STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING, ODISHA

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Notice No. 1674/Date 29.07.2026

It is hereby notified for information of all concerned Principals of Govt. & Pvt. Polytechnics that the bridge Course syllabus effective from 2026-27 for 1st year students along with the Course materials is uploaded in the SCTE&VT, Odisha website(sctevtodisha.gov.in).

There will be 4 periods of Theory class every day in the 1st half which should be interactive session. The 2nd half will be utilized for other activities so as to generate interest among students towards the Diploma Courses. The syllabus is to be completed in 2 week time.

29.7.26

for Secretary.

Memo No. 1675/Date 29.07.2026

Copy to Principals of all Govt. & Pvt. Polytechnics for information.

29.7.2026

for Secretary.

BRIDGE COURSE FOR DIPLOMA ENGINEERING COURSES

W.E.F. ACADEMIC SESSION 2026-27

STATE COUNCIL FOR TECHNICAL EDUCATION &

VOCATIONAL TRAINING, NEAR RAJ BHAWAN,

UNIT-VIII, BHUBANESWAR, ODISHA.

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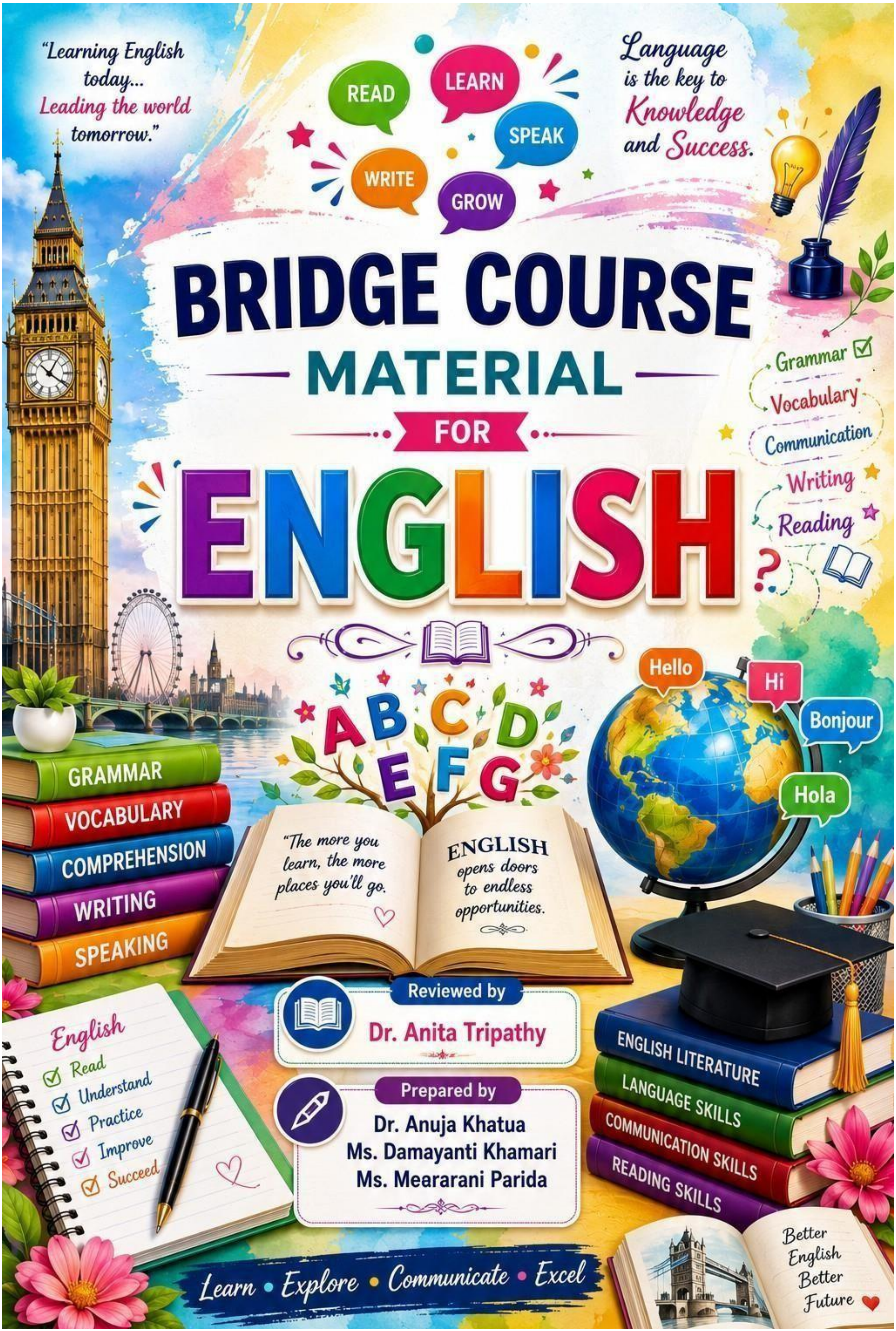
"Learning English today... Leading the world tomorrow."
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LEARN
SPEAK
WRITE
GROW
Language is the key to Knowledge and Success.
BRIDGE COURSE
MATERIAL
FOR
ENGLISH
Grammar
Vocabulary
Communication
Writing
Reading
A B C D E F G
Hello
Hi
Bonjour
Hola
GRAMMAR
VOCABULARY
COMPREHENSION
WRITING
SPEAKING
"The more you learn, the more places you'll go.
ENGLISH opens doors to endless opportunities.
Reviewed by
Dr. Anita Tripathy
Prepared by
Dr. Anuja Khatua
Ms. Damayanti Khamari
Ms. Meararani Parida
English
Read
Understand
Practice
Improve
Succeed
ENGLISH LITERATURE
LANGUAGE SKILLS
COMMUNICATION SKILLS
READING SKILLS
Learn • Explore • Communicate • Excel
Better English Better Future

Bridge Course Material – English

Course Title: English **Total Duration: 10 Periods**

Course Objective

To develop students' sense of understanding, appreciation and ability of expression

Course Outcome

The students will be able to understand the subject matter taught through English medium of teaching and be able to develop their power of expression in an effective way.

Course Contents

UNIT–I: Grammar

Learning Outcomes

After completing this unit, students will be able to:

- Identify different parts of speech.
- Use correct tenses in sentences.
- Change sentences from active to passive voice.
- Convert direct speech into indirect speech and vice versa.

- ### 1. Parts of Speech
- #### Definition
- A **Part of Speech** is the grammatical function of a word in a sentence.
- **There are Eight Parts of Speech**

Part of Speech	Function	Example
Noun	Names a person, place, thing or idea	Ram, India, Book
Pronoun	Replaces a noun	He, She, They
Verb	Shows action or state	Run, Write, Is
Adjective	Describes a noun	Beautiful flower
Adverb	Describes a verb/adjective/adverb	Runs quickly

Part of Speech	Function	Example
Preposition	Shows relationship	In, On, Under
Conjunction	Joins words or sentences	And, But, Because
Interjection	Expresses emotion	Hurrah! Alas! Wow!

Examples

Sentence: *The intelligent boy answered the question quickly.*

Word	Part of Speech
The	Article
Intelligent	Adjective
Boy	Noun
Answered	Verb
The	Article
Question	Noun
Quickly	Adverb

Practice

Identify the Parts of Speech.

- She sings beautifully.
- Rahul is honest.
- We went to school.
- The cat slept under the table.
- Alas! He failed.

- ## 2. Tense

- ### Definition
- Tense tells us **when an action happens.**
- There are three main tenses.

- #### A. Present Tense

Type	Structure	Example

Type	Structure	Example
Simple Present	Subject + V_1	He plays cricket.
Present Continuous	is/am/are + V-ing	He is playing.
Present Perfect	has/have + V_3	He has played.
Present Perfect Continuous	has/have been + V-ing	He has been playing for two hours.

B. Past Tense

Type	Example
Simple Past	She wrote a letter.
Past Continuous	She was writing.
Past Perfect	She had written.
Past Perfect Continuous	She had been writing.

C. Future Tense

Type	Example
Simple Future	I will go.
Future Continuous	I will be going.
Future Perfect	I will have completed.
Future Perfect Continuous	I will have been working.

Common Time Words

Yesterday → Past

Today → Present

Tomorrow → Future

Practice

Change into the correct tense.

1. He _____(go) to school every day.
2. She _____(cook) now.
3. They _____(finish) the work yesterday.
4. I _____(visit) Delhi next month.

3. Voice Change

Definition

Voice tells whether the subject performs or receives the action.

Active Voice

Subject performs the action.

Example

Ram writes a letter.

Passive Voice

Subject receives the action.

A letter is written by Ram.

Formula

Active

Subject + Verb + Object

↓

Passive

Object + Helping Verb + V_3 + by + Subject

Examples

Active	Passive
He writes a letter.	A letter is written by him.
She cleaned the room.	The room was cleaned by her.
They will finish the work.	The work will be finished by them.

Practice

Change into Passive Voice.

1. The teacher teaches English.
2. The students completed the project.
3. The doctor examined the patient.

4. Direct and Indirect Speech

Direct Speech

The exact words are placed inside quotation marks.

Example:

Rita said, "I am happy."

Indirect Speech

The meaning remains the same but quotation marks are removed.

Rita said that she was happy.

Rules

Statement

said → said that

Present → Past

Pronouns change according to the subject.

Question

Use **asked**.

Example

He said, "Where are you going?"

↓

He asked where I was going.

Command

Use **ordered**, **requested**, **advised**.

Example

The teacher said, "Sit down."

↓

The teacher ordered the students to sit down.

Practice

Change into Indirect Speech.

1. She said, "I like coffee."
2. Mother said, "Do your homework."

UNIT–II: Introduction to Vocabulary Building (2 Periods)

Learning Outcomes

Students will be able to

1. Improve vocabulary.
2. Use appropriate words in speaking and writing.

1. Word Derivation

Definition

Word derivation means forming new words using prefixes and suffixes.

Prefixes

Prefix	Meaning	Example
Un	Not	Unhappy
Re	Again	Rewrite
Dis	Opposite	Disagree
Mis	Wrong	Misbehave

Suffixes

Suffix	Example
-ness	Happiness
-ful	Helpful
-tion	Education
-ment	Development

Practice

Make new words.

Happy → __________

Agree → __________

Write → __________

Develop → __________

2. Synonyms

Words having similar meanings.

Word	Synonym
Big	Large
Small	Tiny
Happy	Glad
Honest	Truthful

Word	Synonym
Fast	Quick
Rich	Wealthy
Begin	Start
End	Finish

3. Antonyms

Words having opposite meanings.

Synonym	Antonym
Hot	Cold
Good	Bad
Open	Close
Early	Late
Strong	Weak
Rich	Poor
Success	Failure
Light	Dark

4. Homophones

Words with the same pronunciation but different meanings.

Word	Meaning
Right	Correct
Write	Put words on paper
Sea	Ocean
See	To look
Flower	Blossom
Flour	Wheat powder
Son	Male child
Sun	Star

Practice

Choose the correct word.

1. I can ______(see/sea) the mountain.
2. She will ______(write/right) a letter.
3. The ______(sun/son) rises in the east.

UNIT–III: Writing Skill (3 Periods)

Learning Outcomes

Students will learn

1. Paragraph writing
2. Story writing
3. Reading comprehension

1. Paragraph Writing

A paragraph consists of

1. Topic sentence
2. Supporting details
3. Concluding sentence

A. Describing a Person

Example

My Mother

My mother is the most important person in my life. She is kind, caring, and hardworking. She helps everyone in our family. She teaches me good manners and encourages me to study well. I love and respect her very much.

B. Describing a Picture

Observe carefully.

Write about

- Place
- People
- Activities
- Weather
- Colours
- Feelings

Example

The picture shows a beautiful park. Children are playing happily. Some people are walking while others are sitting on benches. Trees and flowers make the park attractive. Everyone looks happy.

C. Describing an Event

Example

Independence Day Celebration

Our college celebrated Independence Day with great enthusiasm. The Principal hoisted the national flag. Students sang patriotic songs and participated in cultural programmes. The celebration ended with the National Anthem.

2. Connect the Clues and Frame a Story

Clues

Lion – Mouse – Trap – Help – Friendship

Story

One day a lion caught a mouse. The mouse requested the lion to spare its life. After a few days the lion was trapped in a hunter's net. The mouse came and cut the net with its sharp teeth. The lion was saved. They became friends.

Moral: Kindness is never wasted.

Practice

Frame a story from the clues.

Boy – Mango Tree – Stone – Nest – Birds

3. Reading Comprehension

Passage

Riya is a hardworking student. She studies regularly and completes her homework on time. She also helps her friends whenever they need assistance. Her teachers appreciate her honesty and discipline.

Questions

- Who is Riya?
- Why do teachers appreciate her?
- Does she help her friends?
- Write one quality of Riya.

UNIT–IV: Letter Writing (2 Periods)

Learning Outcomes

Students will be able to write simple personal letters.

Format of a Personal Letter

```
Sender's Address

Date

Dear ________,

Body of the Letter

Closing

Yours lovingly,

Name
```

1. Letter to Parents

Subject: Progress in College

BOSE Hostel
Cuttack

20 July 2026

Dear Father and Mother,

I am fine here and hope you are also doing well. My classes are going regularly. I attend all lectures and prepare for my examinations sincerely. The teachers are very helpful. I have also made many new friends.

Please do not worry about me. Convey my regards to grandparents and love to my younger brother.

Yours lovingly,

Rahul

2. Letter to a Friend

Inviting a Friend

Hostel
Cuttack

18 July 2026

Dear Amit,

How are you? I hope you are doing well. Our college is organizing its annual function next month. I invite you to attend the programme. We shall enjoy the cultural events together.

Please inform me about your arrival.

Yours lovingly,

3. Letter to Brother

Advice for Studies

BOSE Hostel
Cuttack

15 July 2026

Dear Brother,

I hope you are healthy and happy. I came to know that your examinations are near. Study regularly and revise your lessons every day. Avoid wasting time on mobile phones and television.

I wish you success in your examinations.

Yours affectionately,

Rahul

4. Letter to Sister

Congratulating on Success

BOSE Hostel
Cuttack

25 July 2026

Dear Sister,

Congratulations on your excellent performance in the examination. I am very happy to hear about your success. Continue your hard work and keep making us proud.

With best wishes for your bright future.

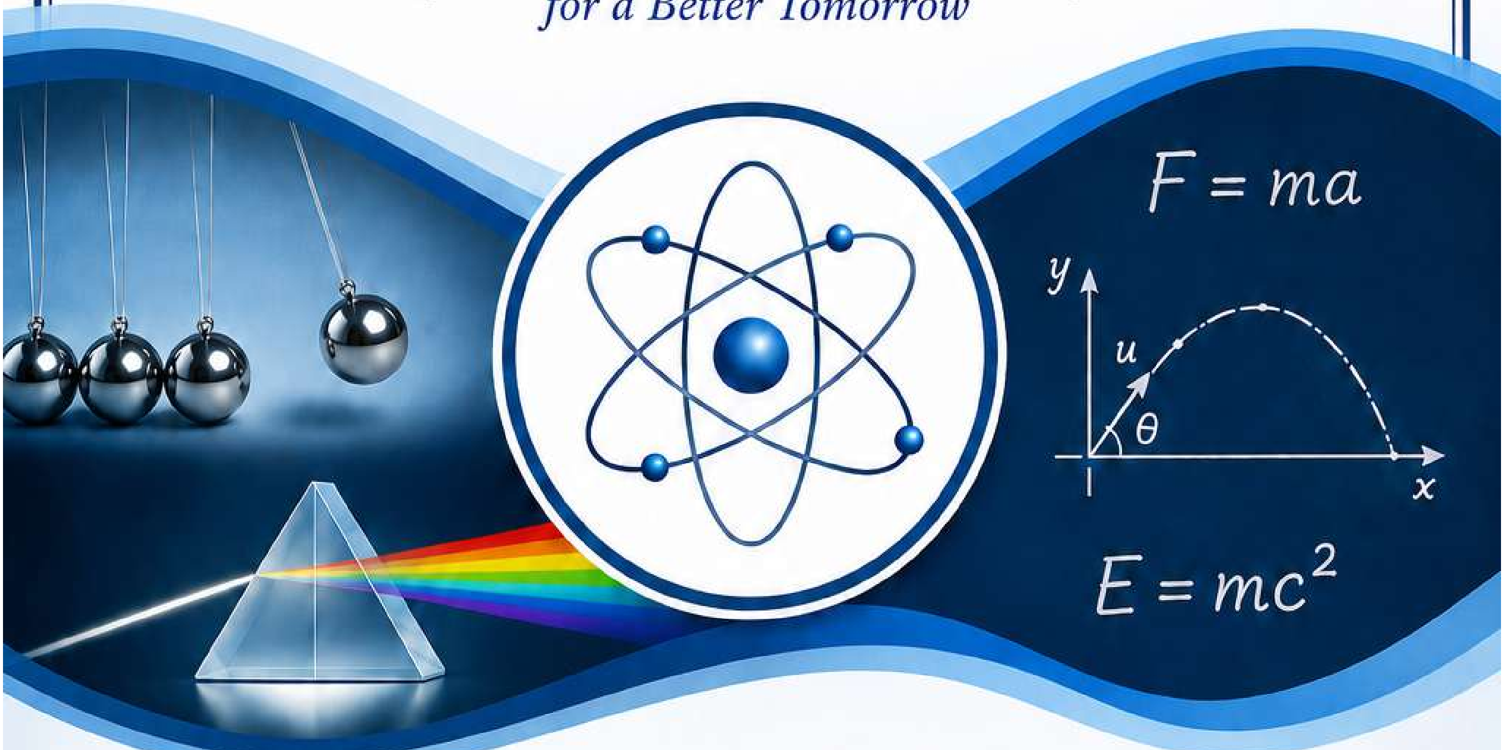
Yours lovingly,

Rahul

BRIDGE COURSE

PHYSICS

Building Strong Fundamentals for a Better Tomorrow



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UNIT - I

Fundamentals of Physical Quantities

Physical quantities

A physical quantity is one that can be measured and consists of a magnitude and unit.

Physical Quantities are of two types.

1. Fundamental Quantities 2. Derived Quantities

1. Fundamental physical quantities are **basic quantities** that cannot be expressed in terms of other physical quantities.
   Ex – Mass(kg), Length(metre), Time(second), Current (Ampere), Temperature (Kelvin), Amount of a substance (Mole), Luminosity (Candela)
2. The quantities that are expressed in terms of base quantities are called derived quantities.
   Ex – Speed(m/s), Velocity(m/s), acceleration(m/s^2), Force (Newton), Pressure (Pascal) etc.

Physical Quantity	Definition	Formula	SI Unit	Symbol
Distance	The total length of the path travelled by an object. It is a scalar quantity.	Speed × Time	metre	m
Displacement	The shortest straight-line distance from the initial to the final position. It is a vector quantity.	Final Position − Initial Position	metre	m
Velocity	The rate of change of displacement with time. It is a vector quantity.	Displacement / Time	metre per second	m/s
Acceleration	The rate of change of velocity with time.	Change in Velocity / Time	metre per second squared	m/s^2
Force	A push or pull that changes or tends to change the state of motion of an object.	Mass × Acceleration (**F = ma**)	newton	N
Linear Momentum	The product of the mass and velocity of an object.	Mass × Velocity (**p = mv**)	kilogram metre per second	kg·m/s
Work	Work is done when a force causes an object to move through a distance in the direction of the force.	Force × Displacement (**W = Fs**)	joule	J

Power	The rate at which work is done or energy is transferred.	Work / Time (**P = W/t**)	watt	W
Energy	The capacity to do work.	Kinetic Energy = ½ x Mass x $(\text{Velocity})^2$	joule	J
Pressure	The force acting per unit area.	Force / Area (**P = F/A**)	pascal	Pa
Density	The mass per unit volume of a substance.	Mass / Volume (**ρ = m/V**)	kilogram per cubic metre	kg/m^3
Volume	The amount of space occupied by an object or substance.	Length x Breadth x Height (V = lbh)	cubic metre	m^3

UNIT-2
FORCE AND MOTION

Concept of Rest and Motion

Rest

A body is said to be **at rest** if its position does not change with time with respect to its surroundings (reference point).

Example: A book lying on a table.

Motion

A body is said to be **in motion** if its position changes with time with respect to its surroundings.

Example: A moving car, a flying bird.

Equations of Motion Along a Straight Line

These equations are valid only for **uniformly accelerated motion**.

Let:

- **u** = Initial velocity (m/s)
- **v** = Final velocity (m/s)
- **a** = Acceleration (m/s^2)
- **t** = Time (s)

- **s** = Displacement (m)

First Equation of Motion

$$v = u + at$$

Second Equation of Motion

$$s = ut + \frac{1}{2}at^2$$

Third Equation of Motion

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

Concept of Inertia, Momentum and Force

Inertia

It is the property of the body by virtue of which body is unable to change its state of rest or motion or direction without the help of an external force.

Types of Inertia

- **Inertia of Rest:** A stationary body tends to remain at rest.

  Ex - When a stationary bus abruptly starts, a standing passenger's feet move with the bus, but their upper body stays at rest, making them fall backward.

- **Inertia of Motion:** A moving body tends to continue moving with the same speed.

  Ex - When a moving bus halts suddenly, passengers are thrown forward because their upper bodies continue moving at the bus's original speed.

- **Inertia of Direction:** A body tends to continue moving in the same direction.

  Ex - When riding a bike or sitting in a car that takes a sharp turn, your body tends to lean or slide outward because your inertia forces you to continue traveling in your original straight line.

Momentum

Momentum is the quantity of motion possessed by a moving body.

Formula

$$p = mv$$

Where:

- **p** = Momentum
- **m** = Mass
- **v** = Velocity

- **SI Unit:** kg·m/s

Key Points

- Momentum is a **vector quantity**.
- Greater mass or velocity means greater momentum.

Force

A **force** is a push or pull that changes or tends to change the state of motion of an object.

Formula

$$F = ma$$

Where:

- **F** = Force
- **m** = Mass
- **a** = Acceleration
- **SI Unit:** Newton (N)

Newton's Laws of Motion

First Law of Motion (Law of Inertia)

Statement:
Every object remains at rest or continues to move with uniform velocity in a straight line unless acted upon by an external unbalanced force.

Example:
A football remains at rest until it is kicked.

Second Law of Motion

Statement:
The rate of change of momentum of a body is directly proportional to the applied force and occurs in the direction of the force.

Mathematical Form

$$F = ma$$

Example:
A Cricket Player moves his hand in backward direction while catching the ball.

Third Law of Motion

Statement:
For every action, there is an equal and opposite reaction.

Example:

- Recoil of a gun.
- Rocket launch.
- Walking on the ground.

Difference Between Mass and Weight

Mass	Weight
Amount of matter in a body.	Gravitational force acting on a body.
Scalar quantity.	Vector quantity.
SI unit: kilogram (kg).	SI unit: newton (N).
Constant everywhere.	Changes with gravity.
Symbol: **m**	Symbol: **W**
Formula: No formula required.	**W = mg**, where *g* is acceleration due to gravity.

UNIT–III: Work, Power and Energy

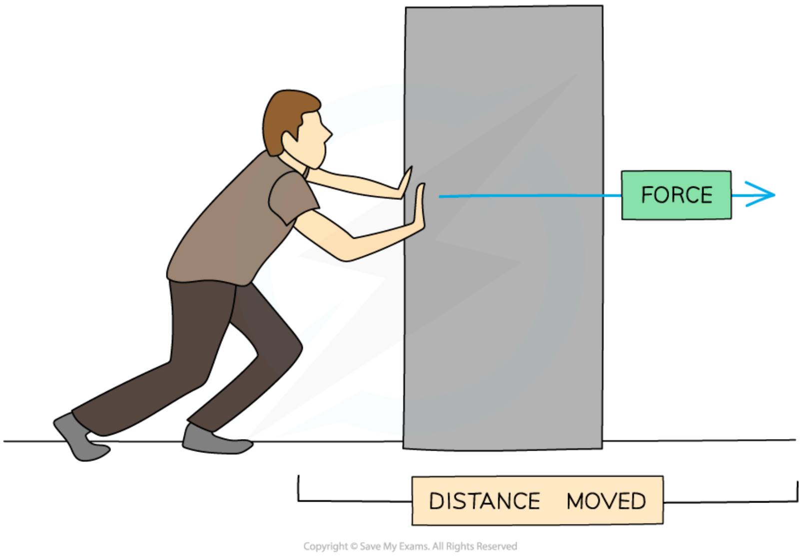
Work: Work is said to be done if a force, acting on a body, displaces the body through a certain distance and the force has some component along the displacements.
The work done can be calculated using the equation:

$$W = Fs$$

Where:

- W = work done (J)
- F = constant force applied (N)
- s = displacement (m)

In the diagram below, the man's pushing force on the block is doing work as it is transferring energy to the block



Units of Work: C.G.S. System: erg**,** S.I. joule (J)

Power: The rate at which work is done is called power.

If work is done at a uniform rate, average power P is defined as $P = \frac{W}{t}$

Units of Power: C.G.S. system: erg s^{-1}, S.I. watt (W) or J/s

1 horse power (hp) = 746 W

Energy: It is the ability of the body to do some work.

Greater the amount of energy contained in the body, greater work it will be able to do.

Examples:

(i) A speedy bullet is able to penetrate a block of wood, thus doing work against friction**.**

(ii) A fast blowing wind is able to turn a wheel.

(iii) A fan starts rotating when electricity is fed to it.

(iv) A nail is driven into wood when it is struck, with a hammer, at its head.

Units: SI unit of energy is joule and C.G.S unit is erg.

Energy is broadly divided into two types. Kinetic Energy (due to motion) & Potential Energy (due to position/configuration).

Potential Energy: The energy acquired by a body by virtue of its position or configuration is called potential energy.

Mathematical expression: Gravitational P.E. = mgh, where m is mass of the object, g is acceleration due to gravity, h is height of the object above a reference point.

Examples:

(i) To stretch a spring, work has to be done against elastic force. This work is stored in it in the form of potential energy.

(ii) A wire hanging vertically from a support and loaded at the other acquires potential energy.

(iii) water stored in a reservoir on a hill has potential energy stored in it. On falling down the potential energy is converted to electric energy in hydraulic dams.

Kinetic Energy: Energy possessed by a body by virtue of its motion is called kinetic energy.

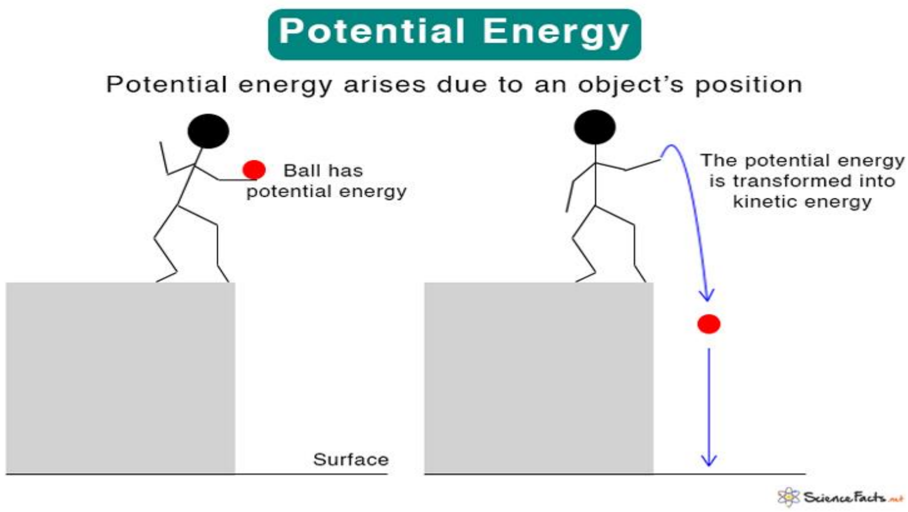
Mathematical expression: $K = \frac{1}{2}mv^2$, where m is the mass of the object and v is its velocity.

Examples:

A moving car: A heavier vehicle moving at 60 km/hr has vastly more kinetic energy than a lighter car at the same speed.

Wind: Moving air molecules possess kinetic energy, which wind turbines convert into electricity.

A rolling or thrown ball: A baseball sailing through the air has kinetic energy that transfers to the bat upon impact.



Law of Conservation of Energy:

This law was first stated by Robert Mayor in 1842. It states that,

"Energy can neither be created nor destroyed; it can only be transformed from one form to another. The sum total of energy, in this universe, is always same."

UNIT–IV: Optics

Reflection of Light: It is defined as the phenomenon in which a part of light incident on a surface returns back to the first medium.

Examples:

1. Looking in a Mirror

When you stand in front of a mirror, the light from your face hits the mirror's surface and bounces back to your eyes, forming a clear image. This is called specular reflection, which happens on smooth, polished surfaces. It's why mirrors are used in bathrooms, dressing rooms, and telescopes to give a crisp, accurate reflection of the object in front.

2. Seeing Moonlight

Ever wondered how the moon glows at night when it doesn't have its own light? The moon reflects the sunlight that hits its surface. Since the moon's surface is uneven, the light reflects in multiple directions, giving us that soft white glow. It's a natural example of diffuse reflection, bright enough to light up the entire night sky.

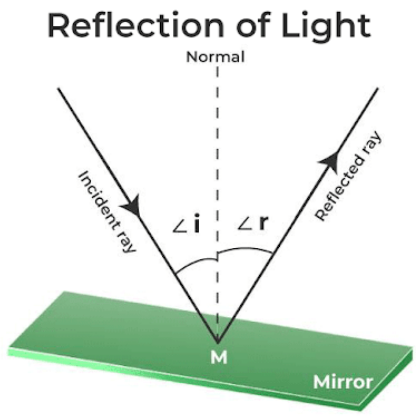
3. Shiny Table Surface

If you place a glass or steel plate on a table near a window, you'll often see light spots or reflections on it. Polished wood, marble, or metal reflects light coming from lamps or the sun. The smoother the surface, the more accurate the reflection, making it easier to see the source of light.

Laws of Reflection:

1st law: The incident ray, the reflected ray and the normal to the surface at the point of incidence all lie in the same plane and that plane is perpendicular to the reflecting surface.

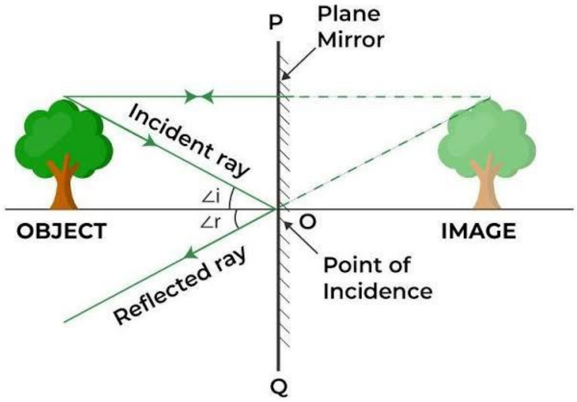
2nd law: The angle of incidence is equal to the angle of reflection.



Plane and Spherical Mirrors:

Plane Mirror: It is flat and creates a virtual, laterally inverted image that is the exact same size as the object.

- **Image Properties:** The image formed is virtual (cannot be projected onto a screen), upright, and located as far behind the mirror as the object is in front. It is also laterally inverted, meaning left and right are reversed.
- **Applications:** Everyday household items like bathroom mirrors and dressing rooms.

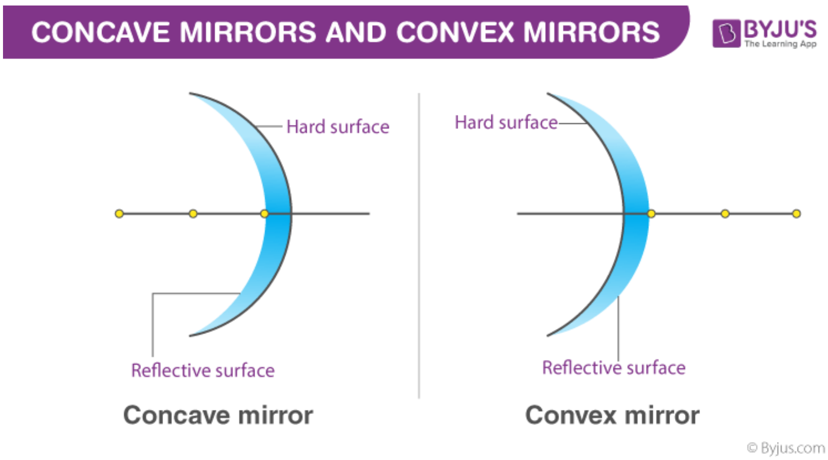


Spherical Mirror: It is curved (like part of a sphere) and alters the size, orientation, and type (real or virtual) of the reflected image.

Spherical mirrors are sections of a hollow sphere and are divided into two categories:

Concave Mirrors: Curved inward like a cave. They can form both real/inverted and virtual/magnified images depending on how far the object is from the surface. They are used as makeup mirrors, in car headlights, and in astronomical telescopes.

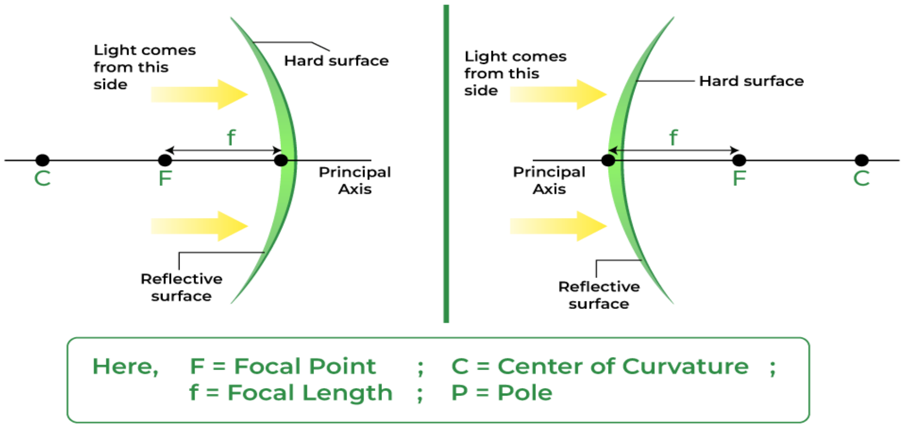
Convex Mirrors: Curved outward. They always produce a virtual, upright, and diminished image. Because they provide a wider field of view, they are used as passenger-side wing mirrors in cars and in security mirrors.



The essential parts of both mirrors are defined below:

- **Pole (P):** The geometric centre or midpoint of the mirror's reflective surface is called the pole.
- **Centre of Curvature (C):** It is the centre of the imaginary, perfect sphere from which the mirror is cut. For a concave mirror, C sits in front of the reflecting surface; for a convex mirror, it sits behind it.
- **Radius of Curvature (R):** it is the total distance from the Pole (P) to the Centre of Curvature (C).
- **Principal Axis:** It is an imaginary straight, horizontal line passing directly through the centre of the mirror, connecting the Pole (P) and the Centre of Curvature (C).
- **Principal Focus (F):** It is the point on the principal axis where light rays parallel to the axis either converge (in a concave mirror) or appear to diverge from (in a convex mirror). It is located exactly halfway between the Pole (P) and Centre of Curvature (C).
- **Focal Length (f):** It is the distance measured from the Pole (P) directly to the Principal Focus (F).

- **Aperture:** The diameter of the exposed, reflective circular area of the mirror is called its aperture. It determines the amount of light the mirror can capture.



Refraction of Light: It is the phenomenon by virtue of which a ray of light going from one medium to the other undergoes a change in its velocity.

Examples:

1. Pencil Appears Bent in Water

Place a pencil in a glass of water. It appears bent or shifted. This happens due to refraction as light travels from water to air.

2. Rainbow Formation

Rainbows form when sunlight passes through water droplets in the air. Light bends (refracts), reflects inside the droplet, and refracts again, creating a spectrum.

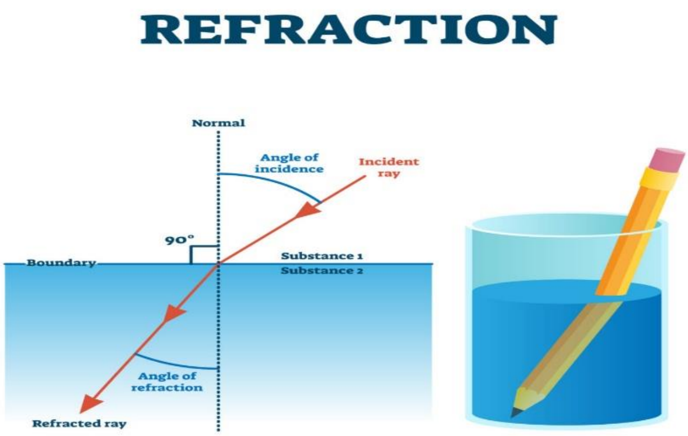
3. Twinkling of Stars

Stars twinkle due to refraction caused by layers of air in Earth's atmosphere. Light bends slightly as it travels through varying air densities.

Laws of Refraction:

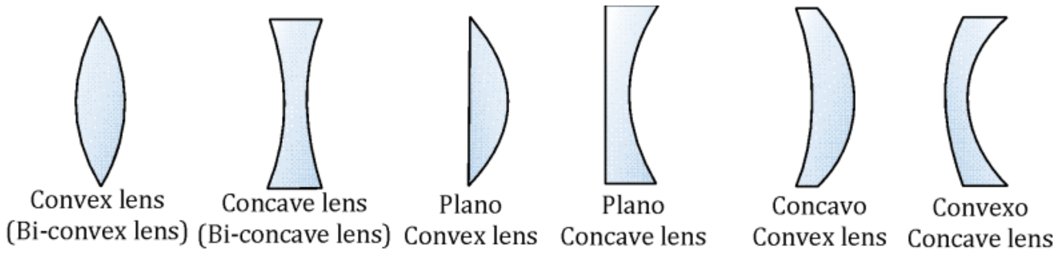
1st law: The incident ray, the refracted ray and the normal to the interface at the point of incidence all lie in the same plane.

2nd law: The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant. $\frac{\sin i}{\sin r} = \text{Constant}$ This is also known as Snell's law.



Lenses: A lens is a transmissive optical device that refracts light to focus or disperse it.
Depending on the application, lenses are used to correct vision (eyeglasses, contact lenses), capture photographs (camera lenses), or magnify images (microscopes, telescopes). A lens is bounded by two surfaces of regular geometrical shape such as spherical, plane, cylindrical or parabolic.
Lens whose surface is portion of a sphere is called a spherical lens. Spherical lenses are of two types:

Convex (Converging) Lenses: Thicker at the centre than at the edges. These refract parallel light rays to a specific focal point and are used for magnification and correcting farsightedness.
Concave (Diverging) Lenses: Thinner at the centre than at the edges. These spread light rays apart and are primarily used to correct nearsightedness.



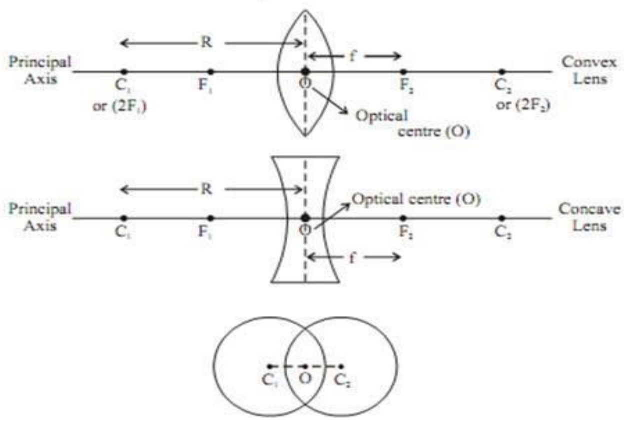
Different types of lenses

Key parts of a lens:

- **Optical Centre (O)**: It is the exact central point of a lens. Any ray of light passing through this point continues straight without any deviation or refraction.
- **Principal Axis**: It is the imaginary horizontal straight line that passes directly through the optical centre and the centre of curvature of both lens surfaces.
- **Centre of Curvature (C_1 and C_2)**: A lens has two spherical surfaces, each representing a section of a full sphere. The centres of these imaginary spheres are the centres of curvature.
- **Radius of Curvature (R)**: It is the distance between the optical centre (O) and either centre of curvature.
- **Principal Focus (F)**:

  Convex Lens: The point on the principal axis where light rays traveling parallel to the axis converge after refraction is called the principal focus.

  Concave Lens: The point on the principal axis where parallel light rays appear to diverge (spread out) from after refraction is called the principal focus.
- **Focal Length (f)**: It is the distance between the optical centre and the principal focus. A **convex** lens has a positive focal length, while a **concave** lens has a negative focal length.
- **Aperture**: The effective diameter of the circular outline of the lens is called its aperture. It dictates the amount of light the lens can gather.



UNIT –V Heat Phenomena

Concept of Heat and Temperature:

Heat is the Thermal Energy and Temperature is the quantification of this energy. Here we will understand the concept of these quantities, and be able to differentiate between them. Heat and Temperature are not the same quantities, although we sometimes use them interchangeably.

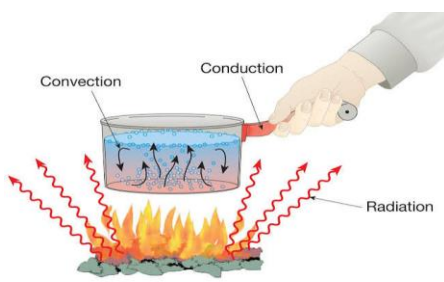
Heat:- Heat is a form of energy transferred from a hotter body to a colder body because of a difference in temperature. Heat transfer continues until both bodies reach the same temperature. E.g. working of steam engine.

UNITS: In C.G.S. erg, In M.K.S / S.I Joules (J) , In F.P.S British Thermal Unit (BTU)

Temperature:- Temperature is the degree of hotness or coldness of an object. Temperature is the measure of average kinetic energy of molecular motion and is a measure of heat. E.g. measurement of room temperature.

UNITS: In C.G.S. Celsius (^oC), In M.K.S / S.I Kelvin (K) , In F.P.S Fahrenheit (^oF)

Modes of Heat Transfer:- There are three modes of heat transfer. Such as :- Conduction, Convection & Radiation **.**



Conduction: In solids like metals, heat transfers via molecular vibrations of the molecules which are in direct contact with each other. In this case, heat is transferred without the actual movement of particles, but by vibration and collision. This method of heat transfer is known as conduction. The medium is required for heat transfer in case of conduction in solids. E.g. Heating one end of a metal rod (solid) makes the other end hot.

Convection: In fluids like water or air, the transfer of heat takes place due to the actual movement of particles from one place to another is known as convection. The heat transfers though convection can occur in a vacuum. In both conduction and convection, heat spreads across all parts of the medium while trying to reach an equilibrium state. E.g. Circulation of hot air in a room using a heater, or boiling water in a pot.(liquid/gas).

Radiation: Radiation is the transfer of heat energy from one place to another without the need for any medium. Heat is transferred through electromagnetic waves. Radiation does not require a medium (solid , liquid or gas).It can travel through vacuum. All hot objects emit radiant energy. E.g. Heat from the Sun reaching the Earth, Feeling warmth from a hot wire without touching it, warmth around a hot iron kept at distance.

Unit VI Current & Electricity

Electric Current:

Electric current is defined as the rate of flow of electric charge (say electrons) through a cross section of a conductor.

Mathematically, Electric current (I) = $\frac{\text{Total charge flow (q)}}{\text{Time taken (t)}}$

Its SI unit is ampere (A)

Electric potential difference:

The amount of work done to move a unit positive charge from one point to another point inside the electric field is known as Electric potential difference.

Mathematically, Electric potential difference = $\frac{\text{Work done(w)}}{\text{Charge(q)}}$

Its SI unit is Volt (V)

Resistance:

Resistance is the property of material by virtue of which it opposes the flow of charge through it.

Mathematically, Resistance (R) = $\frac{\text{Electric potential (v)}}{\text{Electric current(I)}}$

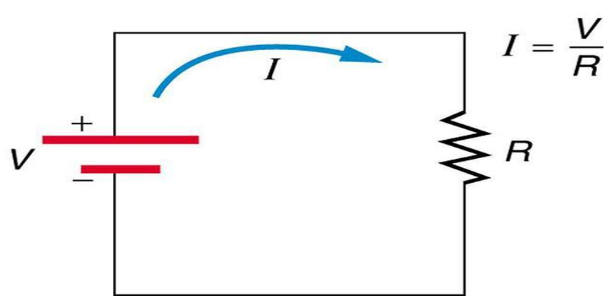
SI unit of resistance is ohm (Ω).

Ohm's Law:

The current flowing through a conductor is directly proportional to the potential difference applied across the end of the conductor provided that all the physical conditions and temperature remain constant.

$$I \propto V \Rightarrow V = IR$$

Where I is electric current, V is Potential difference & R is resistance of the conductor.



BRIDGE COURSE ON CHEMISTRY

Prepared by:

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Bridge Course Syllabus – Chemistry

Course Title: Chemistry **Total Duration: 10 Periods**

Course Objective

To strengthen students' understanding of the fundamental concepts of Chemistry and prepare them to learn Applied Chemistry by revising essential topics in nature of matters, atoms, molecules, atomic structure, Chemical reactions, Acids, bases and salts, etc.

Course Outcomes (COs)

CO1: Explain fundamental physical quantities, units, motion, force, momentum, and Newton's laws, and solve basic numerical problems related to mechanics.

CO2: Apply the concepts of work, power, energy, conservation of energy, and distinguish between mass and weight in practical situations.

CO3: Describe the principles of reflection, refraction, mirrors, lenses, heat, temperature, and modes of heat transfer, and explain their everyday applications.

CO4: Analyze basic electrical circuits using the concepts of electric current, potential difference, resistance, and Ohm's law to solve simple engineering and practical problems.

Topic-wise Distribution of Periods **Total Periods=10**

Sl. No.	Topic	Periods
1	**Composition of Matter**	2
2	**Atoms and Molecules**	2
3	**Writing Chemical Formulae**	2
4	**Solutions**	2
5	**Basic Concepts of Atomic structure**	2

Course Contents

UNIT-I: Composition of Matter **2 Periods**

- Classification of Matters
- Compounds and Mixtures

UNIT–II: Atoms and Molecules **2 Periods**

- Atoms, Molecules, Compounds, Atomic numbers
- Atomic mass, mass number, molecular mass and equivalent mass

UNIT–III: Writing Chemical Formulae **2 Periods**

- Symbol, Valency and Chemical formula
- Steps involved in writing chemical formulae

UNIT–IV: Solutions **2 Periods**

- Solutes, solvents and solutions
- Acids, bases and salts
-

UNIT–V: Basic Concepts of Atomic structure **2 Period**

- Electrons, Protons and Neutrons
- Introduction to Atomic models

Reference Books

- Physical Science Book – Class IX, X, BSE Odisha
- NCERT Chemistry Classes IX & X

UNIT-I: Composition of Matter

Matter is anything that has certain mass and occupies some space. It is fundamentally categorized by its **physical state** (how particles interact) and its **chemical composition** (what it is made of).

Classification of matters

1. Physical Classification (States of Matter)

- **Solid:** Definite shape and definite volume; particles are tightly packed and vibrate in fixed positions.
- **Liquid:** Definite volume but indefinite shape; particles are close together but can move and slide past one another.
- **Gas:** Indefinite shape and indefinite volume; particles are widely separated and move freely.

2. Chemical Classification

A. Pure Substances

Substances with a fixed chemical composition and distinct properties that cannot be separated by physical methods:

- **Elements:** The simplest pure substances made of only one type of atom (e.g., Gold Oxygen, hydrogen, copper, etc.)
- **Compounds:** Pure substances made of two or more elements chemically bonded together in a fixed ratio. Examples: Water (H_2O), Carbon Dioxide (CO_2)

B. Mixtures

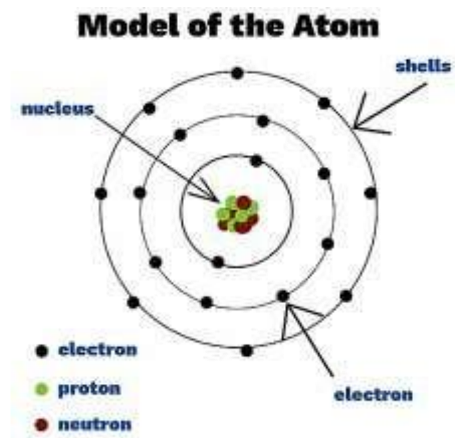
Combinations of two or more substances physically mixed in variable proportions, meaning they can be separated by physical means like filtration, distillation, etc.

- **Homogeneous Mixtures:** Uniform composition throughout (e.g., saltwater, air, brass).
- **Heterogeneous Mixtures:** Non-uniform composition where individual components remain distinct and visible (e.g., sand and water, oil and water)

UNIT–II: Atoms and Molecules

Atoms:

An atom is the basic building block of all matter and the smallest unit of an element that retains its chemical properties. Everything in the universe is made of atoms, which measure about 10^{-10} meters across and are composed of three primary subatomic particles:



- **Protons:** Positively charged particles that, along with neutrons, make up the atom's central nucleus.
- **Neutrons:** Uncharged (neutral) particles located in the nucleus.
- **Electrons:** Lightweight, negatively charged particles that orbit the nucleus in a dynamic cloud.

Molecules:

A molecule is the smallest fundamental unit of a chemical compound that can take part in a chemical reaction. It consists of two or more atoms held together by chemical bonds. These can be atoms of the same element (e.g., O_2) or different elements (e.g., H_2O).

Atomic Number (Z):

The atomic number (represented by the symbol Z) is the total number of protons present in the nucleus of an atom. It uniquely identifies a chemical element; for example, all carbon atoms have an atomic number of 6 because they contain 6 protons. In a neutral atom, it also equals the number of electrons.

Atomic Mass:

The atomic mass of an element may be defined as the relative average mass of one atom of the element as compared to the mass of an atom of carbon (C-12) taken as 12. For example, the atomic mass of Carbon is 12 amu.

Mass Number (A):

The mass number of an element may be defined as the total number of protons and neutrons present in atom of the element.

Mass Number (A) = No. of Protons (P) + No. of Neutrons (N)

Example:

Element	No of Protons	No of Neutrons	Mass Number
C	6	6	12
N	7	7	14
Na	11	12	23

Molecular Mass

Molecular mass is the total mass of a single molecule, calculated by summing the atomic masses of all its constituent atoms.

Examples:

Molecule	Molecular formula	Molecular mass
Water	H_2O	2+16 = 18 amu
Carbon dioxide	CO_2	12+32 = 44 amu
Sulphuric Acid	H_2SO_4	2+32+64 = 98 amu

Equivalent Mass:

The equivalent mass of a substance may be defined as "the no of parts by mass of it which combines with or displaces directly or indirectly 1.008 parts by mass of H, 35.5 parts by mass of Cl or 8 parts by mass of O". Equivalent mass has no unit.

Examples:

The equivalent mass of Ca in $CaCl_2$ can be calculated as follows:

In $CaCl_2$,

2x35.5 parts by mass of Cl combines with Ca = 40 parts

Hence, 35.5 parts by mass of Cl combines with Ca = $\frac{40}{2\times 35.5} \times 35.5 = 20$.

Thus, the equivalent mass of Ca in $CaCl_2$ is 20.

Equivalent mass of Acids:

The equivalent mass (or equivalent weight) of an acid is the mass that can donate one mole of protons (H^+ ions) during a reaction. It is calculated by dividing the acid's molar mass by its basicity.

$$Equivalent\ mass\ of\ Acid = \frac{Molecular\ mass}{Basicity}$$

Basicity: The number of ionizable (replaceable) hydrogen atoms per molecule of the acid.

Example:

$$Equivalent\ mass\ of\ H_2SO_4 = \frac{Molecular\ mass}{Basicity} = \frac{98}{2} = 49$$

Equivalent mass of Base:

The equivalent weight of a base is the mass that provides one mole of OH^- ions. It is calculated by dividing the base's molar mass by its acidity (the number of replaceable hydroxyl ions per molecule).

Basicity: The number of ionizable (replaceable) hydroxyl ions per molecule of the base.

Example:

$$Equivalent\ mass\ of\ Ca(OH)_2 = \frac{Molecular\ mass}{Acidity} = \frac{74}{2} = 37$$

Equivalent mass of Salt:

The equivalent weight of a salt is its molar mass divided by its valency factor (n-factor). The n-factor is the total positive or negative charge of the ions in one formula unit of the salt.

$$Equivalent\ mass\ of\ Salt = \frac{Molecular\ mass}{n - factor}$$

Example:

$$Equivalent\ mass\ of\ CaCl_2 = \frac{Molecular\ mass}{n - factor} = \frac{111}{2} = 55.5$$

UNIT–III: Writing Chemical Formulae

Symbol:

The short hand representation of one atom of an element is called chemical symbol.

Examples: Hydrogen (H), Nitrogen (N), Sodium (Na), Gold (Au), etc.

- Symbols derived from the 1st capital letter of the element: Examples: Hydrogen (H), Nitrogen (N), Oxygen (O), etc.
- Symbols derived from two letters: Examples- Helium (He), Calcium (Ca), Magnesium (Mg), etc.
- Symbols derived from Latin Names: Examples- Sodium (Na)- Latin name- Natrium, Gold (Au)- Latin Name- Aurum, etc.
- Symbols derived from City, University, Country, etc.: Californium (C_f) University of California, Americium (Am)- America, etc.
- Symbols derived from names of scientists: Rutherfordium (R_f)- Rutherford, Einsteinium (E_S) – Einstein, etc.
- Symbols derived from Names of Planets: Examples: Uranium (U) – Uranus, Neptunium (N_P) – Neptune, etc.

Valency:

The combining capacity of an element is called its valency. The valency of an element may be defined as the number of electrons lost, gained or shared by one atom of the element to attain the nearest inert gas configuration.

Valencies of some elements are given below:

H, Li, Na, K, Rb = 1

Be, Mg, Ca, Ba, Sr = 2

B, Al, Ga = 3

C, Si, Ge = 4

Radicals or Ions:

An atom or group of atoms having positive or negative charge/s is called a radical or ion.
Examples: Sodium ion (Na^+), Oxide ion (O^{2-}), Carbonate ion (CO_3^{2-}), etc.

Classification of radicals:

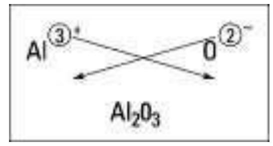
1. **Electropositive Radicals:** The radicals having unit positive charge/s are called electropositive radicals, basic radicals or cations. Examples: Sodium ion (Na^+), Ammonium Ion (NH_4^+), Calcium ion (Ca^{2+}), etc.
2. **Electronegative Radicals:** The radicals having unit negative charge/s are called electronegative radicals, acid radicals or anions. Examples: Chloride ion (Cl^-), Oxide Ion (O^-), Carbonate ion (CO_3^{2-}), etc.

Chemical formula:

- The shorthand representation of one molecule of a substance with the help of symbols and subscript numbers is called a chemical formula. Examples: Water (H_2O), Carbon Dioxide (CO_2)

Steps involved in writing chemical formulae:

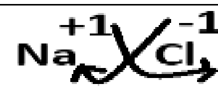
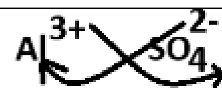
1. Write the symbols of the cation and anion side by side with their valencies at the top.
2. Cancel any common factors between the valencies.
3. Criss-cross the valencies as shown in the side.



Note:

- The valency '1' is not indicated in the formula.
- Multiple number of compound radicals are written inside parenthesis.

Examples:

Molecule	**Cation-Anion**	**Cancelling Common factor**	**Criss-Crossing**	**Chemical formula**
Sodium Chloride	Na^{+1} Cl^{-1}	Na^{+1} Cl^{-1}		NaCl
Aluminium Sulphate	Al^{3+} SO_4^{2-}	Al^{3+} SO_4^{2-}		$Al_2(SO_4)_3$

UNIT–IV: Solutions

A solution is formed when one substance (the solute) is evenly distributed and dissolved into another substance (the solvent). Examples: Salt solution, sugar solution, etc.

Solute: The substance being dissolved (e.g., salt or sugar) in a medium is called a solute.

Solvent: The substance doing the dissolving, typically present in a larger amount (e.g., water) is called a solvent.

Types of solutions: Solutions can exist in various states of matter. Examples include liquids (saltwater), gases (the air we breathe), and solids known as alloys (such as brass or steel). Also solutions may be classified as homogeneous solutions and heterogeneous solutions.

One important parameter of a solution is the concentration, which is a measure of the amount of solute in a given amount of solution or solvent.

The term "aqueous solution" is used when one of the solvents is water.

Solutions may be of three basic types: solid solutions, liquid solutions and gaseous solutions.

Type of Solution	Solute	Solvent	Common Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	Chloroform mixed with nitrogen gas
	Solid	Gas	Camphor in nitrogen gas
Liquid Solutions	Gas	Liquid	Oxygen dissolved in water
	Liquid	Liquid	Ethanol dissolved in water
	Solid	Liquid	Glucose dissolved in water
Solid Solutions	Gas	Solid	Solution of hydrogen in palladium
	Liquid	Solid	Amalgam of mercury with sodium
	Solid	Solid	Copper dissolved in gold

ACIDS: Substances which are sour in taste are known as acids.

EX- Curd, lemon juice, orange juice and vinegar taste sour. The acids in these substances are natural acids.

Name of acid	Found in
Acetic acid	Vinegar
Formic acid	Ant's sting
Citric acid	Citrus fruits such as oranges, lemons
Lactic acid	Curd

Also acids are those chemical substances that when dissolved in water they release H^+ ions.

Example of Acid: HCl, HNO_3, H_2SO_4, CH_3COOH etc.

$HCl\ (water) \rightarrow H^+ (aq) + Cl^- (aq)$

BASES: Substances which are bitter in taste and feel soapy on touch are known as bases.

EX:- Calcium hydroxide, Ammonium hydroxide, Sodium hydroxide, Potassium hydroxide etc.

Name of base	Found in
Calcium hydroxide	Lime water
Sodium hydroxide/ Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia

Also bases are those chemical substances which when dissolved in water release OH^- ions.

EX:- $NaOH(s)\ (\boldsymbol{water}) \rightarrow Na^+ (aq) + OH^- (aq)$

Special type of substances are used to test whether a substance is acidic or basic. These substances are known as indicators. The indicators change their colour when added to a solution containing an acidic or a basic substance. Acidic substances turn blue litmus paper red and basic substances turn red litmus paper blue.

SALT:- The reaction between an acid and a base is known as neutralization reaction. In neutralization reaction a new substance is formed called salt.

Acid + Base → Salt + Water

Salts are regarded as ionic compounds made up of positive and negative ions. The positive part comes from a base while negative part from an acid.

EX:- NaCl, KCl, $CaCl_2$, $MgCl_2$, $NaNO_3$, KNO_3, Na_2SO_4, K_2SO_4 etc.

UNIT–V: Basic Concepts of Atomic structure

An atom is the basic building block of matter consisting of three subatomic particles: electrons, protons, and neutrons. While John Dalton originally suggested that atoms were indivisible, later discoveries proved they have an internal structure. Protons and neutrons are present inside the central nucleus, while electrons revolve around it. For explaining this, many scientists proposed various atomic models.

Subatomic Particles

Atoms contain three primary particles with distinct properties:

Electrons: Discovered by J.J. Thomson using cathode ray experiments. They carry a negative charge (-1) and have negligible mass.

Protons: Discovered by E. Goldstein in canal ray experiments. They carry a positive charge (+1) and a mass of 1u.

Neutrons: Discovered by James Chadwick. They carry no charge (neutral) and have a mass of 1u, equal to a proton.

Evolution of Atomic Models:

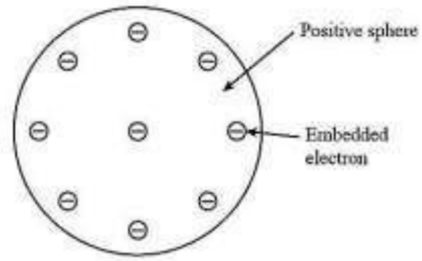
1. Thomson's Model of an Atom:

J.J. Thomson was the first one to propose a model for the structure of an atom. According to him, an atom is similar to that of a Christmas pudding. The electrons, in a sphere of positive charge, were like currants (dry fruits) in a spherical Christmas pudding. It is also called plum pudding model or watermelon model.

Thomson proposed that:

(i) An atom consists of a positively charged sphere and the electrons are embedded in it.

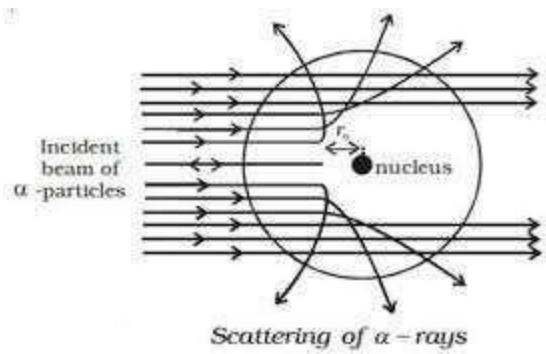
(ii) The negative and positive charges are equal in magnitude. So, the atom as a whole is electrically neutral.



[Fig.: Thomson's model of an atom]

2. Rutherford's Model of an Atom:

Ernest Rutherford was interested in knowing how the electrons are arranged within an atom. Rutherford designed an experiment and bombarded gold foil with alpha particles (positively charged He^{2+} ions).



[Fig.: Rutherford's Scattering Experiment]

Observations:

- Most particles passed straight through the foil, proving the atom is mostly empty space.
- A few were deflected at small angles, indicating the presence of a heavy central positive charge.
- A tiny fraction (about 1 in 20,000) bounced straight back, indicating that the size of the nucleus is quite small.

Conclusions:

- There is a positively charged centre in an atom called the nucleus. Nearly all the mass of an atom resides in the nucleus.
- The electrons revolve around the nucleus like planets revolve around the sun.
- The size of the nucleus is very small as compared to the size of the atom.

Drawbacks:

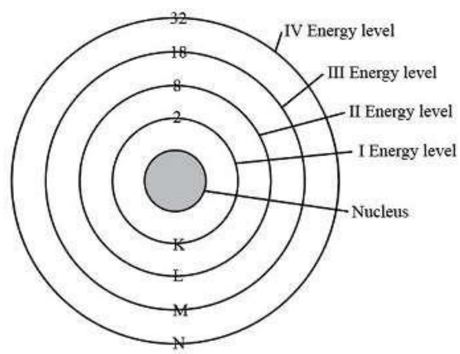
The model couldn't explain atomic stability, as spinning electrons should lose energy and collapse into the nucleus, making matter unstable, which contradicts observations.

3. Bohr's Model of an Atom:

In order to overcome the objections raised against Rutherford's model of the atom, Neils Bohr put forward the following postulates about the model of an atom:

- Electrons revolve around a positively charged nucleus in fixed, circular orbits. These orbits have specific energy levels (energy shells).

- Electrons do not lose or radiate energy while staying in their designated paths.
- Orbits are represented by integers (n = 1, 2, 3, 4…) or letters (K, L, M, N…) starting from the nucleus.
- The shell closest to the nucleus has the lowest energy, and energy increases as you move to shells farther away.
- An electron can jump from a lower to a higher energy level by *absorbing* energy, and it emits energy when jumping from a higher to a lower level.



- The maximum number of electrons present in a shell is given by the formula $2n^2$, where 'n' is the orbit number or energy level index.
- Hence the maximum number of electrons in different shells are as follows:

first orbit or K-shell will have = 2 × 12 = 2 electrons,
second orbit or L-shell will have = 2 × 22 = 8 electrons,
third orbit or M-shell will have = 2 × 32 = 18 electrons,
fourth orbit or N-shell will have = 2 × 42 = 32 electrons, and so on.

Bridge Course

on

Mathematics

Prepared by:

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Bridge Course Syllabus Mathematics

Course Objective

The Students will able to understand the fundamental concepts of mathematics and apply it in different engineering fields.

Course Outcomes

Co1:- Apply Concepts of arithmetic and algebra to solve real life quantitative problems .

CO2:- Apply trigonometry to solve practical problems in Mathematics, Physics and engineering fields

CO3- Apply Co-ordinate geometry to represent point, line and geometrical figures in Co-ordinate plane and solve scientific, engineering and real world problems

Topic wise Distribution of periods **Total period-11**

Sl no	Topics	Periods
1	Basic Arithmetic	2
2	Algebra	3
3	Trigonometry	3
4	Co-ordinate Geometry	3

Course Content

Unit-1. Basic Arithmetic

1.1 :- Number system :- Natural numbers, Integers, Rational numbers, Irrational numbers and real numbers .

1.2:- Prime number and Composite number. Prime factorization of composite

number.

1.3:- Least common Multiple (LCM) and Highest Common Factor(HCF)

1.4 :- Simplification of Expressions containing different operators (BODMAS rule).

1.5:- Fractions, Operations on fractions and decimal representation of fractions.

UNIT-2 Algebra

2.1 :- Algebraic Expressions and Algebraic formulas.

2.2 :- Equation , Linear Equation, Solution of a linear equation with one variable .

2.3 Solution of system of linear equations with two variables by

i) Elimination method ii) Substitution method

iii) Cross multiplication method

2.4:- Quadratic equation , Solution of quadratic equation.

2.5:- Polynomials, Zeros of polynomials, Polynomial factorization and Operations on polynomials.

2.6:- Law of Indices

2.7:- Properties of Logarithm($\log_a x$)

2.8:- Basic concepts of set theory. Operations on Sets and Cartesian product of sets.

UNIT-3 Trigonometry

3.1:-Trigonometry ratios in terms of perpendicular, Base and hypotenuse.

3.2:- Trigonometry table.

3.3:- ASTC rule.

3.4:-Trigonometric Identities

3.5:-Compound Angle:- sin(A+B), sin(A-B), cos(A+B), cos(A-B), tan(A+B), tan(A-B),sinC+sinD, sinC-sinD , cosC+cosD and cosC-cosD etc

3.6:- Multiple of Angle sin2A, cos2A, tan2A, sin3A, cos3A, tan3A.

Unit-4.Co-ordinate geometry

4.1:-Introduction to Cartesian co-ordinate system:

4.2:-Distance between two points :

4.3:-Section formula

Reference book:-

Mathematics book (Algebra, Geometry) for Class IX, X, BSE Odisha.

NCERT Mathematics book for classes IX and X.

Unit-1. Basic Arithmetic

1.1<u>Number System</u>

Natural Number:-

The counting numbers 1,2,3,……………. are called natural numbers.

There is no greatest natural number and smallest natural number is one.

<u>Operations on natural number</u>

1) Addition of two natural number is natural. Example:- 2+3=5

2) Subtraction of two natural number may be natural or may not be.

Example:- 3-2=1   but 2-3 is not a natural number.

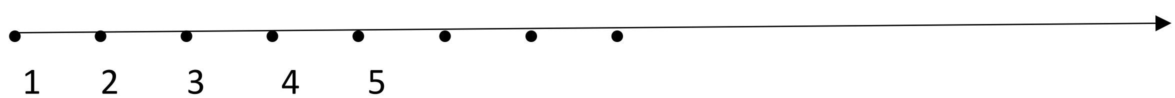
3) Multiplication of two natural number is natural. Ex:- 5X6=30

4) Division of two natural number may be natural or may not be .

Examples:- 6 ÷2 =3   but 7 ÷2 is not a natural number.

Set of natural numbers is denoted by **N.**

Natural numbers can be represented by number line as follows

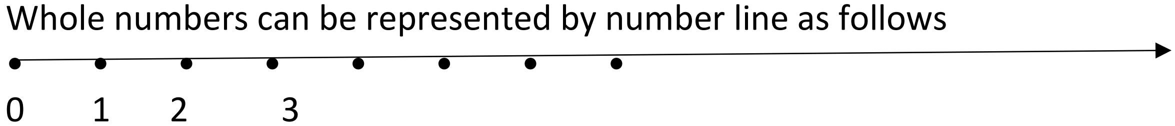


Whole number:-

Whole number is formed by adding the new member zero with natural numbers. 0,1,2,3,……….. are called whole number.

Properties of zero :- i) 0+a=a   ii) 0Xa = 0   iii) 0÷ a =0   iv) a ÷ 0 = undefined.

Whole numbers can be represented by number line as follows



Integers:-

The numbers …………….,-2,-1,0,1,2,……………………………..are called intergers.

<u>Operations on Integers</u>

1) Addition of two Integer is an integer.

2) Subtraction of two Integer is an integer.

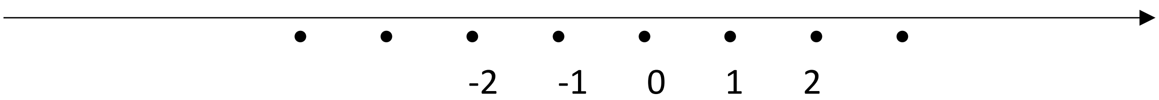
3) Multiplication of two Integer is an integer.

4) Division of two integer may be integer or may not be .

Examples:- 10 ÷2 =5 is an integer but 7 ÷2 is not an integer.

Set of Integers is denoted by **Z or I.**

Integers can be represented by number line as follows.



Rational numbers:-

Numbers in the form $\frac{p}{q}$ where pϵ Z and qϵ N are called rational numbers.

Examples of rational numbers are $\frac{2}{3}, \frac{7}{5}, -\frac{5}{11}$ etc.

1) Sum of two rational number is rational
2) Substraction of two rational number is rational
3) Multiplication of two rational number is rational.
4) Division of two rational number is rational.

It also represented by the number line by finding the range of integers between which it lies.

Irrational Numbers:-

The numbers like $\sqrt{2}, \sqrt{3}, \pi$ etc are called irrational numbers.

Rational numbers are either terminating or non terminating but recurring where as irrational numbers are non terminating nor recurring.

Real Number:-

All the rational numbers and irrational numbers combined to form Real Numbers.

Set of Real Numbers are represented by R.

1.2:-

Prime number: A number greater than 1 that has only two factors 1 and itself.

Examples:- 2, 3, 5, 7, 11

Composite number:- A number greater than 1 that has more than two factors.

Examples:- 4, 6, 8, 9, 12

Fundamental Theorem of Arithmetic :-

The Fundamental Theorem of Arithmetic states that every composite number can be expressed as a product of prime numbers, and this factorization is unique.

Example :- Prime factorization of 24

$24 = 2 \times 2 \times 2 \times 3$

Example 2: Prime factorization of 90

90 = 2x3x3x5

1.3:-

Least common multiple (LCM) and Highest common factor(HCF)

Least common multiple and Highest common factor of numbers can be determined in following way.

Example 1:-

Least common multiple and Highest common factor of 36,48 and 60 is determined as follows

2 | 36, 48, 60

2 | 18, 24, 30

3 | 9, 12, 15

3, 4, 5

From above HCF = 2X2X3=12

LCM= 2X2X3X3X4X5=720

Example2:- Find Least common multiple and Highest common factor of 10,20 and 25 is determined as follows

5 | 10,20,25

2 | 2, 4, 5

1, 2 , 5

LCM= 5x2x2x5= 100

5 | 10,20,25

2, 4, 5

HCF= 5

<u>1.4:-</u>

<u>Simplification of expresssions containing different operators (BODMAS rule)</u>

When we simlify numeriacal expressions containing different operators we follow BODMAS Rule.

Bodmas rule statnds for **B- Bracket**

O- Order (square , cube , square root etc.)

D- Divison

M- Multiplication

A- Addition

S- Substraction

Example:- 1 Find $15+16\div4\times2^2-14+(8-5)$

Ans:- $15+16\div4\times2^2-14+(8-5)$ (1st we have to solve the parentheses term I.e. 8-5=3

$= 15+16\div4\times2^2-14+3$ (2nd we have to find the ordered term i.e. $2^2=4$)

$= 15+16\div4\times4-14+3$ (3rd we have to do the division work i.e.$16\div4=4$)

$= 15+4\times4-14+3$ (4th we have to do the multiplication $4\times4=16$)

$= 15+16-14+3$ (Addition 15+16+3=34)

$= 34-14=20$.

1.5

Fractions:-

Fractions are of two types 1) proper fraction 2) Improper fraction

Proper fraction:- Fraction less than one are called proper fractions.

Example of proper fractions are $\frac{3}{4}$, $\frac{4}{5}$, $\frac{7}{11}$ etc.

Improper fraction:- Fraction which are greater than one is called improper fraction.

Example of Improper fractions are $\frac{5}{4}$, $\frac{7}{5}$, $\frac{17}{11}$ etc.

Operations on fractions

Examples:-

1) $\frac{3}{4} + \frac{1}{4} = \frac{3+1}{4} = \frac{4}{4} = 1$

(Addition of equivalent fractions are very simple as numerators are added with each other as given in example-1)

2) $\frac{5}{4} + \frac{8}{7} = \frac{5X7+8X4}{28}$

(Take the lcm of denominators 4 and 7 which is 28,

then convert the fractions to equivalent fractions having denominator 28

i.e $\frac{5}{4} = \frac{5X7}{4X7}$, $\frac{8}{7} = \frac{8X4}{7X4}$)

$= \frac{35+32}{28} = \frac{67}{28}$

1) $\frac{3}{4}$ X $\frac{5}{7} = \frac{3X5}{4X7} = \frac{15}{28}$

2) $\frac{3}{8} \div \frac{9}{16} = \frac{3}{8}$ X $\frac{16}{9} = \frac{48}{72} = \frac{48\div 24}{72\div 24} = \frac{2}{3}$

(Fractions can be converted to minimal form by dividing both numerator and denominator by the HCF of the numbers present in numerator and denominator . Here 48 and 72 have HCF 24)

Decimal Representation of numbers:-

Fractions can be represented by decimals by dividing the numerator by denominator .

For example 4 | 5 | 1.25

4

10

8

20

20

0

$\frac{5}{4}$ = **1.25**

Unit-2 Algebra

2.1 Algebraic Expressions:-

An algebraic expression is a combination of variables, constants, and operations.

Examples:

5x+3

$x^2 + 3x - 8$

Important formulas of Algebra

1. $(a+b)^2 = a^2 + 2ab + b^2$.

2. $(a-b)^2 = a^2 - 2ab + b^2$.

3. $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$.

4. $(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$.

5. $a^2 - b^2 = (a-b)(a+b)$.

6. $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$.

7. $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$.

8. $(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$

9. $(a+b)^2 + (a-b)^2 = 4ab$

2.2

Equation

Equation is a mathematical statement containing two expressions connected by an equal sign and at least one unknown is involved.

Example:- $2x + 3 = 7$

$x^2 + 2x - 3 = 0$

Linear equation:-

Linear equation is an equation which contain all the unknowns with power one.

Example:- $2x + 3 = 7$

$2x + y = 0$

Solution of linear equation with one variable.

Solution of a linear equation means to find the unknown present in the equation.

Example:- Solve $2x + 3 = 7$.

Ans:- $2x + 3 = 7$

=> $2x = 7 - 3$

=> $2x = 4$

=> $x = \frac{4}{2} = 2$

2.3:-

Solution of linear equations containing two variables

There are three cases when we are going to solve linear equations with two variables :- a) unique solution b) infinite solution c) no solution.

We generally deal with the first case that is unique solution. There are different methods like elimination , substitution , cross multiplication etc to find solution of equations with two variables.

Elimination method:-

The **elimination method** is a technique used to solve a system of linear equations by eliminating one variable so you can solve for the other.

Example:-1

Solve the system: x+2y=5 and x-y=2 by elimination method.

Ans:- Subtracting the 2^{nd} equation from 1^{st} we have,

$$\begin{array}{rl} & x+2y=5 \\ (-) & x-y=2 \\ \hline & 3y=3 \\ & \Rightarrow y=1 \end{array}$$

Putting value of y in Equation 2 , $x-1=2 \Rightarrow x=3$

Hence x = 3 and y = 1.

Example:-2

Solve the system: $3x+2y=5$ and $2x-3y=12$ by elimination method.

Ans:- Multiplying 3 in 1^{st} equation , 2 in 2^{nd} equation and then adding them

y will be eliminated .

$$\begin{array}{ll} \text{Eq(1)x3} & 9x+6y=15 \\ \text{Eq(2)x2} & 4x-6y=24 \\ (+) & \overline{\hphantom{9x+6y=15}} \\ & 13x = 39 \\ & \Rightarrow x=39/13=3 \end{array}$$

Putting value of x in Equation 1 , $3x3+2y=5 \Rightarrow 2y=-4$

$\Rightarrow y=-2$

Hence x = 3 and y = -2

Key idea: Multiply equations if necessary so that one variable has equal and opposite coefficients. Then add or subtract the equations to eliminate that variable, solve for the remaining variable, and substitute back to find the other one.

Substitution method:-

The **substitution method** is a way to solve a system of linear equations by expressing one variable in terms of the other and then substituting that expression into the second equation.

Example

1) Solve the system x+y=7 and 2x−y=2 by substitution method.

Ans:- From the first equation x+y=7 => y = 7-x

Putting value of y in second equation 2x-(7-x)=2

=> 2x-7+x=2 => 3x=9 =>x=9/3=3

Now y= 7-x=7-3=4.

Cross multiplication method

The **cross multiplication method** is used to solve a pair of linear equations in two variables.

General Form :- $a_1x + b_1y + c_1 = 0$

$$a_2x + b_2y + c_2 = 0$$

Solution of the above two equation can be given by

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$$

Example:- Solve the system x+y=7 and 2x−y=2 by cross multiplication method.

Ans:- $\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$

=> $\frac{x}{1X(-2)-(-1)X(-7)} = \frac{y}{(-7)X2-(-2)X1} = \frac{1}{1X(-1)-2X1}$

=> $\frac{x}{-9} = \frac{y}{-12} = \frac{1}{-3}$

=> $x = -\frac{9}{-3} = 3$ and => $y = -\frac{12}{-3} = 4.$

2.4

Quadratic Equation:-

General form of quadratic equation is $ax^2 + bx + c = 0.$

Solution of quadratic equation is $x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$

Example:- Solve $x^2 + 2x - 3 = 0.$

Ans:- $x = \frac{-2\pm\sqrt{2^2-4X1X(-3)}}{2X1}$ here a=1, b=2 and c=-3

$= \frac{-2\pm\sqrt{16)}}{2} = \frac{-2\pm4}{2} = \frac{-2+4}{2}$ or $\frac{-2-4}{2}$ = 1 or -3.

Type of solution of Quadratic Equation

In Quadratic Equation $x^2 + bx + c = 0$, there are three types of solution according to the nature of the discriminant D, Where D = $b^2 - 4ac$

Case-I If D> 0 then equation has two real and distinct roots.

Case-II If D=0, then there are two equal real roots .

Case-III If D<0 , then the roots are complex conjugates.

2.5:-

Polynomials

An algebraic expression in the form $a_0x + a_2x^2 + \cdots\cdots\cdots\cdots\cdots\cdots + a_nx^n$ is called a polynomial in one variable where $a_{0,}a_1 \ldots a_n$ are real numbers.

The highest power of x is called as the degree the polynomial.

For example:- $x^2 + 2x - 3$ has degree 2 and $x^3 + 5x - 3$ has degree 3.

Roots of a Polynomial

The **roots (or zeros) of a polynomial** are the values of the variable for which the polynomial becomes zero.

Definition:
If P(x) is a polynomial, then a number α is called a root if P(α)=0.

Example 1

For the polynomial $x^2 - 5x + 6$, the roots are 2 and 3.

Because P(2) = $2^2 - 5X2 + 6$ = 4-10+6 =0

P(3) = $3^2 - 5X3 + 6$ = 9-15+6 =0 .

Factorization of Quadratic polynomial

A quadratic polynomial $ax^2 + bx + c$ can be factorized by breaking the middle

term that is bx as dx+ex so that we get a common factor. This can be done by choosing appropriate numbers d and e such that d+e = b and de=ac.

Example:- 1 Factorize $x^2 + 2x - 3$.

Ans:- Here ac= 1X(-3)=-3 and b = 2 . So we have to choose d and e such that d+e = 2 and de= -3. Choosing d=3 and e=-1 the condition is satisfied.

$x^2 + 2x - 3$ = $x^2 + 3x - x - 3$ = $x(x + 3) - 1(x + 3)$ = $(x + 3)(x - 1)$.

Example:- 2 Factorize $2x^2 + 7x + 3$.

Ans:- $2x^2 + 7x + 3 = 2x^2 + 6x + x + 3 = 2x(x + 3) + 1(x + 3)$

= $(x + 3)(2x + 1)$.

Operations on polynomials:-

When we add or subtract two polynomials then the terms with same power of x will be operated on each other.

Example:- Q1. Add $x^3 + 5x - 3$ with $x^2 + 2x + 7$.

Ans:- $x^3 \quad + 5x - 3$

$+ \qquad x^2 + 2x + 7$

$x^3 + x^2 + 7x + 4$

Q2. Substract $3x^2 + 2x - 8$ from $5x^2 + x + 3$.

Ans:- $5x^2 + x + 3.$

$- \quad 3x^2 + 2x - 8$

$2x^2 - x - 5$

Q3. Multiply $5x - 3$ with $3x^2 + 2$.

Ans:- $(5x - 3)$ X $(3x^2 + 2)$ = $5x\,(3x^2 + 2) - 3(3x^2 + 2)$ (here constant is multiplied with constants and x terms are multiplied with each other.)

= $15x^3 + 10x - 9x^2$-6 = $15x^3 - 9x^2 + 10x - 6$ (ans)

Q4. Divide $5x^2 + x + 3$ by $2x - 3$

$$
\begin{array}{r|l|l}
2x - 3 & 5x^2 + x + 3 & \frac{5}{2}x + \frac{17}{4} \\
 & 5x^2 - \frac{15}{2}x & \\
 & - \qquad + & \\
\hline
 & \frac{17}{2}x + 3 & \\
 & \frac{17}{2}x - \frac{51}{4} & \\
 & - \qquad + & \\
\hline
 & \frac{63}{4} &
\end{array}
$$

Q4. Divide $x^3 + 3x^2 - 3x - 1$ by $x - 1$

$$
\begin{array}{r|l|l}
x-1 & x^3+3x^2-3x-1 & x^2+4x+1 \\
 & x^3 - x^2 & \\
 & \quad - \qquad + & \\
\hline
 & \quad 4x^2-3x-1 & \\
 & \quad 4x^2-4x & \\
\hline
 & \qquad x-1 & \\
 & \qquad x-1 & \\
 & \qquad - \quad + & \\
\hline
 & \qquad 0 &
\end{array}
$$

2.6 Law of Indicies

1. $a^0 = 1$

2. $a^m a^n = a^{m+n}$.

3. $\frac{a^m}{a^n} = a^{m-n}$.

4. $(a^m)^n = a^{mn}$.

5. $a^{-n} = \frac{1}{a^n}$.

6. $a^m b^m = (ab)^m$.

Example:- $2^3 5^3 = (2X5)^3 = 10^3 = 1000$

$7^3 7^7 = 7^{3+7} = 7^{10}$.

2.7Properties of Logarithm($\log_a x$)

Logarithm$\boldsymbol{\log_a x}$ is the inverse function of exponential (a^x).

1. $\log_a a^x = x$.

2. $a^{\log_a x} = x$.

3. $\log_a mn = \log_a m + \log_a n$.

4. $\log_a \frac{m}{n} = \log_a m - \log_a n.$

5. $\log_a b = \frac{1}{\log_b a}$

6. $\log_a b \ \log_b c = \log_a c$

7. $\log_a 1 = 0$

8. $\log_a a = 1$

9. $\log_a x^n = n \log_a x.$

Examples:- $7^{\log_7 25} = 25.$

$\log_{10} 5 + \log_{10} 2 = \log_{10}(5X2)$= $\log_{10} 10$=1

$\log_2 8$ = $\log_2 2^3 = 3\log_2 2$ =3 X1 =3

2.8 Set Theory

A collection of distinct well defined elements enclosed in a curly bracket is called as a set.

Example:- {1,2,3}

{ India,china,Bhutan,Nepal}

The elements present in a set are called belong to the set denoted by ′ ∈ ′.

If A= {1,2,3}

Then 1 ∈A , 2 ∈A and 3∈A

Null set:- Set having no elements is called as a Null set or empty set denoted by Ø.

Subset (⊂)

A set A is said to be subset of B if all the elements of A are present in B. It is denoted by A⊂ B.

If A= {1,2,3} and If B= {1,2,3,4} then A⊂ B.

Union of sets(∪) and Intersection sets (∩)

Union of sets means to combine the elements of both the sets and intersection of two sets means to take the common elements present in both sets.

If A= { 1,2,3} and B = { 3,4,5} then A ∪ B = {1,2,3,4,5} and A ∩ B= {3}

Difference of two sets (A-B)

Difference of two sets is a set which contain those elements that are in A but not in B i.e. A-B = A- (A ∩ B).

If A= { 1,2,3} and B = { 3,4,5} then A-B= { 1,2}

Power set of a set

Power set of a set A is a set which contain all the subsets of A , it is denoted by P(A).

If A={1,2} then P(A)= { ∅, {1},{2},{1,2}}

Universal set (U)

A set which contain all the elements of a particular contex is called universal set .

For example in number system R = set of real numbers is Universal set.

If we take only counting numbers then set of Natural numbers i.e. N is the universal set.

Complement of a set ($A' or\ A^c$)

A'= U-A

If U=N and A ={ set of all odd numbers} then A'= { set of all even numbers}

If U= { a,b,c,d,e} and A = {a,d,e} then $A^{'}$ = {b,c}

Cartesian or Cross product of two sets (AXB)

Cartesian or Cross product of two sets contain all possible order pairs from A and B where first element is from A and the second element is from B.

Example:- If A = { 1,2} and B= { a,b}

Then AXB = { (1,a), (1,b), (2,a), (2,b)}.

Unit-3:- Trigonometry

3.1:-Trigonometry ratios in terms of perpendicular, Base and hypotenuse

Trigonometry is the branch of mathematics that deals with relationships between the angles and sides of triangles, especially right-angled triangles, and the study of trigonometric functions.
An angle is formed when two rays (sides) meet at a common point (vertex).

Trigonometric Ratios in Terms of p, b, and h

In a right angled triangle ABC,

If $\angle A = \theta$, then Six Trigonometric Ratios are given by

$$\sin\theta = \frac{p}{h}, \quad \cos\theta = \frac{b}{h}, \quad \tan\ \theta = \frac{p}{b}, \cot\ \theta = \frac{b}{p}, \sec\theta = \frac{h}{b}, \operatorname{cosec}\theta = \frac{h}{p}$$

p= perpendicular , b= base and h= hypotenuse.

3.2Trigonometric Table

angle θ	0°	30°	45°	60°	90°	120°	135°	150°	180°
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	$\frac{-1}{2}$	$\frac{-1}{\sqrt{2}}$	$\frac{-\sqrt{3}}{2}$	-1
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Un defined	$-\sqrt{3}$	-1	$\frac{-1}{\sqrt{3}}$	0
cot	undefined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0	$\frac{-1}{\sqrt{3}}$	-1	$-\sqrt{3}$	undefined
sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Un defined	-2	$-\sqrt{2}$	$\frac{-2}{\sqrt{3}}$	-1
cosec	undefined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	undefined

3.3 ASTC Rule

Q1=A = All → All trig functions (**sin, cos, tan**) are **positive** in **Quadrant I**

Q2=S = Students → Only **sin** (and cosec) is **positive** in **Quadrant II**

Q3=T = Take → Only **tan** (and cot) is **positive** in **Quadrant III**

Q4=C = Calculus → Only **cos** (and sec) is **positive** in **Quadrant IV**

Quadrant	Functions Positive
I	sin, cos, tan, cot,sec,cosec
II	sin, cosec
III	tan, cot
IV	cos, sec

3.4 Trigonometric Identities:

1. $\sin^2\theta + \cos^2\theta = 1$
2. $1 + \tan^2\theta = \sec^2\theta$
3. $1 + \cot^2\theta = \operatorname{cosec}^2\theta$

3.5Compound Angles

When an angle formed as the algebric sum of two or more angles is called a compound angles. Thus $A + B$ and $A + B + C$ are compound angles.

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$
$$\sin(A - B) = \sin A \cos B - \cos A \sin B$$
$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$
$$\cos(A - B) = \cos A \cos B + \sin A \sin B$$
$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}, \quad \tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

Product to Sum Formulas:

$$2\sin A\cos B = \sin(A + B) + \sin(A - B)$$
$$2\cos A\sin B = \sin(A + B) - \sin(A - B)$$
$$2\cos A\cos B = \cos(A + B) + \cos(A - B)$$
$$2\sin A\sin B = \cos(A - B) - \cos(A + B)$$

Sum to Product Formulas:

$$\sin(C) + \sin(D) = 2\sin\frac{C + D}{2}\cos\frac{C - D}{2}$$
$$\sin(C) - \sin(D) = 2\cos\frac{C + D}{2}\sin\frac{C - D}{2}$$
$$\cos(C) + \cos(D) = 2\cos\frac{C + D}{2}\cos\frac{C - D}{2}$$

$$\cos(C) - \sin(D) = -2\sin\frac{C+D}{2}\sin\frac{C-D}{2}$$

3.6Multiple of Angles

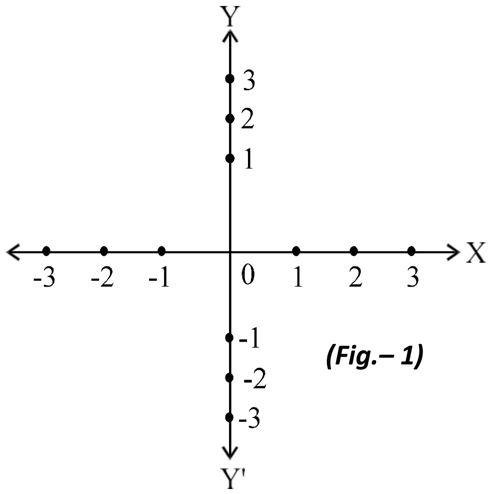
- $\sin 2\theta = 2\sin\theta\cos\theta = \frac{2\tan\theta}{1+\tan^2\theta}$
- $\cos 2\theta = \cos^2\theta - \sin^2\theta = 2\cos^2\theta - 1 = 1 - 2\sin^2\theta = \frac{1-\tan^2\theta}{1+\tan^2\theta}$
- $1 + \cos 2\theta = 2\cos^2\theta\,,\ 1 - \cos 2\theta = 2\sin^2\theta$
- $\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$.

Unit-4 Co-ordinate Geometry

4.1:-Introduction to Cartesian co-ordinate system

We represent each point in a plane by means of an ordered pair of real numbers, called co-ordinates. The branch of mathematics in which geometrical problems are solved through algebra by using the co-ordinate system, is known as co-ordinate geometry or analytical geometry.

Rectangular co-ordinate Axes



(Fig.– 1)

Let X'OX and YOY' be two mutually perpendicular lines (called co-ordinate axes), intersecting at the point O. ***(Fig.1)***.We call the point O, the origin, the horizontal line X'OX, the x-axis and the vertical line YOY', the y-axis.

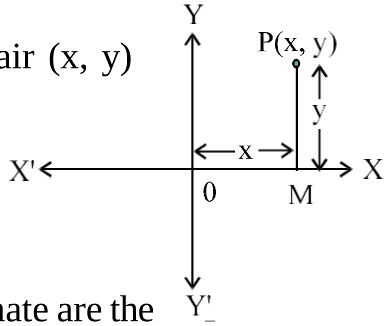
We fix up a convenient unit of length and starting from the origin as zero, mark. distances on x-axis as well as y-axis. X'

The distance measured along OX and OY are taken as positive while those along OX' and OY' are considered negative.

Cartesian co-ordinates of a point

Let X'OX and YOY' be the co-ordinate axes and let P be a point in the Euclidean plane . From P draw PM ⊥X'OX.

Let OM = x and PM = y, Then the ordered pair (x, y) represents the cartesian co-ordinates of P and we denote the point by P(x, y). The number x is called the x-co-ordinate or abscissa of the point P, while y is known as its y-co-ordinate or ordinate.



Thus, for a given point the abscissa and the ordinate are the distances of the given point from y- axis and x-axis respectively.

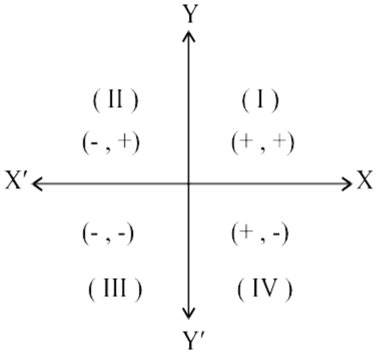
Quadrants

The co-ordinate axes X'OX and Y'OY divide the plane in to four regions, called quadrants.

The regions XOY, YOX', X'OY' and Y'OX are known as the first, the second, the third and the fourth quadrant respectively. In accordance with the convention of signs defined above for a point (x, y) in different quadrants we have

1st quadrant : $x > 0$ and $y > 0$ 2nd quadrant : $x < 0$ and $y > 0$

3rd quadrant : $x < 0$ and $y < 0$ 4th quadrant : $x > 0$ and $y < 0$

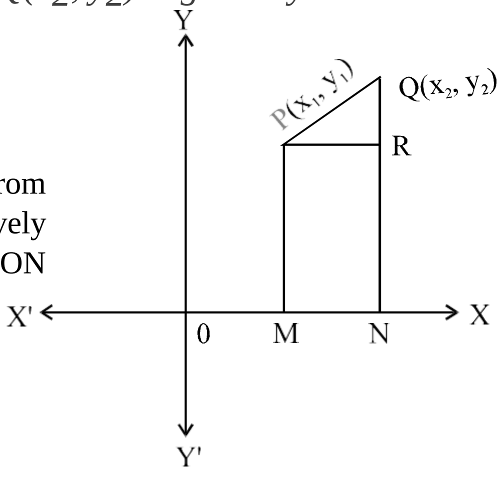


4.2:-DISTANCE BETWEEN TWO GIVEN POINTS

The distance between any two points in the plane is the length of the line segment joining them.

The distance between two points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is given by

$|PQ| = \sqrt{\left((x_2 - x_1)^2 + (y_2 - y_1)^2\right)}$



Proof : Let X'OX and YOY' be the co-ordinate axes . Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ be the two given points in the plane. From P and Q draw perpendicular PM and QN respectively onthe X-axis. Also draw PR ⊥ QN. Then, $OM = x_1$, $ON = x_2$

$PM = y_1$ & $QN = y_2$

$PR = MN = ON - OM = x_2 - x_1$

and $QR = QN - RN = QN - PM = y_2 - y_1$

Now from right angled triangle PQR,

we have $PQ^2 = PR^2 + QR^2$ [by Pythagoras theorem]

$= (x_2 - x_1)^2 + (y_2 - y_1)^2$

$|PQ| = \sqrt{\left((x_2 - x_1)^2 + (y_2 - y_1)^2\right)}$

4.3 Section Formula

Formula for Internal Divisions :

The co-ordinates of a point P(x,y) which divides the line joining A(x_1, y_1) and B(x_2, y_2) internally in the ratio m : n are given by

x=$\frac{mx_2+nx_1}{m+n}$ and y=$\frac{my_2+ny_1}{m+n}$.

Formula for external division:-

The co-ordinates of a point P(x,y) which divides the line joining A(x_1, y_1) and B(x_2, y_2) externally in the ratio m:n are given by

x=$\frac{mx_2-nx_1}{m-n}$ and y=$\frac{my_2-ny_1}{m-n}$.

Example:

If A(2,3) , B(8,9) and P divides AB internally in the ratio 1:2 then find P.

Ans:- P = $(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n})$

Here m=1 , n=2 , $x_1 = 2, y_1 = 3, x_2 = 8$ and $y_2 = 9$.

$= (\frac{1X8+2X2}{1+2}, \frac{1X9+2X3}{1+2})$

$= (\frac{12}{3}, \frac{15}{3})$ = (4,5).