of a substance.

TEMPERATURE:

1. Temperature is the degree of hotness or coldness.
2. Temperature gives us the average kinetic energy of a substance.

THERMAL CONDUCTIVITY:

It is defined as "the amount of heat conducted in one second through one cubic meter of a substance whose two opposite faces are maintained at the temperature difference of one degree centigrade."
It is denoted by "K".
Formula
$K = QL/A\Delta Tt$
Unit:
Unit of thermal conductivity is j/mKs

HEAT TRANSFER:

Heat can be transferred from one point to the other by the following three methods:

Conduction:

It is the method of heat transfer in which heat energy is transferred in the direction of the fall of temperature due to vibration and collision of molecules. In conduction, no actual motion (translational motion) takes place. In solid heat is transferred from one point to the other by conduction phenomenon.

Convection:

It is the method of heat transfer in which heat energy is transferred in the direction of the fall of temperature due to actual motion of molecules. In convection heat is transferred by translation motion molecules. In liquids and gases heat is transferred by convection.

Radiation:

It is mode of heat transferred in which heat is transferred from a hot body to cold body by electromagnetic radiation or thermal radiation. In the process of radiation heat is transferred in the absence of or presence of material medium. Heat released from the sun transfer to the earth by radiation.

BOYLE'S LAW:

It is a quantitative relationship between volume and pressure of a gas at constant temperature.
Statement:
"The volume of a given mass of a gas is inversely proportional to pressure id temperature remains constant"

Mathematically:
According to Boyle's law $V \alpha 1/P$
Where V = constant (1/P)
PV = constant

P1V1 = constant ---i
P2V2 = constant ---ii

Comparing i and ii
P1V1 = P2V2

CHARLE'S LAW:

It is quantitative relation between volume and absolute temperature of a gas at constant pressure.

"The volume of a gas mass at constant pressure is directly proportional to absolute temperature."

Mathematically:
According to Charles's law $V \alpha T$
Where V = (constant) T
V/T = constant
V1/T1 = k
V2/T2 = k

Thus V1/T1 = V2/T2

IDEAL GAS EQUATION:

According to Boyle's law:
Volume of a given mass of a gas is inversely proportional to pressure if temperature remains constant.

$V \alpha 1/P$ ---i

According to Charles's law:

Volume of a given mass of a gas is directly proportional to absolute temperature if pressure remains constant.

$V \alpha T$ ---ii

According to Avogadro's law:

Volume of a gas is directly proportional to no. of moles.

$V \alpha n$ ---iii

Combining i, ii and iii

$V \alpha T\ n1/p$
$V \alpha$ (constant) nT/p
PV/nT = constant

Here constant is R

PV/nT = R or
PV = nRT

This is the equation of state of a gas (Ideal gas equation)
R = Universal gas constant (equal to 8.314 joule)

For initial and final values:

For initial:

When temperature T1 and Pressure P1:

$$P1V1 /T1 = \text{constant} \text{ ---(a)}$$

Similarly for final condition:

$$P1V2 /T2 = \text{constant} \text{ ---(b)}$$

$$P1V1/T1 = P2V2/T2 \text{ ------ from eq (a) and (b)}$$

THERMAL EXPANSION:

Objects undergo changes in dimension when they are heated. This change in length or area or volume is called "Thermal expansion".

Things expand on heating:

When a body is heated its molecules vibrate more energetically against the action of inter-molecular forces and the displacement of molecules is increased. Since the average distance between the molecules increases, the dimension of the body increases. Consequently body expands.

LINEAR EXPANSION:

Expansion in length of solid bodies on heating is called linear expansion.
It depends upon two factors.

1. The increase in length of a solid bar is directly proportional to its original length.

$$\Delta L \ \alpha \ L1 \text{ ---i}$$

2. The increase in length is directly proportional to the change in temperature.

$$\Delta L \ \alpha \Delta T \text{ ---ii}$$

Combining I and ii

$$\Delta L \ \alpha \Delta T \ L1$$

$$\Delta L = \alpha \Delta T \ L1$$

Where α = coefficient of linear expansion of solid.

COEFFICIENT OF LINEAR THERMAL EXPANSION:

"Increase in length per unit original length per kelvin rise in temperature is known as coefficient of linear expansion".
It is denoted by α (alpha).
Value of alpha is constant for a given material but different for different materials.
It is independent of mass and dimensions of a body.
Coefficient of linear expansion depends on the nature of material.

Volumetric Thermal Expansion:

Increase in volume of a body on heating is referred to as "volumetric Expansion" or "cubical expansion"

$$\Delta L = \beta \Delta T \ V1$$

Where β is constant known as "coefficient of linear expansion".

APPLICATION OF THERMAL EXPANSION:

Bimetallic strip:

A bimetallic strip which has been made up of two different types of metal (i.e. iron and brass). This strip was kept on flame of different side face to flame, for some time when it absorbed heat brass being better at thermal expansion tended to expand more than iron but since both strips were joined together, therefore the strip bended as brass expanded more than iron.

Use of bimetallic strip:

1. It can be used in making fire alarm.
2. It can be used in electric iron.
3. It can be used in thermostat etc.

Real and apparent expansion of liquids:

Liquids cannot be taken without a container, therefore, whenever a liquid is heated the container heats first.

- When the container heated, it expands first, the liquid find more room inside the container heats first.
- The falling of the level of liquid will produce confusion in the rise of the level of the liquid when it is heated.
- When the heat is transferred into the liquid after the container, the liquid raise its level.
- If we count the rise in the level of the liquid from present (after expanding of the container) then it is called as the real expansion in liquid.
- If we count the rise in level of the container from the previous(before the expanding of the container, then it is known as the apparent expansion of the liquid.

Anomalous expansion in water:

Water expands on heating but from the range of 0 to 4 degree it contract instead of expanding, similarly from the range 0 to 4 degree on cooling it expand instead of contracting. This is known as the anomalous expansion of water.

Use of the anomalous expansion of water:

During winter season, marine life survives because of this property of water because if it does not behave like this the whole water in the lake, reservoir or ocean becomes ice.

Disadvantage of anomalous expansion of water:

During the winter water season areas where temperature falls below 0 degree centigrade, the pipe lines burst which face the low temperature.

SPECIFIC HEAT:

The specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius. The relationship between heat and temperature change is usually expressed in the form shown below where c is the specific heat. The relationship doesn't apply if a phase change is encountered, because the heat added or removed during a phase change doesn't change the temperature.

$$Q = c\ m\ \Delta T$$

The specific heat of water is 1 calorie/gram ^{o}C = 4200 j kg^{-1} k^{-1} which is higher than any other common substance.

SPECIFIC HEAT CAPACITY:

The specific heat capacity of a solid or liquid is defined as the heat required to raise unit mass of substance by one degree of temperature. This can be stated by the following equation.

$$\Delta Q = m\ c\ \Delta T$$

Where ΔQ = heat supplied to substance m = mass of the substance

c = specific heat capacity ΔT = temperature rise

EVAPORATION:

Change of a liquid into the gaseous state, the process by which liquid water enters the atmosphere as water vapor. Evaporation, mostly from the sea and from vegetation, replenishes the humidity of the air. It is an important part of the exchange of energy in the earth-atmosphere system.

Factors effecting the rate of evaporation:

Flow rate of air:

If fresh air is moving over the substance all the time, then there will be faster evaporation.

Pressure:

Evaporation happens faster if there is less exertion on the surface keeping the molecules from launching themselves.

Surface area:

A substance which has larger surface area will evaporate faster as there are more surface molecules which are able to escape.

Temperature of the substance:

If the substance is hotter, then its molecules have a higher average kinetic energy and evaporation will be faster.

Density:

The higher the density, the slower a liquid evaporates.

REFRIGERATOR:

It is a source of keeping the eatables cool and safe from germs.

Working:

It has mainly three parts, compressor, evaporator and condenser. Gas is first brought to the compressor where it is compressed and get cool then it moves into the evaporator where the heat of the eatables is absorbed by the gas and transferred into the condenser, which again sent to the condenser for being cool. This is the continuous cycle of the working of a refrigerator.

EFFECT OF PRESSURE ON BOILING AND MELTING POINT:

Melting point gets lower while the boiling point gets higher by increasing the pressure. E.g. ice can be melted earlier by applying pressure on it. When we go to Murree we can't cook fast because of the less pressure.

CHAPTER#12

WAVES AND SOUND

Q1. Define the following terms:

PERIODIC MOTION:

Any motion that repeats itself in equal interval of time is known as periodic motion in equal intervals of time along same path back and forth.
E.g. the motion of a mass attached to a spring on a frictionless surface.

TIME PERIOD:

Time required to complete one oscillation is called as time period.

FREQUENCY:

No. of vibrations in one second is called as the frequency of the vibrating body.

DISPLACEMENT:

At any instance of time the distance of a vibrating body from its mean position is known as its displacement.

Q2. Explain the concept of oscillation with the help of an example of a mass attached to a spring on a horizontal frictionless surface.

Ans

MOTION OF A MASS ATTACHED TO A SPRING ON A HORIZONTAL FRICTIONLESS FORCE:

For example:
A mass m attached to one end of spring and placed on a frictionless horizontal surface as shown fig. is placed from its normal or equilibrium position and then released, it will move through the equilibrium position and become extended in the opposite direction.

The mass continues this back and forth oscillatory motion until external effects cause the motion to stop. All oscillatory motion of this type depends directly on the elastic properties of the vibratory materials.

Q3. Explain the concept of simple harmonic motion with the help of a mass attached to a spring on a horizontal frictionless surface.

Ans.

SIMPLE HARMONIC MOTION:

The vibratory motion of a mass attached to a spring is characteristic of an important class of oscillatory phenomenon called simple harmonic (SHM), let's take an example. A block at rest in its equilibrium position on a frictionless surface. If we apply an external force to displace the block to the right, there will be a restoring force F exerted on the block by the spring and this force is directed to the left.

a) A mass m rests on a frictionless surface and is attached to a spring.
b) If m is displaced to the right an amount Xo (by an external force), there will be a restoring force to the left given by F=kXo where k is the force constant characteristic of the particular spring.

We assume that this maximum displacement does not bring change in the elasticity of spring. In the discussion of S.H.M we are usually interested in the restoring force, not in the applied forces.

$$F = - kx$$

Where k is proportionality constant usually referred to as spring constant.
But from the second law of motion we known that F=ma.
We can say that, a=-kx/m
Since, both k and m are constant, therefore a=-(constant)x
OR $a \propto -x$ OR $a \propto -(\text{displacement})$

The type of oscillatory motion which is characterized by the fact that it has an acceleration proportional to its displacement and the acceleration is always directed towards the equilibrium position (which is indicated by the negative sign) is called simple harmonic motion.

Q4. Prove that the motion of a swinging bob of a pendulum is Simple Harmonic Motion.
Ans:

EXAMPLE OF SIMPLE HARMONIC MOTION:

Simple pendulum:

An ideal simple pendulum consists of a point mass suspended by a weightless and inextensible string from a fixed support.
The bob was initially at the mean position under equilibrium, soon after it was displaced from its mean position, there produce restoring force. i.e. force of gravity.
The motion of the bob is vibratory, since it covers equal distances in equal intervals of time along the same path back and forth.
Also the direction of the acceleration of bob is towards the mean position, also the acceleration is proportional to the distance of the bob from the mean position.
This type of oscillatory motion which is characterized by the fact that it has acceleration proportional to its displacement ad the acceleration is always directed towards the equilibrium position (which is indicated in the negative sign) is called simple harmonic motion.
Hence, it is proved that the motion of a Simple pendulum is simple harmonic.

Q5. Define resonance and also give an example.

RESONANCE:

It is the response of an object to a periodic force acting on it is greater when this force has the same period as the object's natural period. Under the influence of 'WS' force has the first object not only begins to vibrate but also the amplitude of its vibration increases.

e.g.: it is observed that sometimes a part of the car begins to vibrate very violently at certain speed (or speed of the engine) of the car. If the speed of the car is increased or decreased from that value the vibrations will cease.

Q6. Define wave and explain Wave Motion with the help of an example:
Ans:

WAVE:

A wave is a travelling disturbance which is produced in the molecules of a substance under the influence of a certain applied force.

WAVE MOTION:

If we dip a pencil into a tub of water and take it out a pronounced circular ripple is set up on the water surface and travels towards the edges of the tub. However, if we dip the pencil and take it out many times, a number of ripples will be formed one after the other.

Ripples on the surface of water:

If you place a small object a piece of wood, etc. on the water surface it moves up and down when a wave passes across its position, the water itself doesn't move outward. Such up and down movement are vibrations of water which constitute waves are the examples of wave motion.

Q7. Explain the wave formation in a rope.
Ans.

FORMATION OF WAVE (DISTURBANCE) IN A ROPE:

When one end of a rope is tied somewhere and jerk is given the other end, disturbance is produced in the rope generating pulse shaped wave.

Q8. Describe the formation of waves in spring.
Ans.

FORMATION OF WAVES IN A SPRING:

Consider the example of a railway engine connected to three bogeys with buffer springs in between them. The engine moves forward covers a distance and then stops. Let us examine what happens to the spring in between the bogeys.
When the engine moves, it elongates the spring between engine E and bogey 1. This elongated spring exerts force on bogey I and moves it towards the engine. The spring between engine E and bogey 1 gets compressed and so on.

Q9. Draw the diagram of a wave and explain the characteristics of the wave.
Ans.

THE CHARACTERISITCS OF WAVES PRODUCED IN WATER:

Crest of a wave:

It is the highest point on a wave patterns.

Trough:

It is the lowest part on the wave pattern:

Wavelength:

It is the distance between two consecutive crests, troughs or mean positions.

Time period:

Time requires for a wave to travel the distance equal to its one wavelength.

Frequency:

The number of waves produced in a unit time (one second)

Amplitude:

Maximum height of crest from the mean position is called as its amplitude.

Q10. Define Reflection of waves with the help of example.

Ans.

REFLECTION:

A wave can be bounced back from the surface. This bouncing back of a wave from a surface is called reflection. The angle at which the wave is reflected is equal to the angle at which the wave is incident on the surface.

Incident and Reflected waves:

Waves coming from the source and hitting an obstacle or barrier are called incident waves. Those that seem to originate from the barriers, called reflected waves.

e.g.: we hear the sound of clap a second time if we are standing near a cliff or in a large hall water waves turned back. Similarly the second sound of the clap is due to the bouncing back of the sound from the surface of the cliff or the distant wall in a hall.

Q11. What do you mean by interference of waves? Describe constructive and destructive interference.

Ans.

INTERFERENCE:

By interference we mean the interaction of two waves passing through the same region of space at the same time.

Constructive interference:

If at a given point the crests or the trough of the two waves arrive simultaneously then the combined wave is larger than either of the two waves. This is called constructive interference.

Destructive interference:

If, however, the crest of one wave arrives simultaneously with the trough of the other waves then the two waves cancel each other and no wave will be observed. This is called destructive interference.

Q11. What do you mean by the following?

Ans.

STATIONARY WAVES/STANDING WAVES:

If, two wave of same amplitude and frequency travelling in opposite direction meet one another, the resulting interference pattern give rise to what are calling standing/stationary waves.

NODE:

The points of destructive interference, called nodes.

ANTI NODES:

The points of constructive interference called anti nodes.

Q12. Describe the characteristics of musical sound:

Ans.

AMPLITUDE:

It determines the loud or faint sound. It depend upon the force and the areas of the vibrating body. Greater is the force or the area louder is the sound.

PITCH:

It is that property of sound which determines the low or high frequency, more is the frequency higher, is the pitch.

QUALITY OR TIMBRE:

It is that quality of sound which enables us to identity between the two similar sounds.

ECHO:

Echo is the reflection of sound waves which it reaches to our ears after 0.1 seconds time period. It then senses as a second sound.

Q13. Differentiate between musical sound and noise.
ANS.

MUSICAL SOUND:

1. The sound which feels pleasing.
2. It does not produce any harmful effect on our nervous system.

NOISE:

1. The sound that feels unpleasant.
2. It produces harmful effect on our nervous system.

CHAPTER#13

PROPAGATION AND REFLECTION OF LIGHT

Q1. Define Reflection of light and state the laws of reflection of light.
Ans.

REFLECTION OF LIGHT:

If a light ray which is travelling in a medium strikes the surface of another and then the ray returns into the first medium, then the phenomenon is known as reflection of light.

LAWS OF REFLECTION OF LIGHT:

Reflection of light obeys the following two laws:

1. The incident ray, reflected ray and normal, all lie on the same plane.
2. The angle of incident equals to the angle of reflection. M<I = M<r

Q2. Define the following general terms used in the phenomenon of reflection of light.
Ans.

INCIDENT RAY:

The light ray travelling in one medium, strikes the surface of another medium is called incident ray.

REFLECTION RAY:

The ray of light bounced back from the second medium is known as reflected ray.

POINT OF INCIDENCE:

The point at which the incident ray strikes on the second medium is called point of incidence.

ANGLE OF INCIDENCE:

The angle between normal and incident ray is called angle of incidence. It is denoted by <i.

NORMAL:

An imaginary line which is perpendicular to the second medium at the point of incidence is called normal.

ANGLE OF REFLECTION:

The angle between normal and reflected ray is called as angle of reflection. It is denoted by <r.

PRINCIPLE FOCUS:

The point of convergence of all rays of light coming parallel with the Principle Axis, after reflection or refraction of light is known as Principle focus.

CENTRE OF CURVATURE:

The center of hollow reflecting sphere from which the spherical mirror is taken is known as center of curvature. It is denoted by C.

POLE:

The geometrical center of the spherical mirror is known as pole. It is denoted by P.

IMAGE DISTANCE:
The distance between image and the pole of the mirror is known as image distance (q).

OBJECT DISTANCE:
The distance between pole and the object is known as object distance. It is denoted by P.

FOCAL LENGTH:
The distance between pole and focus is known as focal length. It is denoted by f.

RADIUS OF CURVATURE:
The distance between pole and the center of curvature is called radius of curvature. It is denoted by r.

PRINCIPLE AXIS:
An imaginary straight line which passes through pole, focus and center of curvature is known as Principle Axis.

MAGNIFICATION:
The ration between size of image to the size of object is known as magnification. It can be evaluated by formula.

$$M = hi/ho$$

It can also be defined as the ratio between image distance (q) to the objects distance (p).

$$M = q/p$$

Q3. Differentiate between regular and irregular reflection of light.
Ans.

REGULAR REFLECTION:
1. Parallel rays of light remains parallel after regular reflection of light
2. It takes place on even surfaces.
3. The sum of the angles of incidence is equal to the sum of the angles of reflection.

$$(\Sigma<i = \Sigma<r)$$

IRREGULAR REFLECTION OF LIGHT:
1. Parallel rays of light do not remain parallel after irregular reflection of light.
2. It takes place on un-even surfaces.
3. The sum of the angles of incidence is not equal to the sum of the angles of reflection.

$$(\Sigma<i \neq \Sigma<r)$$

Q4. Describe the properties of a plane mirror.
Ans.

PROPERTIES OF A PLANE MIRROR:
1. It always forms virtual and erect image.
2. Its surface is smooth.
3. It produces regular reflection of light.

Q5. Draw the image formed by a plane mirror and also describe the properties of image formed by it.

Ans.

PROPERTIES OF THE IMAGE FORMED BY A PLANE MIRROR:

1. It is always virtual and erect.
2. Its size is always equal to the size of the object.
3. It is formed at the same distance from the mirror as that of the object from the mirror.
4. It is always laterally inverted.

Q6. Define Spherical mirror and describe the types of spherical mirror.
Ans.

SPHERICAL MIRROR:

A piece of hollow reflecting sphere is called spherical mirror.

Types of spherical mirror:

Concave mirror (converging mirror):

Such type of spherical mirror which reflects the rays of light from its hollow (inner) polished surface is called "concave mirror".
It is also called converging mirror because it converges all rays of light coming parallel with the Principle Axis at F. it has a real Focus (where light rays can be merged).

Convex mirror (diverging mirror):

Such type of spherical mirror which reflects the rays of light from its bulging (outer) polished surface is called convex mirror.
It has a virtual Focus (where light rays cannot be merged). It is also called diverging mirror because it diverges all rays of light coming parallel with the Principle Axis opposite to virtual F.

Q7. Draw the path of light rays as per the properties of a concave mirror.
Ans.
The light ray which comes parallel to the principle axis when incident on the concave mirror, it is reflected and passes through the focus.
The light ray which comes from the focus when incident on the concave mirror is reflected and becomes parallel to the principle axis.
The light ray which is incident on the pole of concave mirror, is reflected back with the same angle.

M<i = M<r

The ray of light which comes through the center of curvature and incident on the concave mirror is reflected back on the same path.

Q8. Draw image formation by a concave mirror:
Ans.
When the object is lying at center of curvature:
Characteristics of the image:
Nature: inverted and real.
Position: at C.
Size: same as that of the object.

When the object is beyond center of curvature:
Characteristics of the image:
Nature: inverted and real.
Position: Between F and C.
Size: Diminished.

When the object is between F and C:
Characteristics of the image:
Nature: inverted and real.
Position: Beyond C.
Size: Magnified.

When the object is at focus:
Characteristics of the image:
Nature: inverted and real.
Position: at infinity.
Size: very large.

When the object is at infinity:
Characteristics of the image:
Nature: inverted and real.
Position: At Principle Focus.
Size: Smallest possible.

When the object is lying between F and P:
Characteristics of the image:
Nature: Erect and Virtual.
Position: Behind the mirror.
Size: Highly magnified.

Q9. Draw the path of light rays as per the properties of a convex mirror.
Ans.
The light ray which comes parallel to the principle axis when incident on the convex mirror, it is reflected and diverged away opposite to the virtual focus.
The light ray approaching to the virtual focus, when incident on the convex mirror, reflected back and becomes parallel to the principle axis.
The light ray which is incident on the pole of convex mirror, is reflected back with the same angle.

$$M\angle i = M\angle r$$

The ray of light which approaches to the center of curvature, when incident on convex mirror, reflected back along the same path.

Q10. Draw the ray diagram showing the image formed by convex mirror.
Ans.
Object might be placed anywhere in front of the convex mirror.

Characteristics of the image:
Nature: Erect and Virtual.
Position: Behind the mirror.
Size: very small (diminished)

Q11. Differentiate between:
i. Concave and convex mirror.
ii. Real and Virtual image.

CONCAVE MIRROR:

1. Its focal length is positive.
2. It reflects the rays of light from its inner polished surface.

3. It converges the rays of light which come parallel to the principle axis.

CONVEX MIRROR:

1. Its focal length is negative.
2. It reflects the light from its outer polished surface.
3. It diverges the rays of light which come parallel to the principle axis.

REAL IMAGE:

1. It is always inverted.
2. Its distance is taken as positive.
3. It can be obtained on any screen.

VIRTUAL IMAGE:

1. It is always erect.
2. Its distance is taken always negative.
3. It cannot be obtained on any screen.

Q12. Derive mirror equation:

DATA:

AB = height of the object (ho)	A'B' = height of the image (hi).
P = pole of the mirror	F = principle focus
C = center of curvature	f = focal length
P = object distance	q = image distance from pole

OBJECTIVE:

An object is placed between focus and center of curvature, its real and inverted image is formed beyond center of curvature. Using this ray diagram, we can derive an equation for the relationship between focal length of the mirror, distance of the object from the pole of the mirror and the distance of the image from the mirror.

Mathematically evaluating the formula:
As triangles A'PB' and APB is similar:
Therefore: AB/A'B' = PB/PB'
ho/hi = p/q ---i

Also triangle ABF and FDP are similar:
Therefore: AB/DP = BF/FP

According to the diagram, AB=ho, DP=A'B' and A'B'=hi FP=f and BF=P-f
ho/hi = p-f/f ---ii

Comparing i and ii:
p/q = p-f/f

Dividing both sides by p, we get
p/pq = p-f/pf
1/q = 1/f – 1/p
1/f = 1/p + 1/q

Hence, the required mirror equation or mirror formulae has been obtained.

Q13. Describe the four uses of spherical mirrors:
Ans.

USES OF SPHERICAL MIRROR:

1. A concave mirror is used in a microscope to illuminate the object.
2. A concave mirror is used in a telescope to concentrate the parallel beam of light coming from infinity.
3. A convex mirror is used to have the vision on the blind turns.
4. A convex mirror is used as back view mirror in automobiles.

Q14. Describe the following briefly:

a) Pinhole camera.
b) Reflecting telescope.

PINHOLE CAMERA:

It was designed by Ibnul Haitham.

Construction:

It is a hollow cubical box having one inner surface photographic. In front of the photographic side there is a very small hole.

Working:

As light enter the box, real and inverted image is formed is formed on the photographic surface. It must not be expose to light for a long time.
He used this camera to obtain the image of solar eclipse. Besides he used this camera to prove that light always travel along a straight line.

REFLECTING TELESCOPE:

A reflecting telescope consists of two concave mirror exposed to the light coming from infinity. Light is then focused on two convex lenses which enlarge the image formed by concave mirrors. So, the image of very far objects could be seen.

CHAPTER#14

REFRACTION OF LIGHT

Q1. Define refraction of light and describe two laws of refraction of light.
Ans.

REFRACTION OF LIGHT:

The bending effect of a ray of light when it enters a transparent or optical medium is known as refraction of light.

Laws of refraction of light:

There are two laws of refraction of light:

1. Incident ray, refracted ray and normal, all lie on the same plane.
2. The ratio of the sine of the angle of incidence to the sine of the angle of refraction is always constant for a particular medium. (This law is also known as Snell's law).

Q2. Define lens and describe the types of lenses.
Ans.

LENS:

A lens is a transparent medium bounded by one or two spherical surfaces.

a) Concave lens: A concave lens is thinner at the center and thicker at the edges. It is also called as a diverging lens.
b) Convex lens: A convex lens is thicker from the center and thinner from the edges. It is also called as diverging lens.

Q3. What do you mean by total internal reflection of light?
Ans.
When light rays enter from denser medium to rarer medium, angle of refraction forms greater than that of incidence. If we increase the angle of incidence, angle of refraction will also increase. At certain angle of incidence light rays are reflected back to the first medium instead. Of refraction. This condition or phenomenon is called Total internal reflection.

CRITICAL ANGLE:

The angle of incidence at which the angle of refraction will become 90^{o} is called Critical Angle. If angle of incidence further increased then instead of refraction, reflection will take place.

Q4. Draw the path of ray of light to represent the properties of a concave lens.
Ans.

PROPERTIES OF A CONCAVE LENS:

1. When the ray of light is incident on a concave lens approaching its virtual focus, it becomes parallel with the principle axis after refraction.
2. When the ray of light is incident on a concave lens parallel with the principle axis, it is diverged away to the virtual focus.
3. When the ray of light approaches to the optical center. It pass through the lens without bending.

Q5. Draw the ray diagram to show the image formed by a concave lens.
Ans.

IMAGE FORMED BY CONCAVE LENS:

Characteristics of the image formed by a concave lens:

Nature: It is always virtual and erect.
Position: It is always formed on the same side.
Size: It is always diminished.

Q6. Draw the path of a ray of light to represent the properties of a convex lens.
Ans.

PROPERTIES OF A CONVEX LENS:

1. If the ray is coming parallel with the principle axis, it will pass through principle focus after passing through the lens.
2. If the ray of light is coming through Principle Focus, after passing through the lens, it will become parallel with principle axis.
3. If the ray of light is incident on a convex lens approaching the optical center, it will pass through the lens without bending.

Q7. Draw the ray diagram to represent the image formation by a convex lens.
Ans.

IMAGE FORMATION BY CONVEX LENS:

When the object is paced at infinity:
Characteristics of the image:
Nature: Real and Inverted.
Position: At principle focus F
Size: Smallest possible.

When the object is placed beyond (2F):
Characteristics of the image:
Nature: Real and Inverted.
Position: Between F and 2F.
Size: Smaller than the object.

When the object is placed at 2F:
Characteristics of the image:
Nature: Real and Inverted.
Position: At 2F.
Size: Equal to that of the object.

When the object is placed between Focus and 2F:
Characteristics of the image:
Nature: Real and Inverted.
Position: Beyond 2F.
Size: Magnified.

When the object is placed at F (Principle Focus):
Characteristics of the image:
Nature: Real and Inverted.
Position: At infinity.
Size: Largest real image.

When the object is placed between Focus and Optical center (within focal length):
Characteristics of the image:
Nature: Virtual and erect.
Position: On the same side.

Size: Highly magnified.

Q8. Write down the definitions, reasons and corrections of the defects of vision.
Ans.

COMMON DEFECTS OF VISION:

a) Short sightedness or Myopia:

A short sighted person can't see distant objects clearly, but can see nearer object clearly.

Reason: Either the eye ball is elongated or the focal length of eye lens is too short. Concave lens of suitable focal length is used so that the image could focus on Retina.
Correction: A concave lens of suitable focal length is used so that the image could focus on Retina.

b) Long sightedness:

A long sighted person cannot see near objects clearly, but you can see far objects clearly.

Reason: Either the eye ball is too short or the focal length of eye lens is too long.
Correction: A convex lens of suitable focal length is used so that the image could focus on Retina.

c) Astigmatism:

If the cornea or the surface of eye is not perfectly spherical. In this situation the eye has different focal points in different planes and an object is not focused clearly on the retina.

Correction: Astigmatism is corrected by using asymmetrical lenses which have different radii of curvature in different planes.

d) Lack of accommodation or Presbyopia:

At old age, the eye lens loses its natural elasticity and ability to change its shape and the ciliary muscles weaken resulting in a lack of accommodation. This disease is called "PRESBYOPIA".

Correction: This defect can be corrected by using convex lens for long sighted person and Concave lens for short sighted person.

Q9. Define the following terms:

i. **REFRACTIVE INDEX:**
It is the ration of the sine of the angle of incidence to the sine of angle of refraction. This ratio remains same.

ii. **PRISM:**
A prism is a refracting body bounded by two triangular and three rectangular surfaces.

iii. **OPTICAL CENTER:**
It is the geometrical center of a lens.

Q10. Explain the phenomenon of refraction of light through a prism.
Ans.

REFRACTION OF LIGHT THROUGH A PRISM:

Optical instruments such as telescopes, binoculars and periscope use glass prisms to turn a beam of light through 90^o or 180^o.

- The angle between the two refracting rectangular surfaces opposite to the base is called the angle of the prism (<A).
- On entering the prism the ray of light bends towards the normal OL. The refracted ray FG on emerging out of the prism, becomes the emergent ray GH.
- The angle EFO is the angle of incidence (<i).
- Angle LFG is the angle of refraction (<r). The angle KMG (<D) is called the angle of deviation. The value of the angle of deviation varies with the angle of incidence.

Q11. Write down any two applications of Total Internal Reflection.
Ans.

TOTALLY REFLECTING PRISM:

- A totally reflecting prism has one of its angles equal to 90^o and each of the remaining two angles equal to 45^o.
- If a ray of light strikes one of is faces perpendicularly, it enters the prism without any change of direction and meets the hypotenuse at an angle of 45^o.
- As the critical angle of glass is 42^o the ray striking the hypotenuse suffers total internal reflection. That's why it is called totally reflecting prism.

OPTICAL FIBER:

- Very important application of total internal reflection is in the exciting field or fiber optics.
- Light can be trapped by total internal reflection inside a very thin glass rod and traveled along a curved path.
- A single very thin plastic or glass fiber of about the thickness of a human hair (1/100 of a millimeter across) behaves the same way.
- This allows total internal reflection to take place everywhere inside the fiber.

Q12. Write down the uses of Optical Fiber.
Ans.

USES OF OPTICAL FIBER:

1. In an optical fiber the light can travel with little loss because the light is totally reflected whenever it strikes the core cladding interface.
2. In developed countries, optical fibers are used to carry telephone signals and other modem communication systems using laser beams. A single strand of light carrying fiber can carry several thousand telephone calls at the same time without interfering with each other. Several thousand telephone calls at the same time without interfering with each other.

Q13. Define the following:
Ans.

CAMERA:

A camera is a device used to capture image formed by a convex lens on a photographic screen.

HUMAN EYE:

Human eye is a natural camera and the most important sense organ for us. It has a convex lens which form image on the inner most layer (Retina) of our eyes and the image is senses by the function of brain.

POWER OF A LENS:

The reciprocal value of the focal length and large aperture. It usually made of two convex lenses.

Q14. Describe the construction and working of an astronomical telescope with the help of a ray diagram.
Ans.

ASTRONOMICAL TELESCOPE:

It is an optical instrument used to view heavenly bodies such as moon, stars, planets and distant object.

Construction:

Astronomical telescope consists of two convex lenses: Objective and Eye piece.

i. Objective:
The objective is a convex lens of large focal length and large aperture. It usually made of two convex lenses in contact with each other to reduce the chromatic and spherical aberrations.

ii. Eye piece:
- The eye piece is also a convex lens. Its focal length is smaller than that of objective. It is also a combination of two lenses.
- The objective is mounted on a wide metallic tube while the eye piece is mounted on a small tube. The distance b/w the eye piece and the objective can be changed by moving tubes.

Working:

- The rays coming from a distant object falls on objective as parallel beam at some angle and these rays after refraction and passing through the objective converge at its focus and make an inverted and real image.
- This image acts an object for the eye piece. This distance of the eye piece is so adjusted that the image lies within the focal length of the eye piece.
- The eye piece forms the final image. The final image is magnified, virtual and inverted with respect to object.

M = focal length of objective/focal length of eye piece

This expression shows that in order to obtain high magnification, focal length of object must be large and that of eye piece is small.

Q15. Describe the construction and working of a compound microscope with the help of a ray diagram.
Ans.

COMPOUND MICROSCOPE:

It consists of two converging lenses Objective and Eye piece.

Objective:

The lens in front of object is called objective. Its focal length is taken to be very small. The objective forms real, inverted and magnified image of the object placed just beyond the focus of objective.

Eye piece:

The lens towards the observer's eye is called eye piece. Focal length of eye piece is greater than the focal length of objective. Eye piece works as a magnifying glass.

Working:

- The objective is so adjusted that the object is much closed to its focus. The objective forms a real, inverted and magnified image of the object beyond 2F of objective with in the focal length of eye piece.
- The eye piece is so adjusted that it forms a highly magnified virtual image.

Q16. Describe the construction and working of a simple microscope with the help of a ray diagram.
Ans.

SIMPLE MICROSCOPE:

A simple microscope is an instrument used to enlarge the image to clear the vision normally.

Construction:

It consists of a double convex lens with its handle.

Working:

See through the convex lens by maintain the suitable distance of the lens with the object, image shall be observed very clear and magnified. As the object brought closer to the lens, size of the image will proportionally magnified.

CHAPTER# 15
NATURE OF LIGHT AND ELECTROMAGNETISM SPECTRUM

Q1. Define light also describe its importance briefly.
Ans.

LIGHT:

Light is a form of energy. Life on earth without it would not have existed and it enables us to see objects.

Q2. Describe the main aspects of newton's corpuscular theory of light.
Ans.

NEWTON'S CORPUSCULAR THEORY OF LIGHT:

Definition:

Newton in the middle of seventeenth century proposed that light consist of minute particles, called corpuscles which on emission from the source of light travel along straight line with great speed.

Main aspects:

When these particles enter the eyes, they create the sensation on interacting with the retina of the eye. This is known as the corpuscular theory of light.
The theory explains the formation of shadows and propagation along straight paths in a straight-forward manner. It also explains the phenomenon of reflection by arguing that reflection of light particles from a surface takes place in the same manner as the reflection of a rubber ball from a hard surface.

Objections:

Phenomenon of refraction, however, presented difficulties. Though newton did explain the refraction phenomenon, he had to assume that velocity of light in denser medium like water will be greater than in air.
In 1850 A.D French Physicist Foucault proved that Newton's result, that velocity of light in water should be greater than air, is wrong. Newton's corpuscular theory was thus abandoned.

Q3. Describe Huygens's wave theory of light?
Ans.

WAVE THEORY OF LIGHT:

Huygens, a contemporary of Newton, proposed an alternate theory known as wave theory of light. Newton's a towering personality did not allow Huygens's theory to gain acceptance of over one hundred years.

Main aspects:

Christian Huygens believed that light travelled as waves like ripples on water pond. It was assumed that all space was filled with a hypothetical medium called the Ether which enables the propagation of light waves through space.
The wave theory of light explained the rectilinear propagation of light, formation of shadows, reflection, refraction and a few other properties of light.

Objections:

But if light is waves, 19th century scientists wondered, how can light travel a vacuum? Therefore, the assumption about the existence of the invisible ether as a medium for the propagation of light remained on vogue till the beginning of the 20th century.

Q4. Explain Plank's Quantum Theory of dual nature of light.
Ans.

QUANTUM THEORY AND DUAL NATURE OF LIGHT:

In 1905, Max Plank while studying heat radiated from hot body came to the conclusion that radiation (light) was emitted in the form of tiny packets of energy. He called these packets of energy "photons".

Main aspects:

The again revived the idea of Newton's light corpuscles. But these photons of Einstein are not material particles such as balls; they can behave as waves also. This peculiar nature of light is now called the dual nature of light. It never both at same time. Sometimes it behaves as a particle and sometimes as a wave depending on how you look at it.

Success:

The success of the photon idea explains the existing phenomenon of light through empty space.

Q5. Define Dispersion and explain the phenomenon of Dispersion through a prism.
Ans.

DISPERSION:

The fact that sunlight consists of different colors was first investigated by Newton with the help of the following experiment.

Dispersion through a prism:

A prism was placed in the path of the beam of light. A band of various colors was produced on the wall. This band of color is known as a solar spectrum and the phenomenon of spreading out of light into its constituent colors is called dispersion of light.
The amount of refraction of the waves depends on their frequencies. This experiment shows that sunlight is a combination of various waves. The waves of higher frequencies bend more than those of lower frequencies. And the visible light region would separate in the shape of a spectrum of colors.

Q6. How a rainbow is formed:
Ans.

RAINBOW:

The rainbow is an arc of spectral colors formed across the sky during or after rainfall in the morning or evening. The rain drops behave like prism and white light entering the raindrops is split up into colors on refraction. The light enters the raindrop from one side but doesn't pass through. It is reflected from the opposite side and re-emerges through the side it entered but at an angle of about 42^{o} to its original direction.

Q7. Define spectrum. What is visible spectrum?
Ans.

SPECTRUM:

When dispersion of sunlight or white light is produced with the help of a prism, a band of (different colors is observed consisting of red, orange, yellow, green, blue and violet color. A band of color formed in this way is called a spectrum.

Visible spectrum:

Each color in this spectrum represents a certain of frequency and wavelength. The visible spectrum range from about 400nm in the deep violet to about 750nm in the deep red (1nm = $10\text{-}9_m$).

Q8. Why is light considered to be electromagnetic in nature?
Ans.
A Scottish physicist, James clerk Maxwell (1831-79), working on electromagnetism predicted a formula for the speed of electromagnetic waves in terms of electric and magnetic quantities. When these quantities were measured and the speed of electromagnetism waves was calculated it was discovered that the velocity of electromagnetic waves is same as the velocity of light in vacuum. This suggested that light might be electromagnetic in nature.

Q9. Describe briefly the radiations in the electromagnetic spectrum.
Ans.

THE ELECTROMAGNETIC SPECTRUM:

The spectrum of electromagnetic/radiation consists of radio waves, microwaves, infrared waves, visible waves, ultraviolet waves, X-rays and gamma rays etc. A brief description of the range of each type of waves is given as follows.

Radio waves:

Are electromagnetic waves with a large range of wavelength from a few millimeters to several meters.

Microwaves:

Are radio waves of shorter wavelength between 1mm and 300mm. Microwaves are used in radar and microwave ovens.

Infrared waves:

Are also called heat waves; these waves are radiated by hot bodies at different temperatures. The earth's atmosphere is at mean temperature of 250K and radiates infrared waves with a wavelength having a mean value of 10 micrometers.

Visible waves:

Have wavelength range between 400 and 700 nanometers. The peak of the solar radiation is at a wavelength of about 550nm. The human eye is most sensitive to this wavelength.

Ultraviolet waves:

Their wavelength ranges from down to 60nm. These are emitted by hotter stars having a mean temperature greater than 2500^oF, X-rays wavelength ranges from 1.0 nm to 0.01 nm.

Gamma rays:

Their wavelength is less than 10-11 m. they are emitted by the nucleus of certain radioactive substances.

Q10. Define Green House effect.
Ans.

GREEN HOUSE EFFECT:

We know that due to atmospheric pollution the ozone layer is being damaged day by day. As a result the amount of radiation penetrating the atmosphere is increasing which is accelerating the trapping of heat around earth which is known as greenhouse effect. This effect according to some scientist might ultimately raise the temperature of the earth to such an extent that it will melt the polar ice-caps raising the level of the ocean and of course drowning all the coasts. Infrared rays are absorbed by carbon dioxide and water vapors present in the atmosphere and are not radiated back.

CHAPTER#16

ELECTRICITY

Q1. Define the following terms:
Charge, unit charge, static charge, electricity, current electricity, electric field, intensity of electric field, electrostatic potential.

Ans.

Charge:

The ability of attraction or repulsion between two substances because of losing or gaining electron is known as charge. Hence, the substances having this ability are known as charged substances.

Unit of charge:

In SI system the unit of charge is Coulomb. One coulomb is the quantity of charge which can repel or attract another charge when they are 1 meter apart with a force of 9x10^9 N.

Static charge:

If the charges substance don't interact with each other because of being far or having any obstruction between them, the charge doesn't flow it remain at rest. This type of charge is known as static charge.

Electricity:

It is the branch of physics in which we study the existence and behavior of charges.

Current electricity:

It is the branch of physics in which we study the behavior of flowing charge.

Electrostatic potential:

The ability of attracting or repelling a charge by another charge is known as the Electrostatic potential of that charge. The increasing or decreasing of this ability depends upon the number of charges of the same kind. E.g. more no. of positive charges will produce greater electrostatic potential for positive charge and vice versa.

Q2. What do you mean by the Intensity of electric field? Describe intensity of electric field mathematically.

Ans.

INTENSTIY OF ELECTRIC FIELD:

The strength of the force of attraction or repulsion between two charges at any particular point within the electric field is known as the Intensity of that electric field.

Mathematical representation:

$$E = F / q_o = q / 4 \pi E_o r^2$$

Where,
E = Intensity of the electric field
F = Electrostatic force of attraction or repulsion between two charges.
q = charge which exert electrostatic force.
qo = change which is being attracted by charge "q".
E_o = permittivity of the free space
R = Distance between the charge and point where the strength is calculated.

Q3. State coulombs law and establish a relationship for the electrostatic force between two charges.

Ans.

COULOMB'S LAW:

According to Coulomb "The electrostatic force between the charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them".

Mathematical representation of coulombs law:

$$F = k\, q_1\, q_2 / r^2$$

Where,

F = Electrostatic force of attraction or repulsion between two charges.
q_1 = first charge (Which exert electrostatic force).
q_2 = second charge (Which is being exerted the electrostatic force)
r = Distance between the charge and the point where the strength is calculated.
K = Constant of proportionality and its value in SI system is $9x10^{\wedge}9\ Nm^2C^{-2}$

Q4. What do you mean by Electrostatic Induction? Describe a method to induce a substance with charge. What is the purpose of Electrostatic Induction?

Ans.

ELECTROSTATIC INDUCTION:

It is a process by which the opposite charge in a neutral substance are separated so that the substance could show electrostatic force.

Inducing charge in a neutral substance:

- Take two metallic plates (both neutral).
- Bring a negative charge glass rod near one of these plates.
- The positive charges of the plate will be attracted towards rod while the negative charges shall be repelled away of the rod.
- Now touch other plate with this plate and then same will be happened in other plate also.
- This is how the opposite charge in both plates will be separated in such a way that all negative charges will be deviatedaway and all positive charge will be attracted towards the rod.
- At this time all positive charges will be motivated towards first plate and all negative charge will be motivated towards second plate.
- Now simply separate the plates as well as remove the glass rod.
- Now the first plate will behave as positively charged and the second plate will behave as negatively charged substance.
- This is how the charges are separated and the neutral substance are made charged by the process of electrostatic induction.

Purpose of the process of electrostatic induction:

By the process of electrostatic induction, neutral substances are made charged being able to exert electrostatic force on other substances. Capacitors are made by this process which store charges which could be used for some time when it is required to flow the charge for having a short term flow of electric current.

Q5. What do you mean by Electroscope? Describe the construction and working of a Gold leaf electroscope.

Ans.

ELECTROSCOPE:

An electroscope is a device which is used to detect charge, whether the object is negatively charged or positively charged.

CONSTRUCTION OF A GOLD LEAF ELECTROSCOPE:

A gold leaf electroscope consists of a glass frame, two thin leaves of gold which are able to diverge from each other. The gold leaves are connected with a metallic base outside the glass case.

WORKING OF THE GOLD LEAF ELECTROSCOPE:

As soon as a charged object is brought near to the Gold leaf electroscope, charges are separated inside the electroscope and hence same charge appears on the end where both leaves are fixed. As a reaction both leaves starts repelling each other being same charged. This is how the gold leaf electroscope detects the charge.

Q6. Define capacitor and Farad.
What is Capacitance of a capacitor how it can be changed?

Ans.

CAPACITOR:

A capacitor is actually a device which could store different charges on the separate plates. As soon as the plates are connected, electric current starts to flow for a short term.

FARAD:

Unit of capacity of a capacitor is farad. 1F is the capacity of a capacitor if it stores the charge of 1 coulomb and the potential difference between the plates is 1 volt.

CAPACITANCE OF A CAPACITOR:

The ability of a capacitor to store the charge inside it is known as the capacitance of that capacitor. The capacitance can be increased or decreased by increasing or decreasing the potential difference between the plates of that capacitor.

Q7. Define an electric cell.
Differentiate between Primary and Secondary cells.

Ans.

ELECTRIC CELL:

They are used to obtain electric current. There are different types of electric cells which develop the electrostatic potential required for the flow of electric current.

Primary Cell:

1. A primary cell doesn't depend upon any external source but just its own components for working.
2. A primary cell work until all the chemicals are exhausted and no more current can be produced.
3. Voltaic cell, Daniel cell, Leclanche cell and dry cell are the example of primary cells.

Secondary cell:

1. A secondary cell depends upon external source other than its own components for working.
2. In case of a secondary, the chemical potential energy is regained by passing electric current through it, this process is known as charging of the cell.
3. The most common example of secondary cell is lead acid accumulator.

Q8. Define electrostatic force (e.m.f.), potential difference.
Ans.

ELECTRSTATIC FORCE E.M.F:

Since, electric current means the flow of charge and according to newton's first and second laws of motion, no displacement is possible without applying force, therefore, to make charges moving in a circuit (i.e. electric current). Some force must be exerted on the charges, this force is known as electromotive force (e.m.f). In cells this force is generated by the action of chemicals inside the cell.

POTENTIAL DIFFERENCE (VOLTAGE):

Potential difference is required to produce and maintain the flow of charge. Higher potential difference will produce higher current and vice versa.

ELECTRIC CURRENT:

An electric circuit is actually the path for the flow of charge.

Q9. What do you mean by Resistance, describe the factors affecting the resistance in a wire?
Ans.

RESISTANCE:

The hindrance in the flow of charge through a substance in a circuit is known as Resistance. Good conductors have low resistance while bad conductors have high resistance.

FACTORS AFFECTING RESISTANCE IN A WIRE:

i. Length of the wire:
Greater is the length of the wire, more will be the resistance in the wire, shorter is the length, lesser will be the resistance in the wire.

ii. Thickness of the wire:
More is the thickness of the wire, lesser will be the resistance in the wire, lesser is the thickness of the wire, higher will be the resistance of the wire.

Q10. Differentiate between series and parallel resistance circuits.
Ans.

SERIES CIRCUIT:

i. In series circuit, all the resistances are arranged in series such that there is a single way for the flow of charges means same current flows through all resistances. Total currentflowing through the circuit is same as that of each resistance or resistor.

ii. In series circuit, each resistor has own individual potential difference. Sum of the potential difference across each resistor is same as that of the main source of potential difference.

iii. In series circuit, sum of all the resistors could be easily obtained by simply adding all the resistors.

PARALLEL CIRCUIT:

i. In parallel circuit, all the resistances are arranged in parallel, such that each resistor has its own way for the flow of charges means the sum of the current through all resistor is same as the total current flowing through the circuit.
ii. In parallel circuit, total potential difference of the main source is same as that of each resistance.
iii. In parallel circuit, reciprocal of the sum of all the resistors could be obtained by adding the reciprocals of all the resistors.

Q11. Differentiate between Alternating and Direct current.
Ans.

DIRECT CURRENT:

1. Direct current can be obtained by connecting terminals of a battery through a wire.
2. Direct current flows like water flows from a tap, it doesn't change its direction.
3. Direct current is not used widely like Alternate Current because it is not convenient to transmit through far distances and transform from higher to lower values or vice versa.

ALTERANTING CURRENT:

1. Alternate current can be obtained by connecting a resistor to a source of alternating current.
2. Alternate current changes its direction many times in a second.
3. Alternate current is used widely as it is conveniently transmitted through far distances as well as it is transformed from higher to lower values and vice versa.

Q12. State ohm's law. Establish a relationship between voltage, resistance and current.
Ans.

OHM'S LAW:

It state, "Potential difference across the terminal of an electric circuit is directly proportional with the current flowing in the circuit if the resistance of the circuit remains constant."

RELATIONSHIP BETWEEN VOLTAGE, RESISTANCE AND CURRENT:

According to Ohm's Law, voltage is directly proportional with the current in the circuit.

$$V \propto I \quad OR \quad V = IR$$

Where,
I = Current
R = Resistance

Q13. State joule's Law. Derive a relation for the work done in carrying charges through a wire when heat energy is obtained by the flow of current. Derive a relation to show the measurement of electrical energy in KWh supplied by WAPDA for the preparation of electric bills.

Ans.

JOULE'S LAW:

"If 1 coulomb of charge moves through a potential difference of 1 volt in the direction of the electric field, then, 1 joule of energy is released".

DERIVATION FOR THE HEAT ENERGY:

We know that: $W = F \times S$ eq(i)
Where, W = Work done
F = Force
S = Displacement

But, in case of electric current, force to drift a charge is electromotive force provided by a charge therefore, F = q similarly the displacement covered by a charge is across the terminals, therefore, S = V
Replacing the values of "F" and "S" we get:

$$W = q \times V \quad \text{eq(ii)}$$

We also know from Coulombs law $I = q/t$ and $q = I \times t$
Replacing the values of q in eq (ii) we get

$$W = I \times t \times V \quad \text{eq(iii)}$$

But from ohm's law we know that $V = I \times R$ replacing the value of "V" in eq(iii) we get

$$W = I \times t \times I \times R$$
$$W = I^2Rt$$

This is known as Joule's Law Equation and it relates that how much electrical energy converted into heat energy to carry on the work done.

EQUATION FOR THE MEASUREMENT OF ELECTRICAL ENERGY:

From joule's law we know that,

$$W = I^2Rt$$

We also know that

$$P = W/t \quad \text{eq(1)}$$

Replacing the value of "W" in eq(1) we get

$$P = I^2R$$

OR

$$P = I\,IR \quad \text{eq(2)}$$

From ohms law we know that

$$V = I\,R$$

Now, if the power is measured in KW, this equation gives the use of electrical energy for 1 hour.
KWh = I x V
Will give total used up electrical energy in no. of hours.

Q14. Describe the main features of a safe house circuit.
Ans.

HOUSE CIRCUIT:

Following are the main features of a safe house circuit:

1. Parallel circuit:
   There must be a parallel circuit for all the component resistors in a house so that if one or few don't work the rest could work regularly.
2. Fuses:
   There must be proper fusing in the main circuit so that the fluctuation in the voltage could not affect the appliances.
3. Proper thickness of wire:
   Thickness of all the sires used in the house circuit must be appropriate to the power of the component resistors or appliances so that no wire could burn out because of the excess heat produced in the wires.

4. Earth:
   Earth is also very important for a safe house circuit so that heavy current could go to earth safely without making any hazard.

CHAPTER#17

MAGNETISM AND ELECTROMAGNETISM

Q1. Define magnet, magnetic poles, magnetic field, magnetic force, magnetic substances and ferromagnetic substances.
Ans.

MAGNET:

It is a substance which attracts iron, nickel and cobalt towards itself with a certain of its own because of its special arrangement of particles. A magnet could be any of these three substances.

MAGNETIC POLES:

Every magnet has its maximum power of attraction at its ends which are called so its poles i.e. North Pole and South Pole. Magnetic lines of force travel from North Pole to South pole.

MAGNETIC FIELD:

It is the area around a magnet where the force of attraction of the magnet works. Within the limit of this field, North Pole of a magnet can attract South Pole or repel North Pole of another magnet.

MAGNETIC FORCE:

It is the force of a magnet by which it can attract or repel another magnet or magnetic substance. This force is stronger at the poles and weaker in the middle.

MAGNETIC SUBSTANCES:

Substances like Iron, Nickel or Cobalt which could be attracted by a magnet are known as Magnetic substances.

FEROMAGNETIC SUBSTANCES:

Substances that behave like a magnetic in the pressure of a magnetic field are known as Ferromagnetic substance.

Q2. Describe the properties of magnetic substances.
Ans.

PROPERTIES OF MAGNETIC SUBSTANCES:

Lines of force of a magnet start from North Pole and enter South Pole. They tends to expand laterally and contact longitudinally. They run continuous through the body of magnet. These lines of force can pass through iron more easily as compare to air. Two magnetic lines of force cannot intersect each other.

Q3. Describe the methods of making a magnet.
Ans.
Artificial magnets can be made by the following methods:

SINGLE TOUCH METHOD:

In this method, a rectangular iron bar is made magnet by rubbing a natural magnet on it. Edge of North Pole is rubbed throughout the bar along just one direction many times. After that the magnetism of the bar can be checked by bringing some iron nails near it, it will attract them. This shows that magnetism has been produced in the bar. But this is not a permanent magnet, it will work only for a limited time period.

ELECTRIC METHOD:

In this method a rectangular iron bar is made magnet by passing electric current through it. Insulated copper wire is coiled around the bar. Iron fillings are spread around the bar and then electric current is set on. It is observed that the bar starts attracting iron pieces which shows that it has been turned into magnet. This type of magnet is called as Electromagnet and it remains no more a magnet if the supply of electric current discontinued.

Q4.
Define solenoid and describe its properties.
Ans.

SOLENOID:

Solenoid is a coil of wire wound on a cylindrical frame of iron or any material. When an electric current passes through the solenoid, a magnetic field is produced around it. It has suitable numbers of turns of wire. There is a strong magnetic field inside the solenoid.

Q3. Describe the construction and working of an electric bell.
Ans.

ELECTRIC BELL:

Construction:

Important parts of an electric bell are:

1. Electromagnet
2. Armature
3. Gong
4. Armature rod
5. Hammer
6. Spring

Structure:

One end of armature winding is connected to first terminal and the other to a spring, which is mounted on a soft iron strip.
A rod is attached to the armature and the free end of the rod carries a small hammer, which strikes a bell. A very light spring is attached to a screw, which is joined to second terminal.

Working:

The electric bell is completed through a battery and push switch button connected to the terminals. When the push button is presses the electric circuit is completed and the armature is attracted towards the electromagnet as a result, the small spring gets detached from the screw due to which the electric circuit is broken and the electromagnet is demagnetized.
Hence, the attraction disappears and the armature is brought back by the spring to its original position. Contact of the spring with the screw is now remade, which completes the electric circuit. The actions is repeated over and over again consequently. The armature vibrates and hammer attached to it strikes the gong and the bell rings and sound is produced.

Q6. Describe the construction and working of a Galvanometer.
Ans.

GALVANOMETER:

It is an electromechanical instrument which is used for the detection of electric currents through a circuit. Being a sensitive instrument, Galvanometer cannot be used for the measurement of heavy currents.

Working:
It works on the principle of electrical energy in to mechanical energy.

Parts of a Galvanometer:
There are five essential parts of a Galvanometer:

1. U-shaped permanent magnet
2. Soft iron cylinder
3. Rectangular coil of wire
4. Pointer or needle
5. Scale

Construction:
Rectangular coil of wire runs around the soft metal cylinder of suitable number of turns. It is suspended between the Poles of U-shaped magnet by a thin strip. At one end it is soldered to a loose and soft spiral. There is a needle attached to the spiral which is rotatable by the action of cylinder. There is a scale extremely under the area where the needle moves.

Working:
When the current is passed through the coil it becomes a magnet. There is force of attraction is setup between the poles of magnet and coil. As a result a couple is produced in the coil and it is deflected, the current passes through the coil and the angle of deflection has direct relation with each other. The deflection is measured by a pointer attached to the coil.

Q7. What do you mean by Ammeter? How a galvanometer can be converted into an ammeter? What is the need of converting galvanometer into Ammeter?

Ans.

AMMETER:

It is an electrical measuring device, which is used to measure electric current through the circuit.

Connection of Ammeter:
An Ammeter is always connected in series to a circuit.

How a Galvanometer converted into an Ammeter:
In order to convert a Galvanometer into an ammeter, a very low resistance as shunt resistor is connected parallel to Galvanometer.
Value of shunt is so adjusted that most of the current passes through the shunt. In this way a Galvanometer is converted into Ammeter and can measure heavy currents without full deflected.

The need of converting galvanometer into an ammeter:
Since Galvanometer is very sensitive instrument therefore it can measure heavy currents.

Q8. What do you mean by voltmeter? How a galvanometer can be converted into Voltmeter? What is the need of converting galvanometer into voltmeter?

Ans.

VOLTMETER:

It is an electrical measuring device, which is used to measure potential difference between two points in a circuit.

Connection of Voltmeter**:**

It is always connected in parallel to circuit.

How we convert galvanometer into a voltmeter:

In order to convert a galvanometer into voltmeter, a very high resistance known as "Series resistance" is connected in series to galvanometer.

The need of converting a galvanometer into a voltmeter:

Since galvanometer is a sensitive instrument, therefore it can't measure high potential difference.

Q9. Describe an experiment to show that the earth is a big magnet.

Ans.

OBJECT:

To show that the earth is a big magnet.

APPARATUS:

An iron stand as a bar magnet, thread and chalk.

PROCEDURE:

1. Tie the bar magnet with the help of the thread.
2. Hang the bar magnet on the stand with the help of the thread.
3. Rotate the bar magnet randomly giving many turns.
4. Leave the bar magnet after giving the turns.
5. As soon as the magnet comes to rest, mark the direction where North and the South of the magnet point.
6. Repeat this process many time.

OBSERVATION:

1. After withdrawing the rotating force on the bar magnet, it will be observed that the magnet start rotating in the opposite direction and finally it stops at a particular position.
2. It was noted that every time, when the magnet come to rest the direction where North and South at the magnet point remain same.
3. Every time, the North Pole of the magnet stops coinciding south of the Earth irrespective of the force applied on it.

CONCLUSION:

Here is a force which attracts North and South of the magnet and magnet stops. Since, a magnet can only be attracted by another magnet; therefore there must be another bigger magnet which could only be Earth.

Q10. Describe the methods of demagnetizing a magnet.

Ans.

DEMAGNETIZING:

A permanent magnet can be partially demagnetized by hard hammering or strong heating but the best method is to pass alternate electric current through it. All methods of demagnetizing the magnet can be conducted only if the magnet is pointing East-West direction.

Q11. Describe the similarities between magnetism and electric current.
OR
Describe the magnetic effect of electric current.

Ans.

MAGNETIC EFFECT OF ELECTRIC CURRENT:

There are great similarities between magnetism and electric current:

MAGNETISM:

1. There are two magnetic Poles, North Pole and South Pole.
2. Like Poles repel while opposite Poles attract each other.
3. Magnets set up their magnetic field of attraction or repulsion.
4. Magnetism can also be produced by rubbing.

ELECTRIC CURRENT:

1. There are two types of charges i.e. Positive charge and Negative charge.
2. Like charge repel while opposite charges attract each other.
3. Charged objects set up their electric field of attraction or repulsion.
4. Objects can be electrically charged by rubbing.

Q12. Compare the field of action of a magnet and that of electric current.
Ans.

MAGNETIC FIELD:

1. Magnetic field makes curves that run from North Pole to the South Pole.
2. Magnetic field of a permanent magnet is permanent.

ELECTRIC FIELD:

1. Electric field make circles that runs clockwise and anti-clockwise.
2. Electric field depends upon flow of electric current. It is not permanent field.

Q13. Describe the construction and working of an Electric Motor.
Ans.

ELECTRIC MOTOR:

Principle:

When a rectangular coil carrying current is placed in a magnetic field, a torque acts on the coil which rotates it continuously.
When the coil rotates. The shaft attached to it also rotates and thus it is able to do mechanical work.

CONSTRUCTION AND WORKING:

Parts of a DC motor:

Armature:

A D.C motor consists of a rectangular coil made of insulated copper wire wound on a soft iron core. This coil wound on the soft iron core forms the armature. The coil is mounted on an axle and is placed between the cylindrical concave poles of a magnet.

Commutator:

A commutator is used to reverse the direction to flow of current. Commutator is a copper ring split into two parts C1 and C2. The split rings are insulated from each other and mounted on the axis of the motor. The two ends of the coil are soldered to these rings. They rotate along with the coil. Commutator rings are connected to a battery. The wires from battery are not connected to the rings but to the brushes which are in contact with the rings.

Brushes:

Two small strips of carbon, known as brushes press slightly against the two split rings, and the slit rings rotate between the brushes.

WORKING:

When the coil is powered, a magnetic field is generated around the armature. The left side of the armature is pushed way from the left magnet and drawn towards the right, causing rotation.
When the coil turns through 90^{o}, the brushes lose contact with the commutator and he current stops flowing through the coil.
However the coil keeps turning because of its own momentum.
Now when the coil turns through 180^{o}, the sides get interchanged. As a result the commutator ring C1 is now in contact with brush B2 and commutator ring C2 is in contact with brush B1. Therefore, the current continues to flow in the same direction.

The efficiency of the DC Motor increases by:

- Increasing the number of turns in the coil.
- Increasing the strength of the current.
- Increasing the area of cross-section of the coil.
- Increasing the strength of the radial magnetic field.

CHAPTER#18

ELECTRONICS

Q1. Define: Electronics, Rectifier, Rectification, Doping and Fabrication.
Ans.

ELECTRONICS:

It is the branch of physics which deals with development of electron-emitting devices, there use and control flow in electrical circuits. Electronics also deals with semiconductors, diode, rectifiers etc.

RECTIFIER:

A rectifier is a device which is used to convert alternating current (AC) into direct current (DC). PN-junction diode is used as rectifier.

RECTIFICATION:

The process of converting alternating current into direct current is called rectification.

DOPING:

Addition of an element to a pure insulator element like Silicon or germanium to convert them into semiconductor substance (p-type or n-type) by increasing their electrical conductivity is called Doping.

FABRICATION:

A small amount of indium is placed on a plate or wafer of N-type germanium. Indium on heating at 550^{o}C melts and diffuse through a small part of the N-type germanium. Indium being a P-type impurity, converts the part of the N-type germanium to P-type material. Thus a junction is formed between P-type section and an N-type section of germanium. A brass-base is used to fix the PN-junction to which leads are attached the whole apparatus is sealed in a glass tube or a metallic tube.

Q2. Differentiate between P-type and N-type substances.
Ans.

P-TYPE SUBSTANCES:

1. Pure insulator element turned into partially positive by the process of doping are known as P-type substances.
2. If a trivalent element from the 3rd group such as Gallium (Ga) or indium (In) is added to pure crystals of Germanium (Ga) or Silicon (Si), three electrons of impurity from covalent bonds with three atoms of (Ge) or (Si), while three exists a vacancy for an electron in the fourth band. This vacant space is called Hole. This Hole behaves like a positive charge and can move in the structure of substances.

N-TYPE SUBSTANCES:

1. Pure insulator element turned into partially negative by the process of doping are known as N-type substances.
2. If a pentavalent element from 5th Group such as Antimony (Sb) is added to pure Germanium (Ge) or silicone (Si), then four electrons of (Sb) will form covalent bonds with four (Ge) or (Si) atoms. The fifth electron of Sb is free to move which makes (Ge) or (Si) partially conductor.

Q3. Differentiate between Forward biasing and Reverse biasing.
Ans.

FORWARD BIASING:

1. When n-type end of PN-junction is connected to negative terminal and p-type end with positive terminal of a DC supply, then the height of potential barrier reduces and provides easy flow of electric charge.
2. PN-junction conducts electricity. In this condition PN-junction is said to be Forward Biased.

REVERSE BIASING:

1. When p-type end of PN-junction is connected to the negative terminal and n-type end with positive terminal of a DC supply. The height of potential barrier increases to maximum and the flow of electric charge across the junction will become zero.
2. In this condition a PN-junction diode is called Reverse Biasing.

Q4. Define a PN-junction diode, describe the working of PN-junction diode.
Ans.

PN-JUNCTION DIODE:

A PN-junction diode is an electronic device formed from a p-type and an n-type substance semiconductor. A semiconductor diode has the property of one way conduction i.e. it allows electric current to flow in only one direction.

WORKING:

As we know that a P-type substance has excess of mobile positive charge or holes and n-type substance has an excess of negative charge or electrons, the electrons from n-type and holes from p-type sections flow across the junction and combine.
In this way a layer of positive charges is formed on the n-type and a layer of negative charges on p-type material.
Due to induction of these layers a potential barrier is now developed across the junction and further flow of charges is prevented from one side to the other.

Q5. Define a transistor, describe the construction and working of a transistor.
Ans.

TRANSISTORS:

A three terminal semiconductor electronic device is called transistor. Transistors are widely used in electronic appliances such as computers, radio, audio video equipment, bio-medical instrument etc.

Construction:

A transistor is a three layer semiconductor which consists a very thin central layer of one type of semiconductor materialsand witched between two relatively thick layers of second type.

Parts of transistor:

There are three essential parts of a transistor.
Base: It is the central layer denoted by b.
Emitter: It is the outer layer denoted by e.
Collector: It is the outer layer denoted by c.

Working:

Consider any one of the transistors for example a pnp-transistor. Let the two p-end are connected to two batteries as shown in the diagram. The forward bias causes the holes in the p-type emitter to flow towards the base which constituent Ie current. These holes cross into the n-type base, they try to combine with electrons but the base is lightly doped and is very thin.
Therefore only few holes combine with electrons and the remaining holes cross into the collector and generates collector current Ic. In this way almost the entire emitter current flows in the collector circuit. From the above description it is clear that:

$$Ie = Ib + Ic$$

Thus there are two current paths through a transistor. One is the base-emitter path or input and the other is the collector-emitter path or output.

Q6. Describe the types of a transistor.
Ans.

1. **PNP TRANSISTOR:**
   In this type of transistors n-type semiconductor piece is sand witched between two pieces of p-type semiconductor layers.

2. **NPN TRANSISTOR:**
   In this type of transistors p-type semi-conductor piece is sand witched between two pieces of n-type semi-conductor layers.

CHAPTER#19

NUCLEAR PHYSICS

Q1. Define Nucleus, Atomic number, Radioactivity, Einstein's theory of relativity.
Ans.

NUCLEUS:

The center part of an atom is called Nucleus. It has spherical shape. It has a very small size. Diameter of nucleus is about $1x10^{-14}$m. It has positive charge due to presence of proton. Neutron and protons are collectively known as Nucleon.

ATOMIC NUMBER:

Total number of proton in the nucleus of an atom is called its atomic number.
OR
Total number of electrons in an atom is also known as atomic number, because in an atom numbers of an electron are always equal to proton.

$$A = z + n$$

Where:
A = Atomic number
Z = Number of protons or electrons

EINSTIEN'S THEORY OF RELATIVITY:

According to Einstein's theory of relativity "Mass and Energy are inter convertible". Einstein established a relation between mass and energy known as "Einstein's Mass Energy Equation".

$$E = m c^2$$

Where:
E = Energy
M = Mass
C = Velocity of light ($3x10^8$ m/s)

RADIOACTIVITY:

All the elements having atomic number greater than 82 emit invisible radiation all the time. The phenomenon of emission of these powerful rays is called Natural Radioactivity" and the element that emits such rays is called "Radio Active Element".
There are three types of radioactive rays:

1. Alpha rays.
2. Beta rays.
3. Gamma rays.

Q3. Differentiate between nuclear fission and nuclear fusion:
Ans.

NUCLEAR FISSION:

1. The process in which a heavy nucleus is broken into two lighter nuclei with the release of energy is called nuclear fission.
2. In one fission of $_{92}U^{235}$ nucleus, about three neutrons are obtained. In 1939, Hann and Stress man discovered that fission can be produced by bombarding $_{92}U^{235}$ with slow neutrons. When $_{92}U^{235}$ is bombarded with neutron, it is broken down into two lighter nuclei and about 200Mev energy is released in this process.

NUCLEAR FUSION:

1. The process of forming heavy nucleus from two or more light nuclei in which energy is released is called nuclear fusion.
2. Nuclear fusion between Deuterium and tritium when 1H2 and 1H3 nuclei are brought together they form $_2He^4$ nucleus with the release of energy.

$$_1H^2 + _1H^3 \rightarrow {}_2He^4 + {}_0n^1 + \text{Energy}$$