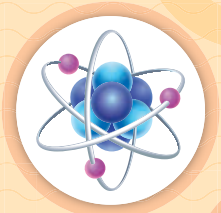
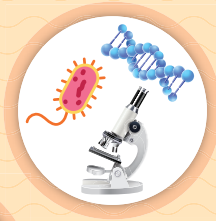
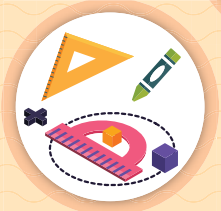
CBSE

FLASH CARDS

Set-1 **Class X**







Aakash + BYJU'S

Name : .....

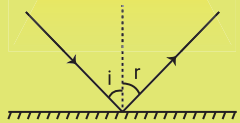
Roll No. : .....

LIGHT-REFLECTION AND REFRACTION

Light

Form of Energy Gives the Sensation of Vision

Reflection



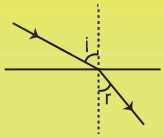
☑ Bouncing back of light into the same medium.

Laws of Reflection

☑ Incident ray, reflected ray and the normal at the point of incidence, all lie in the same plane.

☑ $\angle i = \angle r$

Refraction

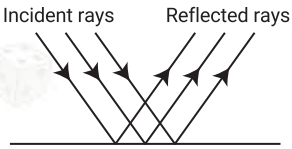
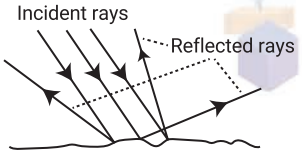


☑ Bending of light as it passes from one medium into another.

Laws of Refraction

☑ Incident ray, refracted ray and the normal at the point of incidence all lie in the same plane.

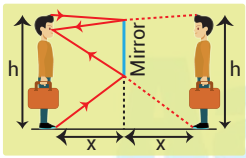
☑ $\frac{\sin i}{\sin r}$ = constant (Snell's law)

Regular Reflection	Irregular Reflection
☑ In regular reflection parallel beam of light remains parallel after reflection.	☑ In irregular reflection, the parallel beam of light does not remain parallel after reflection.
☑ It occurs on the smooth surfaces like mirror.	☑ It occurs on the rough surfaces like stone, wood.
☑ Image is formed.	☑ No image formation takes place.
☑ The incident rays are reflected parallel in one direction.	☑ The incident rays are reflected abruptly in many directions.
	

Mirrors

Plane Mirror

- ☑ **Nature of image**
  - ♦ Virtual and Erect
- ☑ The image formed by a plane mirror is of same size, laterally inverted and is at the same distance behind the mirror as the object is in front of it.



Spherical Mirror

Concave Mirror

- ☑ Its reflecting surface is curved inwards.
- ☑ **Nature of image**
  - ♦ Virtual and Erect
  - ♦ Real and Inverted

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

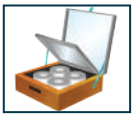
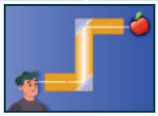
Convex Mirror

- ☑ Its reflecting surface is curved outwards.
- ☑ **Nature of image**
  - ♦ Virtual and Erect

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F, behind the mirror	Highly diminished or point-sized	Virtual and erect
Between infinity and the pole P of the mirror	Between P and F, behind the mirror	Diminished	Virtual and erect

Uses of Mirror

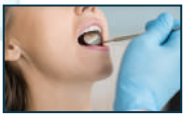
Plane mirror

Convex mirror



Concave mirror


Mirror formula : $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Magnification (m) = $\frac{h_i}{h_o} = -\frac{v}{u} = \frac{f - v}{f} = \frac{f}{f - u}$

Absolute Refractive Index

If first medium is air or vacuum.

$$n = \frac{c}{v} = \frac{\lambda_a}{\lambda}$$

$\lambda_a \rightarrow$ Wavelength of light in air.

$\lambda \rightarrow$ Wavelength of light in medium.

Relative Refractive Index

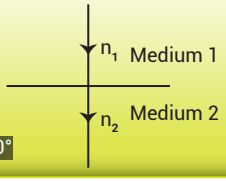
$$n_{21} = \frac{v_1}{v_2}$$

$$n_{12} = \frac{v_2}{v_1}$$

It is a unit less quantity.

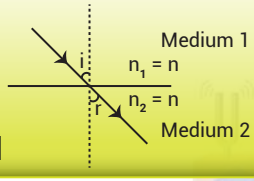
Conditions for No Bending

Incident light falls normally on boundary passes undeviated.



$\angle i = \angle r = 0°$

Refractive indices of two media are equal, light ray passes undeviated.



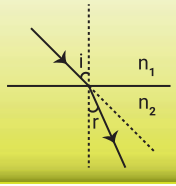
$\angle i = \angle r$

Bending of Light Ray

Rarer to Denser Medium

$\angle i > \angle r$

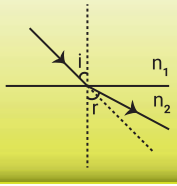
Light ray bends towards the normal.



Denser to Rarer Medium

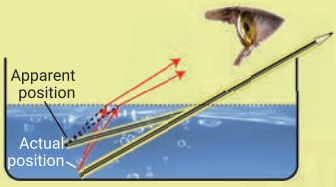
$\angle i < \angle r$

Light ray bends away from the normal.

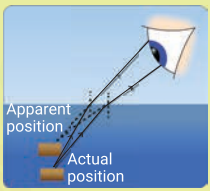


Effects of Refraction

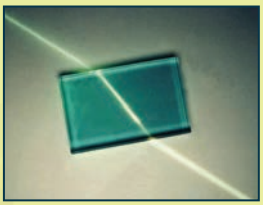
Pencil appears to be bent

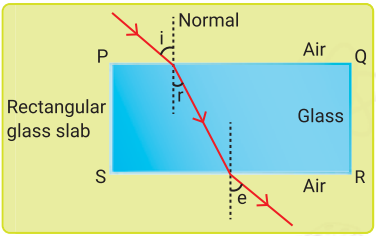


Bottom of beaker appears to be raised



Refraction Through a Rectangular Glass Slab





☑ $\angle i = \angle e$ ☑ Incident ray displaced parallel to itself.

Lenses

Convex Lens

- ☑ Its spherical surfaces are bulging outwards.

- ☑ **Nature of image**
  - ♦ Virtual and Erect
  - ♦ Real and Inverted

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

Concave Lens

- ☑ Its spherical surfaces are curved inwards.

- ☑ **Nature of image**
  - ♦ Virtual and Erect

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At focus F_1	Highly diminished or point-sized	Virtual and erect
Between infinity and optical centre O	Between focus F_1 and optical centre O	Diminished	Virtual and erect

Lens formula : $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Magnification (m) = $\frac{h_i}{h_o} = \frac{v}{u} = \frac{f - v}{f} = \frac{f}{f + u}$

☑ **Power of a Lens :** It is the ability of a lens to converge or diverge the rays of light. It depends on focal length.

Power of lens (P) = $\frac{1}{f}$

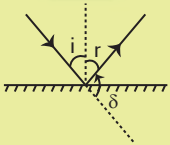
Its SI unit is Dioptre (D)

☑ **Power and Focal Length of Combination of Lenses**

$P = P_1 + P_2 + P_3 + ...$

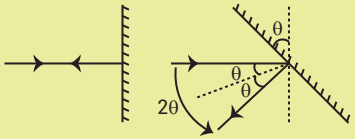
$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + ...$

Reflection at Plane Surface



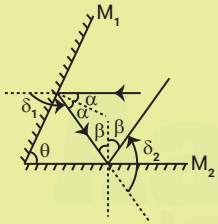
Angle of deviation, $\delta = 180° - 2i$

$\delta_{max.} = 180°$ ($\angle i = 0°$)



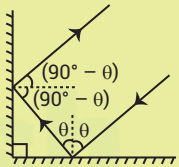
(Before rotation) (After rotation)

Reflected ray makes angle 2θ with original reflected ray.



Net deviation $\delta = \delta_1 + \delta_2$

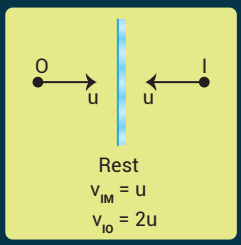
$= 360° - 2\theta$

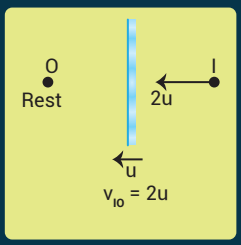


$\delta = 360° - 2 \times 90°$

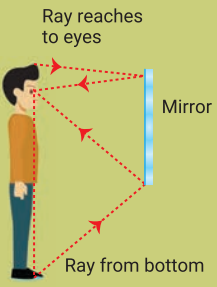
$\delta = 180°$

Speed of Image in a Plane Mirror

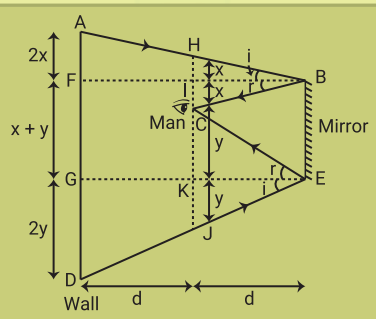




Minimum Length of Plane Mirror



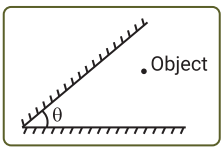
The minimum height of plane mirror to enable a person to see full image is half of his height.



Minimum length of the mirror required by a man standing midway between wall and the mirror, to see full height of the wall (behind him), is h/3 where h is height of the wall.

Images Formed in a Pair of Mirrors

If $\frac{360°}{\theta}$ = Even number → Number of images = $\frac{360°}{\theta} - 1$



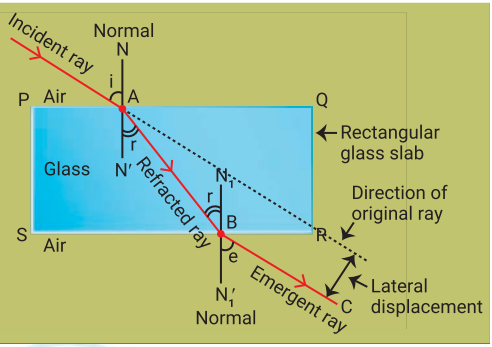
If $\frac{360°}{\theta}$ = Odd number

- If object lies symmetrically: Number of images = $\frac{360°}{\theta} - 1$
- If object lies asymmetrically: Number of images = $\frac{360°}{\theta}$

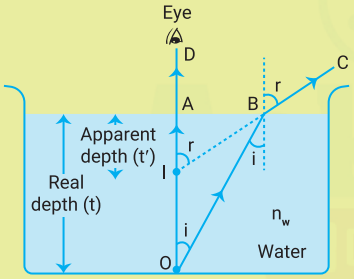
If $\frac{360°}{\theta} \neq$ Integer → Number of images formed equals to integral part.

Lateral Displacement (d)

$$d = \frac{t \sin(i - r)}{\cos r}$$



Apparent Depth of Tank



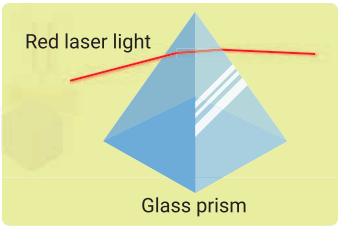
$$t' = \frac{t}{n_w}$$

$$\text{Shift in depth } (\Delta t) = t\left(1 - \frac{1}{n_w}\right)$$

Laser and Its Uses

Laser

LASER : Light Amplification by Stimulated Emission of Radiation.



Uses of Laser

Optical fibre helps us in communication

Flash Light

Lasers Focus Light

CHEMICAL REACTIONS AND EQUATIONS

Symbolic form of a chemical reaction is known as **"Chemical Equation"**.

Balancing of a chemical equation should be done in order to follow **"The law of conservation of mass"**.

TYPES OF CHEMICAL REACTIONS

1. Combination Reaction
2. Decomposition Reaction
   - Electrolytic Decomposition Reaction
   - Thermal Decomposition Reaction
   - Photolytic Decomposition Reaction
3. Displacement Reaction
4. Double Displacement Reaction
5. Redox Reaction

1 Combination Reaction

The reaction in which a single product is formed from two or more reactants is known as 'Combination Reaction'.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$$

(Quick lime) (Slaked lime)

2 Decomposition Reaction

The reaction in which single reactant breaks down to give simpler products.

$$2FeSO_4(s) \xrightarrow{\Delta} Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

(Smell of burning sulphur)

There are three types of decomposition reactions.

Electrolytic Decomposition Reaction

The reaction in which electricity is used for decomposition of reactant.

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

(At cathode) (At anode)

Thermal Decomposition Reaction

The reaction in which heat is used for decomposition of reactant.

$$2Pb(NO_3)_2(s) \xrightarrow{\Delta} 2PbO(s) + 4NO_2(g) + O_2(g)$$

(Brown Fumes)

Photolytic Decomposition Reaction

The reaction in which sunlight is used for decomposition of reactant.

$$2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$$

3 Displacement Reaction

The reaction in which a more reactive element replaces the less reactive element from its salt solution.

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

There is a reactivity series which needs to be learnt for solving questions.

How to remember the REACTIVITY SERIES ?

Please	Potassium
Stop	Sodium
Calling	Calcium
Me	Magnesium
A	Aluminium
Careless	Carbon
Zebra	Zinc
Instead	Iron
Try	Tin
Learning	Lead
How	Hydrogen
Copper	Copper
Saves	Silver
Gold	Gold

Least Reactive

4 Double Displacement Reaction

The reaction in which there is an exchange of ions between the reactants.

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$
(White ppt.)

Double displacement reaction is necessarily not always precipitation reaction.

5 Redox Reaction

The reaction in which one substance is getting oxidised while other is getting reduced is a redox reaction.

$$CuO(s) + H_2(g) \xrightarrow{\Delta} Cu(s) + H_2O(l)$$

One very important reaction need to be discussed here now!

Quick lime reacts with water to form calcium hydroxide.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$$

Calcium hydroxide reacts further with CO_2 to produce white ppt. of limestone.

$$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$$
(White ppt.)

This reaction is used in laboratory to check the evolution of CO_2 gas.

If excess of CO_2 is being provided then limestone further reacts to form calcium bicarbonate which is soluble in water.

$$CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$$

There are some other important types of reactions as well.

EXOTHERMIC REACTION

The reaction in which heat/energy is released.

$$C_6H_{12}O_6(aq) + 6O_2(aq) \rightarrow 6CO_2(aq) + 6H_2O(l) + \text{Energy}$$

Respiration is an exothermic process.

Exo (Exit) therm (Heat)

ENDOTHERMIC REACTION

The reaction in which heat/energy is absorbed.

$$6CO_2(aq) + 6H_2O(l) \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} C_6H_{12}O_6(aq) + 6O_2(aq)$$

Photosynthesis is an endothermic process.

Endo (Within) therm (Heat)

PRECIPITATION REACTION

The reaction in which a solid substance is formed.

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s)\downarrow + 2NaCl(aq)$$

White ppt. of $BaSO_4$ is formed.

Not every precipitation reaction is double displacement reaction and vice versa.

NEUTRALISATION REACTION

The reaction in which acid and base react with each other to form salt and water.

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

Not every salt formed is neutral in nature.

My other name is oxidising agent. My job is to oxidise others by gaining electrons.

My other name is reducing agent and I loose electrons so that others get reduced after gaining them.

Both processes are simultaneous and opposite to each other

OXIDATION

- Oxygen is being added
- Hydrogen is being removed
- Electrons are lost

REDUCTION

- Oxygen is being removed
- Hydrogen is being added
- Electrons are gained

What about OXIDATION in daily life ?

CORROSION

Degradation of metal by the action of air, moisture or a chemical on their surface is called corrosion. E.g. Rusting of iron, tarnishing of silver etc.

RANCIDITY

Oxidation of fats and oils present in food which causes change in smell and taste of food.

Types of Chemical Reaction

On the basis of Physical State

Homogeneous Reaction

Physical state of all reactants and products is same. E.g.

$N_2(g) + O_2(g) \rightarrow 2NO(g)$

Heterogeneous Reaction

Physical state of all reactants and products is not same. E.g.

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

On the basis of Direction of Reaction

Irreversible Reaction

Reaction proceeds only in one direction. E.g.

$C(s) + O_2(g) \rightarrow CO_2(g)$

Reversible Reaction

Reaction proceeds in both directions. E.g.

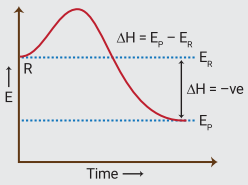
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

On the basis of Absorption or Evolution of Heat

Exothermic Reaction

Heat is evolved. E.g.

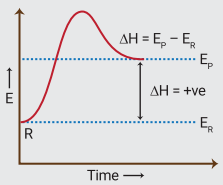
$C(s) + O_2(g) \rightarrow CO_2(g) + Heat$



Endothermic Reaction

Heat is absorbed. E.g.

$N_2(g) + O_2(g) + Heat \rightarrow 2NO(g)$



POLYMERISATION REACTION

$nA \xrightarrow{\text{Polymerisation}} -(A)-_n$

Monomer → Polymer

E.g. $nCH_2=CH_2 \xrightarrow[\text{\& Pressure}]{\text{High temp.}} -(CH_2-CH_2)-_n$

Ethene → Polyethene

ISOMERISATION REACTION

Atoms rearranges, molecular formula remains same

E.g. $NH_4CNO \xrightarrow{\Delta} H_2N-CO-NH_2$

Ammonium Cyanate → Urea

Red ox

Reduction half part

Oxidation half part

Reduction

Oxidation

$\overset{0}{Fe} + \overset{+2}{CuSO_4} \longrightarrow \overset{+2}{FeSO_4} + \overset{0}{Cu}$

Fe: Reducing Agent

$CuSO_4$: Oxidising Agent

Types of Redox Reaction

Intermolecular Redox Reaction

Two substance react, one is oxidant and other is reductant

$Mg(s) + O_2(g) \rightarrow MgO(s)$

Disproportionation

Same element get oxidised as well as reduced

$2H_2\overset{-1}{O_2}(l) \xrightarrow{h\nu} 2H_2\overset{-2}{O}(l) + \overset{0}{O_2}(g)$

Intramolecular Redox Reaction

One element of same compound gets oxidised and other element gets reduced

$2KClO_3(s) \xrightarrow{\Delta} 2KCl(s) + 3O_2(g)$

Rates of Chemical Reaction

$$\text{Rate} = \frac{\text{Decrease in conc. of reactants}}{\text{Time taken}} = \frac{\text{Increase in conc. of products}}{\text{Time taken}}$$

For $nA + mB \longrightarrow pC + qD$

$$\text{Rate} = \frac{dx}{dt} = -\frac{1}{n}\frac{\Delta[A]}{\Delta t} = -\frac{1}{m}\frac{\Delta[B]}{\Delta t} = \frac{1}{p}\frac{\Delta[C]}{\Delta t} = \frac{1}{q}\frac{\Delta[D]}{\Delta t}$$

$\frac{dx}{dt} \propto [A]^a [B]^b$ **Or** $\frac{dx}{dt} = k[A]^a [B]^b$

Rate law or Rate equation

- $k \rightarrow$ Rate Constant
- $a \rightarrow$ Order w.r.t. A
- $b \rightarrow$ Order w.r.t. B
- $n = a + b$ = overall order

Factors Affecting Rate of Reaction

- **Activation Energy**: Lower activation energy higher rate of reaction
- **Catalyst**: Alters the rate of reaction without itself changing chemically
- **Temperature**: Rate of reaction increases with temperature
- **Light**: Generally light increases rate of reaction
- **Physical State**: Powdered form shows higher rate than solid form due to high surface area
- **Concentration**: Generally higher concentration of reactant increases rate of reaction

Positive Catalyst	Negative Catalyst
Increases the rate of reaction	Decreases the rate of reaction
E.g. $2KClO_3(s) \xrightarrow[473\text{-}633K]{MnO_2(s)} 2KCl(s) + 3O_2(g)$	**E.g.** $2H_2O_2(l) \xrightarrow{\text{Glycerine}} 2H_2O(l) + O_2(g)$

Enzymes act as **Biochemical Catalysts**

LIFE PROCESSES

Nutrition
Process by which an organism obtains its food and utilizes it to get energy.

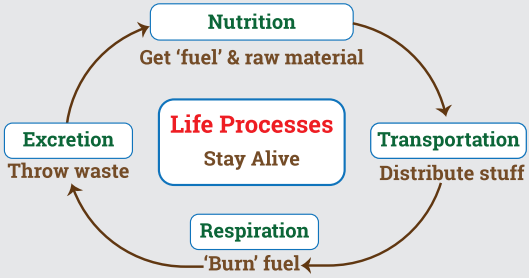
Respiration
Process by which food is burnt in the cells of the body with the help of oxygen to release energy.

Autotrophic
e.g. green plants, bacteria

Heterotrophic
e.g. animals, fungi

Gaseous exchange occurs through **stomata (leaf)** in plants

Gaseous exchange occurs through **alveoli (lungs)** in animals



Transportation
Process where substances synthesized or absorbed in one part of the body are carried to other parts of the body.

Excretion
Removal of harmful toxic wastes from the body.

Occurs through **vascular tissues** in plants

Occurs through **circulatory system** in animals

Oxygen, resins, gums etc are by-products in plants

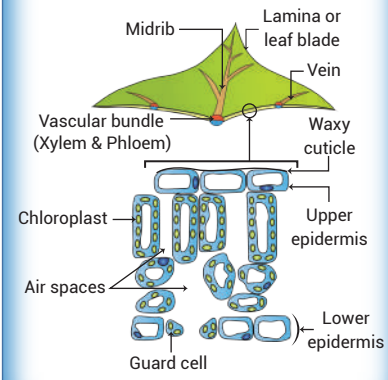
Urea, sweat, carbon dioxide are waste materials in animals

Nutrition in Plants

Photosynthesis

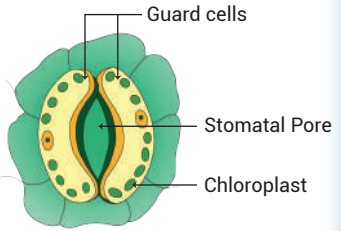
Process by which green plants prepare their food using sunlight and chlorophyll.

$$6CO_2 + 12H_2O \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$
(glucose)



Cross-section of Leaf

STOMATA



Swelling of guard cells causes opening of stomatal pore

Shrinkage of guard cells causes closing of stomatal pore

Mechanism

- Absorption of light energy by chlorophyll
- Conversion of light energy to chemical energy
- Splitting of water molecules into hydrogen and oxygen
- Reduction of carbon dioxide into carbohydrates (glucose)

NUTRITION IN ANIMALS

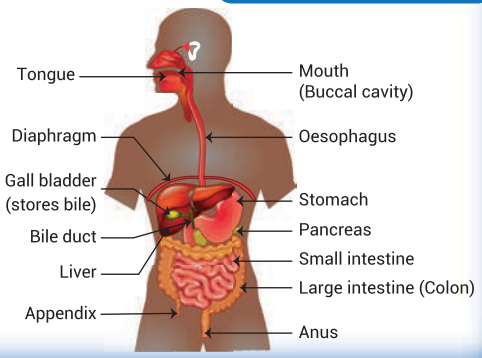
Buccal Cavity: Contains teeth & muscular tongue.

Pharynx: Common passage for food & air.

Oesophagus: About 25 cm long tube connecting the stomach.

Stomach: Secretes HCl that makes the medium acidic.

Human Digestive System



Small intestine: Longest & highly coiled part of alimentary canal consisting of villi that increase the surface area for absorption.

Large intestine: Caecum is small blind sac that give rise to vermiform appendix (vestigial organ).

Mechanism of Digestion

Mouth (Buccal Cavity)
Salivary amylase present in saliva helps in the digestion of starch.

Oesophagus (Food pipe)
Peristalsis occurs that passes the food down into stomach.

Stomach
Protein digestion by pepsin enzyme of gastric juice.

Small intestine
Protein digestion & fat digestion is mediated by pancreatic juice (trypsin) & intestinal juice (lipase) respectively.

Large Intestine
No digestion of food components occurs here. Only absorption of water occurs.

Anus
Helps in elimination of waste and its opening is regulated by anal sphincters.

RESPIRATION IN PLANTS

Glycolysis
(Breakdown of glucose)

Glucose
(6-carbon molecule)

Cytoplasm →

2 Pyruvate
(3-carbon molecule)

+ ATP

Aerobic respiration

- Oxygen is required
- Occurs in mitochondria
- Complete breakdown of glucose
- End Products: $CO_2 + H_2O$
- Pyruvate (3C) $\xrightarrow[\text{Mitochondria}]{O_2}$ $CO_2 + H_2O + ATP$
- ATP (adenosine triphosphate) is the energy currency of the cell

Anaerobic respiration

- Oxygen is not required
- Occurs in cytoplasm
- Partial breakdown of glucose
- End Products: CO_2 + ethanol (Yeast)
- **Alcoholic Fermentation**
  Pyruvate (3C) $\xrightarrow[\text{Yeast}]{}$ Ethanol + CO_2 + ATP
- **Lactic Acid Fermentation**
  Pyruvate (3C) $\xrightarrow[\text{Muscle}]{}$ Lactic Acid (3C) + ATP

RESPIRATION IN ANIMALS

Aquatic Animals

- Use dissolved oxygen for breathing
- Breathing rate is faster
- E.g. Gills are present in fishes

Terrestrial Animals

- Use atmospheric oxygen for breathing
- Breathing rate is slower
- E.g. Lungs present in terrestrial animals

HUMAN RESPIRATORY SYSTEM

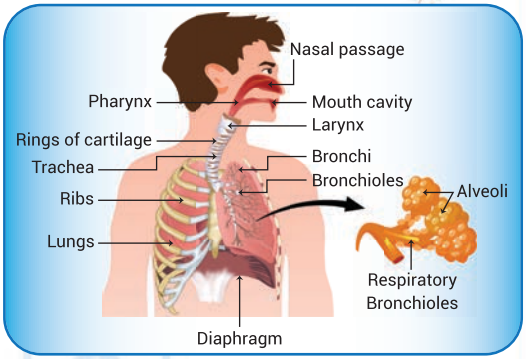
External nostrils
Help in intake of O_2 and release of CO_2

Nasal cavity
Contain hairs and mucus that trap the dust particles present in air

Pharynx
Common chamber for food and air

Larynx
Also known as voice box (Adam's apple in males)

Trachea
Made up of cartilaginous rings that prevent the collapsing of air passage



Bronchi and bronchioles
Trachea divides to form bronchi that enter both the lungs which further divide to form bronchioles

Haemoglobin
Respiratory pigment present in RBCs that helps in transport of O_2 and CO_2

CO_2 is more soluble in water than O_2 and hence it is mostly transported in dissolved form

MECHANISM OF BREATHING

Inhalation

- Intake of oxygen
- Ribs lift up and diaphragm contracts and flattens
- Volume of chest cavity increases
- Air flows into the lungs

Exhalation

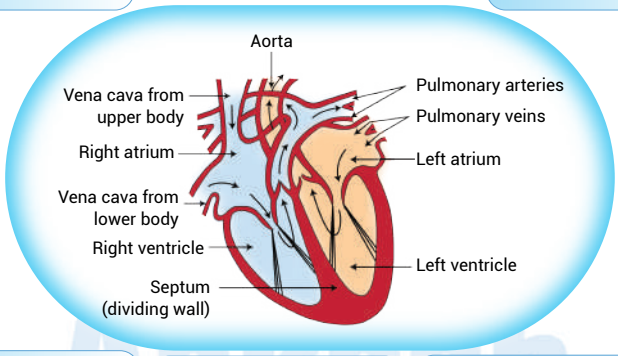
- Release of carbon dioxide
- Ribs return to normal position and diaphragm relaxes and becomes dome shaped
- Volume of chest cavity decreases
- Air is forced out of the lungs

Transportation in Human Beings

Heart is a muscular pumping organ, roughly the size of the fist

Heart contains two upper smaller chambers **(atria)** and two larger lower chambers **(ventricles)**

Valves in heart prevents the backward flow of blood

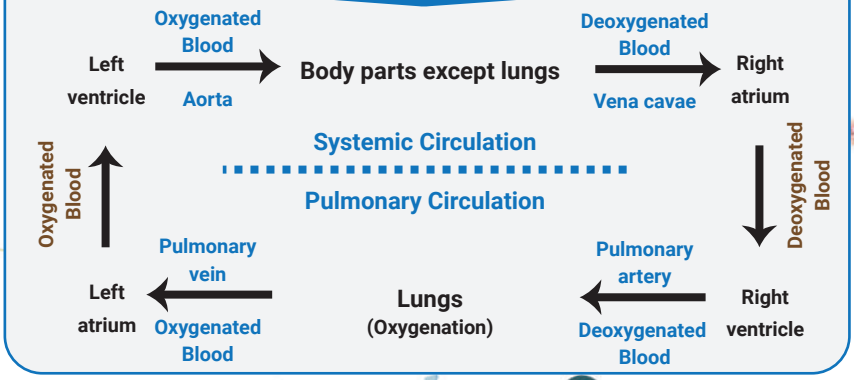


Right side of the heart **(right atrium)** receives deoxygenated blood from body tissues

Left side of the heart **(left atrium)** receives oxygenated blood from lungs through pulmonary vein

There is no mixing of oxygenated and deoxygenated blood as all the chambers are well separated through muscular wall

Double Circulation in Humans



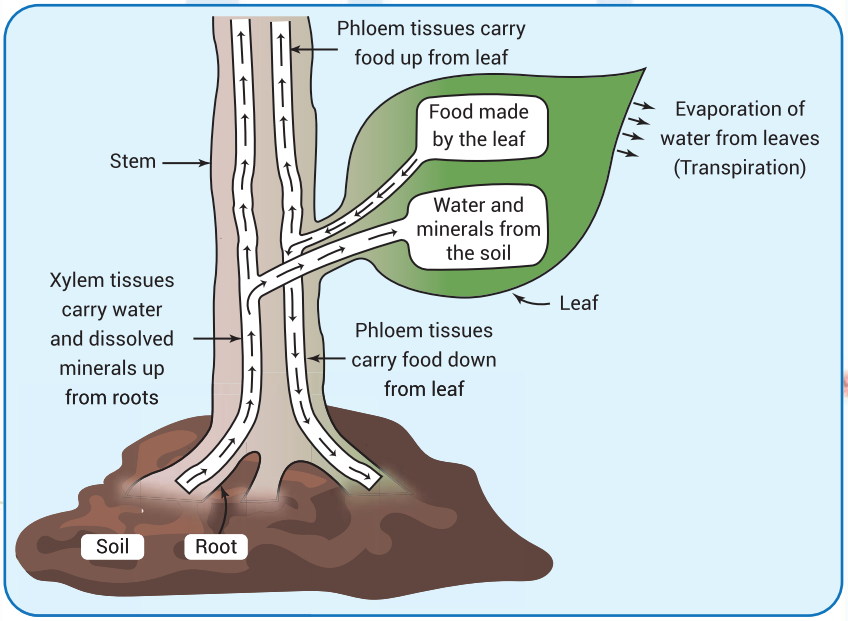
Transport of Molecules Across Plasma Membrane

Transportation of water and minerals

- Occurs through xylem
- Movement of water is unidirectional
- Root pressure and transpiration are the driving force
- Energy is not required
- **Transpiration** is the loss of water from aerial parts of the plant in the form of vapours

Transportation of food

- Occurs through phloem
- Movement of food is bidirectional
- Occurs from site of synthesis to the site of requirement
- Energy is required
- **Translocation** is the movement of materials from leaves to other parts of the plant



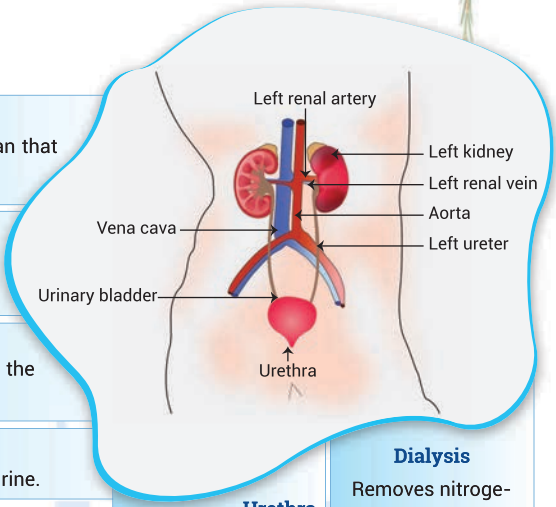
Excretion in Human Beings

Kidneys
One in pair, main excretory organ that filters the blood to form urine.

Nephron
Basic structural & functional unit of kidney that filters blood.

Ureter
Two in number & it connects the kidneys to the urinary bladder

Urinary bladder
Site for temporary storage of urine.

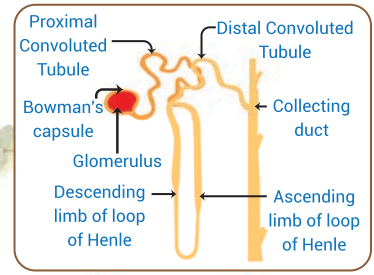


Urethra
Common passage for urine and sperm.

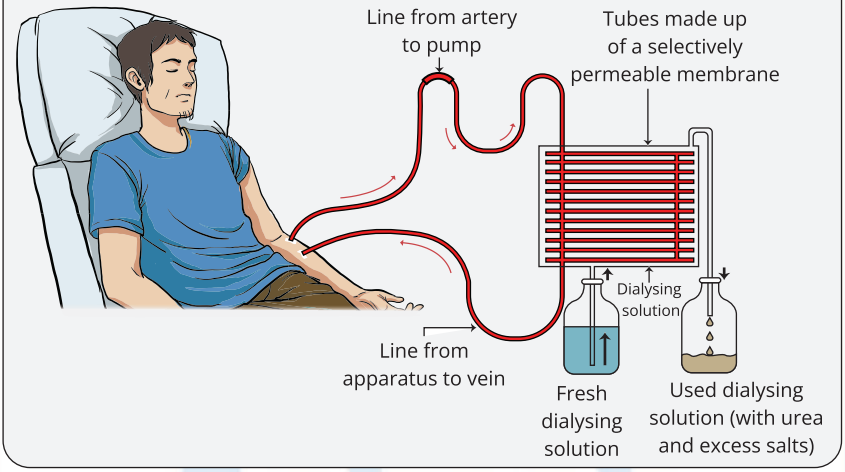
Dialysis
Removes nitrogenous waste through artificial kidney

Structure of Nephron

- **Malpighian body or renal corpuscle**
  - Glomerulus
  - Bowman's capsule
- **Renal tubules**
  - Proximate convoluted tubule (PCT)
  - Henle's loop
  - Distal convoluted tubul (DCT)



Hemodialysis



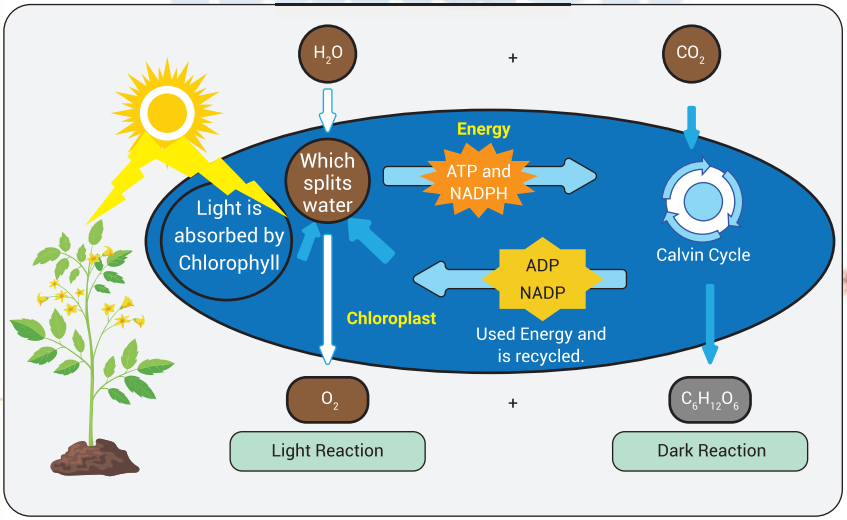
Excretory Wastes in Plants

- Shedding of leaves containing waste products
- Oxygen, a waste product of photosynthesis
- Excess water released through transpiration
- Resins and Gums
- Root exudates in soil

Mechanism of Photosynthesis

Light dependent phase/Photochemical phase/Light reaction/Hill's reaction	Light independent phase/Biosynthetic phase/Dark reaction/Blackman's reaction
Occurs in thylakoid membrane of chloroplast.	Occurs in stroma of chloroplast (a type of plastid).
Light absorption occurs.	No light absorption.
Splitting of water occurs.	No water splitting.
Oxygen is liberated.	Carbon dioxide is fixed.
ATP and NADPH are produced.	ATP and NADPH are used to produce energy.

Photosynthesis



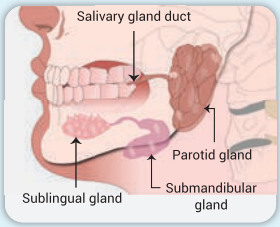
Human Teeth

Tooth Type	Function	Number in Children	Number in Adult
Incisors	Cutting of food	8	8
Canines	Tearing of food	4	4
Premolars	Chewing and grinding of food	0	8
Molars		8	12
Dental formula		$\frac{2102}{2102}$	$\frac{2123}{2123}$

Digestive Glands in Human Body

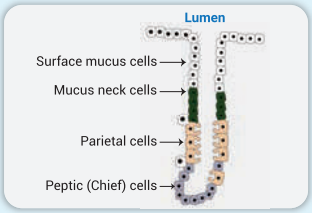
Salivary gland

- Location: Buccal cavity
- Secretion: Saliva, salivary amylase
- Function: Lubrication of food, digestion of starch
- Parotid is the largest and sublingual is the smallest salivary gland.



Gastric gland

- Location: Stomach lining
- Secretion: Mucus, pepsinogen, HCl, gastric lipase
- Function: Digestion of protein, HCl makes the medium acidic
- Peptic cells and parietal cells secrete enzyme and HCl respectively.

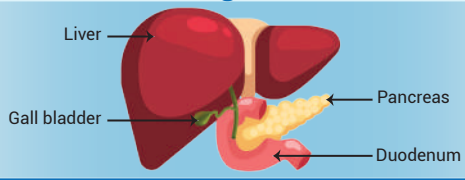


Liver

- Location: Right side of abdomen
- Secretion: Bile juice with bile pigments & bile salts
- Function: Digestion of fat, storage of Vitamin A, D, E, K and B_{12}
- Largest gland in the human body that contains Kupffer cells (phagocytic cells).

Pancreas

- Location: Limbs of duodenum
- Secretion: Pancreatic juice
- Function: Digestion of proteins, fats and carbohydrates
- Heterocrine gland with both exocrine and endocrine part.



Respiratory Organs in Different Animals

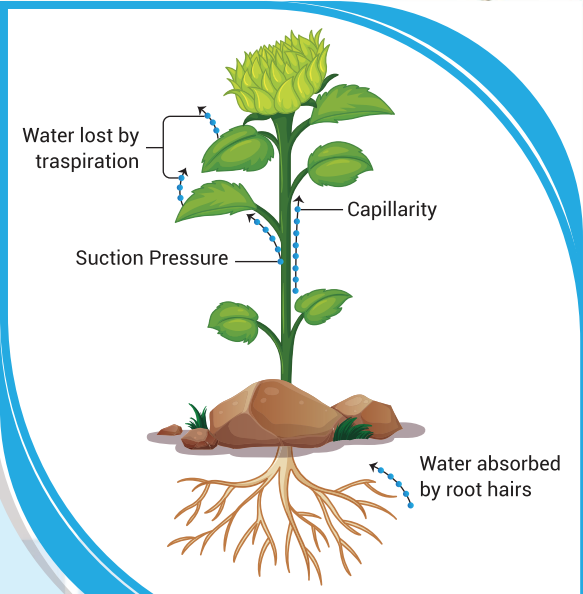
Respiratory Organs	Examples
Body surface	*Amoeba*, sponges
Trachea	Insects (cockroach)
Skin	Frogs, earthworms
Gills	Fishes
Lungs	Terrestrial animals
Book lung	Scorpions, spiders

Breathing VS Respiration

Breathing	Respiration
Involves inspiration (O_2) and expiration (CO_2).	Involves oxidation of food to release energy, CO_2 and H_2O.
Energy is not released.	Energy is released in the form of ATP.
It is a physical process.	It is a biochemical process.
It is an extracellular process.	It is both extracellular and intracellular process.

Transporation in Plants

Transpiration is the major driving force behind transportation in plants



Transpiration is the loss of water from aerial parts of the plants in the form of water vapours

Cuticular Transpiration
Occurs through cuticle (waxy covering)

Lenticular Transpiration
Occurs through lenticels (minute pores on the bark)

Stomatal Transpiration
Occurs through stomata (minute pores in the epidermis of leaf)

Respiration in plants

Compensation point

Point on the graph where amount of carbon dioxide released during respiration becomes equal to the amount of carbon dioxide utilized in photosynthesis.

Methods of Water Absorption in Plants

Passive Absorption

- Energy independent process
- Movement of water occurs along the concentration gradient

Active Absorption

- Energy dependent process
- Movement of water occurs against the concentration gradient

Types of Blood Cells

Characteristics	Red Blood Cells	White Blood Cells	Platelets
Formation	Erythropoiesis	Leucopoiesis	Thrombopoiesis
High count	Polycythemia	Leucocytosis	Thrombocytosis
Low count	Erythrocytopenia	Leucocytopenia	Thrombocytopenia
Function	Help in transport of O_2 and CO_2	Help the body to fight against infections	Help in blood clotting

Cardiac Cycle in Humans

Sequential events that are repeated cyclically in heart form **cardiac cycle**

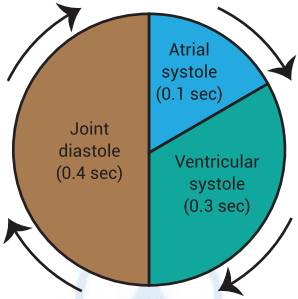
One cardiac cycle constitutes one heart beat **(0.8 sec)**.

Events occurring during Cardiac Cycle

Atrial Systole

Contraction of atria

Filling of remaining 30% ventricles



Joint Diastole

Chambers of heart are relaxed

Filling of both the ventricles occurs by 70%

Ventricular Systole

Contraction of ventricles

Deoxygenated blood is pumped into lungs and oxygenated blood is pumped in the body

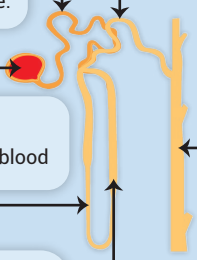
Role of Nephron in Urine Formation

Glomerular Filtration	Tubular Reabsorption	Tubular Secretion
Waste material brought by renal artery along with blood is filtered out from glomerulus into Bowman's capsule.	About 99% of the filtrate is reabsorbed back into the blood either actively (amino acids, Na+) or passively (nitrogenous wastes)	H^+, K^+ and ammonia are secreted into the filtrate to maintain ionic and acid base balance of body fluids

Function of Renal Tubules

Proximal Convoluted Tubule
Reabsorbs nutrients, 70-80% electrolytes & water and secretes H^+, NH_3 & K^+ ions to maintain pH and ionic balance.

Distal Convoluted Tubule
Reabsorbs Na^+, water & HCO^{3-} and secretes H^+, NH_3 & K^+ ions to maintain pH & sodium-potassium balance in blood.



Collecting Duct
Reabsorbs water to produce concentrated urine and secretes H^+ & K^+ ions to maintain pH & ionic balance.

Glomerulus
Filters small solutes from the blood

Descending limb of loop of Henle
Permeable to water but impermeable to electrolytes. This concentrates the filtrate as it moves down.

Ascending limb of loop of Henle
Impermeable to water but permeable to electrolytes. This dilutes the filtrate as it moves up.

Points to Remember

Glycogen is reserve food material in animals.

Sphygmomanometer is used to measure blood pressure

Cuscuta (amarbel), ticks, tape worms have parasitic mode of nutrition.

Amoeba obtains its food by producing pseudopodia.

Normal systolic & diastolic pressures are **120** & **80** mm Hg respectively

All reptiles have three chambered heart except **crocodile**.

REAL NUMBERS

A number that can be represented by a unique point on a number line is a **Real Number**.

Or

The collection of all rational and irrational numbers are called **Real Number**.

Real Number

- **Rational number**: $\frac{p}{q}$, $q \neq 0$ form, where p, q are any integers)
- **Irrational number**: not of the form $\frac{p}{q}$, $q \neq 0$, where p, q are any integers)

Natural Number (1, 2, 3,.....)

Whole Number (0, 1, 2, 3,.....)

Integers (..., −1, 0, 1, ...)

- +Ve integers (1, 2, 3,...)
- −Ve integers (...., −3, −2, −1)

Non-negative integer number (0, 1, 2, 3, ...)

Non-positive integer number (..., −3, −2, −1, 0)

Zero is neither positive nor negative number, it is a neutral number.

FUNDAMENTAL THEOREM OF ARITHMETIC

Every composite number can be expressed as a product of primes, and this expression is unique, apart from the order in which they appear.

THEOREM

Let p be a prime number and a be a positive integer. If p divides a^2, then p divides a also.

APPLICATIONS OF FUNDAMENTAL THEOREM OF ARITHMETIC

- To find HCF and LCM of two or more positive integers
- To prove irrationality of numbers
- To determine the nature of the decimal expansion of rational numbers

HCF AND LCM OF TWO NUMBERS

HCF (a, b) Product of smallest powers of each common prime factors.

LCM (a, b) Product of greatest powers of each prime factors involved in the numbers.

For any two positive integers a & b, $HCF(a, b) \times LCM(a, b) = a \times b$

Note: $a \times b \times c \neq HCF(a, b, c) \times LCM(a, b, c)$; $a, b, c \in I^+$

FOR PROVING IRRATIONALITY OF NUMBERS, REMEMBER:–

STEP 01 The sum or difference of a rational and an irrational number is irrational.

STEP 02 The product and quotient of a non-zero rational and an irrational number is irrational.

STEP 03 The product of 2 irrational numbers may or may not be irrational

STEP 04 The sum or difference of two irrational numbers may or may not be irrational

IRRATIONAL NUMBER

A number a is called an irrational if it can't be written in the form $\frac{p}{q}$ where p and q are integers and $q \neq 0$

Theorem

If p is a prime number, then $\sqrt{p}$ is irrational.

E.g. $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, $\sqrt{6}$ etc.

- Pi, π = 3.14159265358979...

HCF AND LCM OF THREE NUMBERS

LCM (a, b, c)

$$\frac{a.b.c.\ HCF\ (a, b, c)}{HCF\ (a, b)\ .\ HCF\ (b, c)\ .\ HCF\ (a, c)}$$

HCF (a, b, c)

$$\frac{a.b.c.\ LCM\ (a, b, c)}{LCM\ (a, b)\ .\ LCM\ (b, c)\ .\ LCM\ (a, c)}$$

LCM AND HCF OF FRACTIONS

LCM of fractions $= \frac{\text{LCM of numerators}}{\text{HCF of denominators}}$

HCF of fractions $= \frac{\text{HCF of numerators}}{\text{LCM of denominators}}$

CONCEPT OF UNIT'S DIGIT

Unit's digit of number (x)	Unit's digit of number (x^n)	Cyclicity of Number
0	0	1
1	1	1
2	2, 4, 6, 8	4
3	3, 9, 7, 1	4
4	4, 6	2
5	5	1
6	6	1
7	7, 9, 3, 1	4
8	8, 4, 2, 6	4
9	9, 1	2

Note: The fifth power of any number has the same unit place digit as the number itself.

FACTORS / DIVISORS

Let N be a composite number, then its prime factorisation be $N = a^p \cdot b^q \cdot c^r \cdot d^s \ldots$

1. Total Number of divisors or factors of $N = (p + 1)(q + 1)(r + 1) \ldots$
2. Sum of all the factors of $N = \left(\frac{a^{p+1} - 1}{a - 1}\right)\left(\frac{b^{q+1} - 1}{b - 1}\right)\left(\frac{c^{r+1} - 1}{c - 1}\right) \ldots\ldots$

3 Product of all the factors of N = $(N)^{\frac{\text{Total divisors}}{2}}$

4 If $N = (x)^a(y)^b(z)^c$ where x, y, z are prime factors

- Number of even factors of N = (a) (b + 1) (c + 1) [N must contain 2 at least once.]
- Number of odd factors of N = (b + 1) (c + 1) [The exponent of 2 i.e. a has to be 0 always]

Euclid's Division Lemma

THEOREM

Given positive integers a and b, there exist unique integers q and r satisfying $a = bq + r$, $0 \le r < b$ (here, $a > b$)

Important observations about quotient and remainders

(a) Quotient q is a positive integer when a is greater than or equal to b.

(b) Quotient q = 0, when a < b

(c) Remainder r is a whole number whose value is less than b.

Lemma is a restatement of the long division process which we have been doing for the last many years OR we can say, a lemma is proven statement used for proving another statement.

Euclid's Division Algorithm

It is a technique to compute the highest common factor (HCF) of two given positive integers.

To obtain the HCF of two positive integers p and q with p > q, we use following steps

1. Find whole numbers a and b such that $p = aq + b$ $(0 \le b < q)$
2. If b = 0, then q is the HCF of p and q. If $b \neq 0$ apply division lemma to q and b.
3. Continue the process until we get remainder zero. Divisor at the step where we get remainder 0 is the required HCF

NATURE OF DECIMAL EXPANSION OF RATIONAL NUMBER

Rational Number

Terminating Decimal expansion

$x = \frac{p}{q}$, $q \neq 0$, p & q are coprime

q is of the form : $2^m.5^n$, where m and n are non-negative integers.

E.g. $\frac{7}{100} = \frac{7}{2^2 \times 5^2} = 0.07$

q can be of the form: $2^m \cdot 5^n$ also

E.g. $\frac{7}{2} = 3.5$, $\frac{7}{5} = 1.4$

'x' terminates after K place of decimal, where K is the greater number among m and n. i.e.

K = max (m, n)

Before checking whether a fraction is terminating or non-terminating it should first be reduced to its simplified form.

Non-terminating repeating decimal expansion

$x = \frac{p}{q}$, $q \neq 0$, p & q are coprime

q is not of the form : $2^m.5^n$ where m and n are non-negative integers.

E.g. $\frac{7}{30} = \frac{7}{2 \times 3 \times 5}$

POLYNOMIALS

The degree of a polynomial is the highest power of x in the given polynomial.
Degree of polynomial is always a whole number.

TYPES OF POLYNOMIALS BASED ON THEIR DEGREES

Type of Polynomial	Degree	Form
Constant	0	$p(x) = a$
Linear	1	$p(x) = ax + b$
Quadratic	2	$p(x) = ax^2 + bx + c$
Cubic	3	$p(x) = ax^3 + bx^2 + cx + d$
Bi-quadratic	4	$p(x) = ax^4 + bx^3 + cx^2 + dx + e$

Zero (0) is called zero polynomial

Degree of the zero polynomial is not defined

The value of the polynomial p(x) for any real number α is obtained after replacing x by α in p(x). This is known as the value of the polynomial at $x = \alpha$ and it is denoted by $p(\alpha)$.

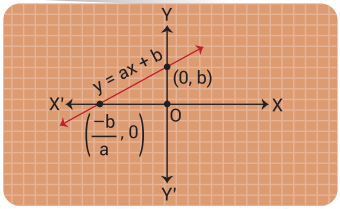
The zero(s) of a polynomial is the value of x for which the value of the polynomial becomes zero.

Geometrical meaning of the zeroes of a polynomial

Zero(s) of a polynomial p(x) would be those point where graph of the polynomial p(x) will cut or touch the x-axis.

If it is given that the polynomial is in variable "y", then p(y) will cut or touch the y-axis.

1. Graph of Linear Polynomial

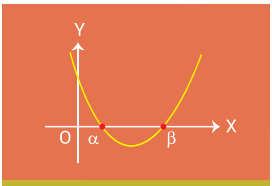


- $p(x) = ax + b, a \neq 0$
- Graph of linear polynomial is always a straight line.
- A linear polynomial has exactly one zero and its graph intersects the x-axis at atmost one point.

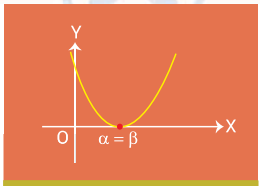
2. Graph of Quadratic Polynomial

- The graph of a quadratic polynomial is parabolic in nature.
- It looks like a ∪ shape curve which either opens upward or opens downward depending on the value of 'a' in $y = ax^2 + bx + c, a \neq 0$
- If a > 0, then parabola open upwards like ∪
- If a < 0, then parabola open downwards like ∩
- Graph of quadratic polynomial can cut the x-axis at 0, 1 or two points.

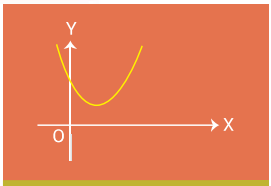
Case - I : When a > 0 (parabola open upwards)



Zeroes are real & distinct

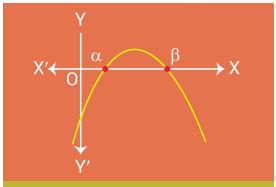


Zeroes are real & equal

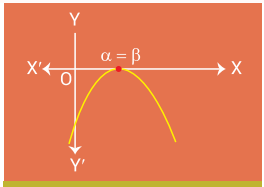


There are no zeroes

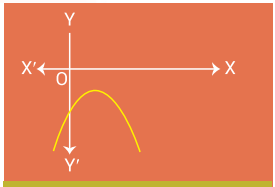
Case - II : When a < 0 (parabola open downwards)



Zeroes are real & distinct



Zeroes are real & equal



There are no zeroes

Graph of the polynomial $y = x^n$, n is a whole number.

- A polynomial p(x) of degree n, the graph of y = p(x) intersects the x-axis at most n points.
- A polynomial p(x) of degree n has atmost n zeroes.

RELATIONSHIP BETWEEN ZEROES AND COEFFICIENTS OF A POLYNOMIAL

Polynomial	Form	Number of Zero(s)	Relation
Linear	$ax + b, a \neq 0$	1	$K = \frac{-b}{a}$, K = constant (Zero of the polynomial)
Quadratic	$ax^2 + bx + c, a \neq 0$	2	$\alpha + \beta = \frac{-b}{a}$, $\alpha\beta = \frac{c}{a}$
Cubic	$ax^3 + bx^2 + cx + d, a \neq 0$	3	$\alpha + \beta + \gamma = \frac{-b}{a}$, $\alpha\beta\gamma = \frac{-d}{a}$, $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$

- If we need to form a polynomial of degree two, when sum and product of zeroes are given, then $K[x^2 - (\alpha + \beta)x + \alpha\beta]$ is the required polynomial, $K \neq 0$
- For cubic polynomial,
  $K[x^3 - (\alpha + \beta + \gamma)x^2 + (\alpha\beta + \beta\gamma + \gamma\alpha)x - \alpha\beta\gamma]$, $K \neq 0$

Division Algorithm for Polynomials

If p(x) and g(x) are any two polynomials with $g(x) \neq 0$, then we can find polynomials q(x) and r(x) such that

$p(x) = g(x).q(x) + r(x)$, where

r(x) = 0 or degree of r(x) < degree of g(x).

Extra Notes

Division algorithm for real numbers:

Divident = Divisor × Quotient + Remainder

$p(x) = g(x)\, q(x) + r(x)$

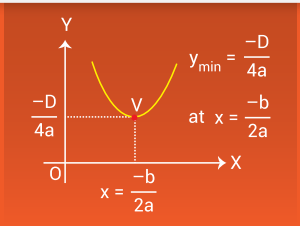
Extra Notes

A quadratic polynomial has at most two zeroes and the graph intersect the x-axis at the points equal to the number of zeroes of the polynomial.

If $y = ax^2 + bx + c, a \neq 0$

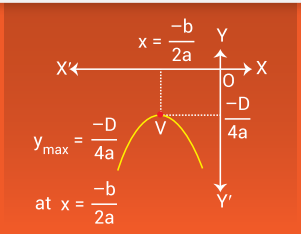
If quadratic expression is positive i.e. y > 0 then,

a > 0 & D < 0, where D is discriminant of polynomial given by, $D = b^2 - 4ac$



If quadratic expression is negative i.e. y < 0 then,

a < 0 & D < 0, where D is discriminant of polynomial given by, $D = b^2 - 4ac$



Extra Notes

Bi-quadratic polynomial, $ax^4 + bx^3 + cx^2 + dx + e = 0, a \neq 0$

- $\alpha + \beta + \gamma + \delta = \frac{-b}{a}$
- $(\alpha + \beta)(\gamma + \delta) + \alpha\beta + \gamma\delta = \frac{c}{a}$
- $(\alpha + \beta)\gamma\delta + (\gamma + \delta)\alpha\beta = \frac{-d}{a}$
- $\alpha\beta\gamma\delta = \frac{e}{a}$

Identification of Signs of Coefficients of a Quadratic Polynomial

For Nature of a:

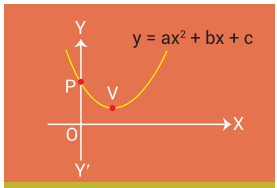
If a > 0, then graph opens upwards and if a < 0, then graph opens downwards.

For Nature of c:

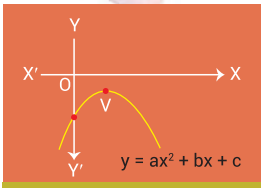
If graph cuts y-axis above the origin, then c > 0 and c < 0 when it cuts y-axis below the origin. But at origin, c = 0.

For Nature of b:

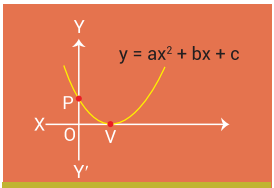
For checking the nature of b, we will check the sign of **abscissa** of the **vertex** $\left(\frac{-b}{2a}\right)$



a > 0, c > 0, b < 0



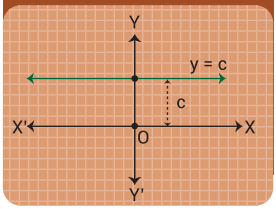
a < 0, c < 0, b > 0



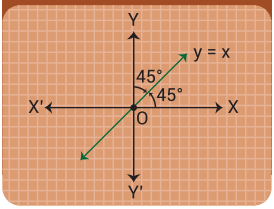
a > 0, c > 0, b < 0

SPECIAL GRAPH OF POLYNOMIALS

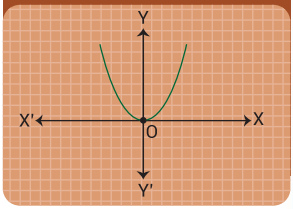
y = c (Constant Polynomial)



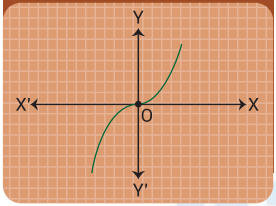
y = x (Linear Polynomial)



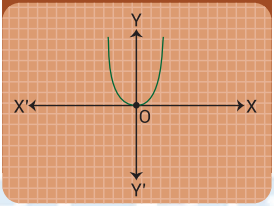
y = x^2 (Quadratic Polynomial)



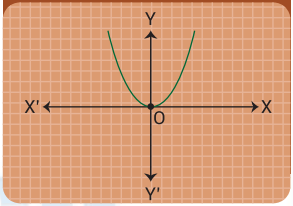
y = x^3 (Cubic Polynomial)



y = x^4 (Biquadratic Polynomial)

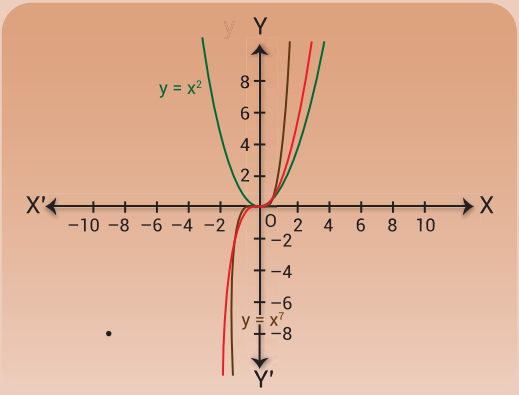


y = x^2 = $|x^2|$ = $|x|^2$



Graph of the polynomial y = x^n, n is a whole number.

- As n increases, the graph becomes steeper or draws closer to the y-axis
- If n is odd, the graph lies in the first & third quadrants.
- If n is even, the graph lies in the first & second quadrants.
- The graph of y = $-x^n$ is the reflection of the graph of y = x^n on the x-axis



PAIR OF LINEAR EQUATIONS IN TWO VARIABLES

Linear Equations in Two Variables

$ax + by + c = 0$, where a and b both are not zero & a, b, c $\in$ R

A pair of two linear equations

$a_1x + b_1y + c_1 = 0$ & $a_2x + b_2y + c_2 = 0$

is called a system of simultaneous linear equations in two variables :

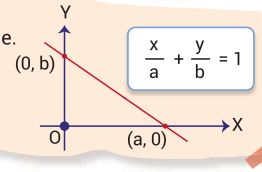
$a_1, a_2, b_1, b_2, c_1, c_2 \in R$ | $a_1^2 + b_1^2 \neq 0$ & $a_2^2 + b_2^2 \neq 0$

A pair of values of the variables x and y satisfying each one of the equations in a given system of two simultaneous linear equations in x & y is called the solution of the system of equations.

NOTE

Graph of a linear equation is always a straight line.

- (a, 0) & (0, b) are the solutions of given equation of straight line.



Consistent System

- A system consisting of a pair of linear equations in two variables is said to be consistent if it has at least one solution.
- The system consisting of a pair of linear equations in two variables having infinitely many solutions is also called the "Consistent system of dependent equations".

Inconsistent System

- A system consisting of a pair of linear equations in two variables is said to be inconsistent if it has no solution.

A pair of linear equations in two variables can be represented and solved by

Graphical Method

The graph of a pair of linear equations in two variables is represented by two lines.

Algebraic Method

Following are the methods for finding the solutions of a pair of linear equations:

(a) Substitution method

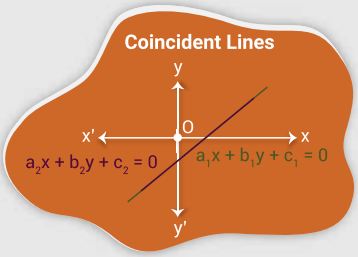
(b) Elimination Method

Condition for Consistency

Let the two equations be: $a_1x + b_1y + c_1 = 0$ & $a_2x + b_2y + c_2 = 0$ then

Relation between coeff. of the pair of Linear equations	Graph	Number of Solutions	Consistency of System
$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	Intersecting Lines: $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$	Exactly One Solution (Unique)	Consistent
$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	Parallel Lines: $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$	No Solution	Inconsistent

$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$



Infinitely many Solutions — Consistent

Solution of Pair of Linear Equations in Two Variables Algebraically

1 Substitution Method

STEP 1

From one of the equations, express one of the variables say 'y' in terms of the other variable 'x'.

STEP 2

Substitute the value of y, obtained in above step, in other equation, getting an equation in x.

STEP 3

Solve the equation and get the value of x.

STEP 4

Substitute the value of x in expression for y obtained in first step and get the value of y.

2 Elimination Method or Equating the Coefficients

STEP 1

In the two given equations, make the coefficients of one of the variables in both equations numerically equal. To do so, multiply these coefficients by suitable constant.

STEP 2

Add or subtract the equations obtained in above step accordingly as the terms having same coefficients are of the opposite or of the same signs and get an equation in only one variable.

STEP 3

Solve the equation obtained in step 2 and get the value of one of the variables.

STEP 4

Substitute the value of this variable in either of the two given equations and find the value of the other variable.

Cross Multiplication Method

Let $a_1x + b_1y + c_1 = 0$ & $a_2x + b_2y + c_2 = 0$

a_1, b_1 not equal to zero
a_2, b_2 not equal to zero
$a_1, a_2, b_1, b_2, c_1, c_2 \in R$

then, $\frac{x}{b_1 \times c_2 - b_2 \times c_1} = \frac{y}{c_1 \times a_2 - c_2 \times a_1} = \frac{1}{a_1 \times b_2 - a_2 \times b_1}$

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{b_2a_1 - b_1a_2}$$

$$x = \frac{b_1c_2 - b_2c_1}{b_2a_1 - b_1a_2} \qquad y = \frac{c_1a_2 - c_2a_1}{b_2a_1 - b_1a_2}$$

provided $a_1b_2 - a_2b_1 \neq 0$

NOTE

To apply the above formula all the terms must be in the **left** to the equal sign in the system of equations.

Equations Reducible to Pair of Linear Equations in Two Variables

1. $\frac{a}{u} + \frac{b}{v} = c$ & $\frac{a'}{u} + \frac{b'}{v} = c'$ → Convert to → $ax + by = c$ & $a'x + b'y = c'$ Now solve for x & y

   where $\frac{1}{u} = x$ & $\frac{1}{v} = y$, also a, b, c a', b', c', (u, v) ∈ R, u, v ≠ 0

2. $au + bv = cuv$ & $a'u + b'v = c'uv$ → Divide both side by uv & Convert to → $\frac{a}{v} + \frac{b}{u} = c$ & $\frac{a'}{v} + \frac{b'}{u} = c'$

   Now proceed as explained in method (1)

3. $\frac{a}{lx+my} + \frac{b}{cx+dy} = k$ & $\frac{a'}{lx+my} + \frac{b'}{cx+dy} = k'$ → Convert to → $\frac{a}{u} + \frac{b}{v} = k$ & $\frac{a'}{u} + \frac{b'}{v} = k'$

   where $\frac{1}{lx+my} = u$ & $\frac{1}{cx+dy} = v$

   Now further proceed as explained in method (1)

SOLUTION OF PAIR OF LINEAR EQUATIONS OF THE FORM ax + by = c AND bx + ay = d, WHERE a ≠ b

STEP 1

$ax + by = c$ ..... (I)

$bx + ay = d$ ..... (II)

STEP 2

Add, equation I & II then

$x + y = \frac{c+d}{a+b}$ ..... (III)

STEP 3

Subtract, equation II from I then

$x - y = \frac{c-d}{a-b}$ ..... (IV)

STEP 4

Solve equation III & IV to get the value of x & y.

Equations of Different Form

$a_1x + b_1y = c_1$ $\quad$ $a_2y + b_2z = c_2$ $\quad$ $a_3z + b_3x = c_3$

STEPS TO SOLVE THESE EQUATIONS

Take any one equation → Obtain the value of one of the variable (x) → Substitute the value of variable (x) obtained in remaining equations → Solve these two remaining equation to get y & z → Put the value of y & z in any equation to get the value of x

NOTE

There are several situations which can be mathematically represented by two equations that are not linear to start with. But we allow them so that they are reduced to a pair of linear equations.

QUADRATIC EQUATIONS

- A polynomial of degree 2 is known as a quadratic polynomial.
- Standard form of quadratic polynomial is $p(x) = ax^2 + bx + c$, $a, b, c \in R$, $a \neq 0$
- A quadratic equation in the variable x is an equation of the form

$$ax^2 + bx + c = 0, \quad a, b, c \in R \ \& \ a \neq 0$$

- This is also called "Standard form of quadratic equation."

Roots of Quadratic Equation

- A real number 'α' is called a root of the quadratic equation

$$ax^2 + bx + c = 0, \ a \neq 0 \quad \text{if} \quad a\alpha^2 + b\alpha + c = 0$$

- Roots of Q.E. $ax^2 + bx + c = 0, a \neq 0$, is given by

$$x = \frac{-b \pm \sqrt{D}}{2a}, \ D = b^2 - 4ac$$

- It is also called "Sridharacharya" formula.

Method for solving Quadratic Equation

a. By factorisation method

b. By direct formula method i.e. $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Nature of Roots

Let $ax^2 + bx + c = 0$, $a \neq 0$ then its root is given by

$$x = \frac{-b \pm \sqrt{D}}{2a}, \ D = b^2 - 4ac$$

a. if $D = 0 \Rightarrow$ roots are real and equal

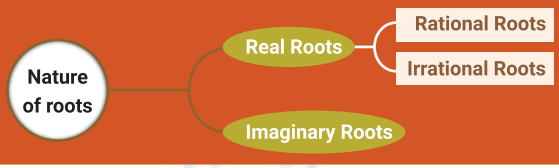
b. if $D > 0 \Rightarrow$ roots are real and distinct

c. if $D < 0 \Rightarrow$ roots are imaginary

NOTES

Another method of solving a quadratic equation is Completing the Square Method.

NOTES



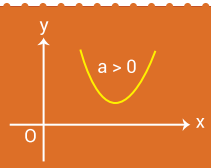
Graphical representation of nature of roots of Quadratic equation

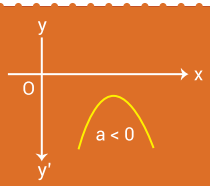
Geometrically, a Quadratic equation represents a parabola.

Case I D = 0 [real and equal roots]

Case II D > 0 [real and distinct roots]

Case III D < 0 [Imaginary roots]

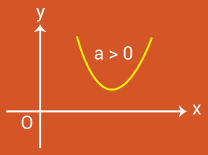


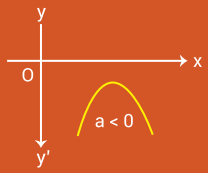


In each cases, vertex of parabola is given by $V\left(\frac{-b}{2a}, \frac{-D}{4a}\right)$

NOTES

If $f(x) = ax^2 + bx + c$





a $f(x) > 0$ when $a > 0$ & $D < 0$

$y_{min} = \frac{-D}{4a}$ at $x = \frac{-b}{2a}$

b $f(x) < 0$ when $a < 0$ & $D < 0$

$y_{max} = \frac{-D}{4a}$ at $x = \frac{-b}{2a}$

Important points regarding nature of roots of quadratic equations.

$ax^2 + bx + c = 0, a \neq 0, a, b, c \in R$

01 If D is perfect square, then roots are rational provided that a, b, c are rational. Otherwise roots may be irrational.

02 If D is perfect square and a = 1 and b, c are integers, then roots must be integers.

03 Irrational roots always occurs in conjugate pair, i.e. if one root is $\alpha + \sqrt{\beta}$, then other root must be $\alpha - \sqrt{\beta}$ provided that all the coefficients are rational.

04 If roots of the given quadratic equation $ax^2 + bx + c = 0$ are equal in magnitude but opposite in signs, then coefficient of $x = 0$ i.e. $b = 0$

05 If one root of $ax^2 + bx + c = 0$ is reciprocal of the other, then the coefficient of x^2 = constant term. i.e. $c = a$

06 If the sum of the coefficients of $ax^2 + bx + c = 0$ is zero (i.e. if $a + b + c = 0$), then the roots of the equation are 1 and $\frac{c}{a}$

Similarly, if $a - b + c = 0$, then the roots of $ax^2 + bx + c = 0$ are -1 and $\frac{c}{a}$

07 A quadratic equation, whose roots are α and β can be written as $K(x - \alpha)(x - \beta) = 0, K \neq 0$

08 If a quadratic equation $ax^2 + bx + c = 0$ has more than two roots, then it is an identity i.e. it is true for all values of x and $a = b = c = 0$

Extraneous Root: A value obtained for an unknown in the solution of an equation which is not a root of the equation.

Solutions of Some Important Inequalities

01 $ax - b > 0 \Rightarrow x > \frac{b}{a}$ if $a > 0$ and $x < \frac{b}{a}$ if $a < 0$

02 $x^2 - a^2 > 0 \Rightarrow x < -a$ or $x > a$

03 $x^2 - a^2 \geq 0 \Rightarrow x \leq -a$ or $x \geq a$

04 $x^2 - a^2 < 0 \Rightarrow -a < x < a$

05 $x^2 - a^2 \leq 0 \Rightarrow -a \leq x \leq a$

06 $x^2 + a^2 \geq 0 \Rightarrow x \in R$

07 $(x - a)(x - b) > 0, a < b \Rightarrow x < a$ or $x > b$

08 $(x - a)(x - b) \geq 0, a < b \Rightarrow x \leq a$ or $x \geq b$

09 $(x - a)(x - b) < 0, a < b \Rightarrow a < x < b$

10 $(x - a)(x - b) \leq 0, a < b \Rightarrow a \leq x \leq b$

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