

# General Science

## PHYSICS

**Physics** is the branch of science which deals with the study of matter, energy, and the interaction between them.

### PHYSICAL QUANTITIES

In physics, large number of physical quantities can be broadly classified into two categories- Scalars & Vectors.

- A **scalar** is a physical quantity that has only a magnitude (size) E.g. : Distance, speed, time, power, energy, etc.
- A **vector** is a physical quantity that has both a magnitude and a direction. E.g. Velocity, displacement, acceleration, force, etc.

Some physical quantities like moment of **inertia**, **stress**, etc. are neither scalar nor vector. They are **tensor**.

### Fundamental and Derived physical Quantities and their units

#### Seven Fundamental Physical Quantities and their Units

Physical Quantity	SI Unit	Symbol
Length	meter	<i>m</i>
Mass	kilogram	<i>Kg</i>
Time	second	<i>S</i>
Electric Current	ampere	<i>A</i>
Temperature	kelvin	<i>K</i>
Luminous intensity	candela	<i>Cd</i>
Amount of substance	mole	<i>mol</i>

#### Some Derived Physical Quantities and their Units

S. No	Physical Quantity	egs unit	SI unit	Relation
1.	Force	dyne	newton	1 newton = $10^5$ dyne
2.	Work	erg	joule	1 joule = $10^7$ erg

### NEWTON'S LAWS OF MOTION

- **First law of Motion** - *An object at rest will remain at rest or in uniform motion remains in uniform motion unless acted on by an external unbalanced force.*  
This law is often called the law of inertia. i.e., resistance to change.
- **Second law of Motion** - *The rate of change of momentum of a body is directly proportional to the unbalanced*

*external force applied on it.*

$$\text{i.e., } \vec{F} \propto \frac{d\vec{p}}{dt} \text{ or, } \vec{F} = k \frac{d\vec{p}}{dt} \text{ or } \vec{F} = m\vec{a}$$

Force  $\vec{F} = m\vec{a}$  where  $m$  = mass of the object and  $a$  = acceleration produced.

**Impulse:** If a large force acts on a body or particle for a smaller time, then impulse ( $J$ ) = **product of force and time**. Then,  $J = Ft$   $\vec{F}$  = force, and  $t$  = time So,  $J = Ft = m\Delta v$ .

Impulse = Change in momentum.

- **Third law of Motion** - *For every action there is an equal and opposite reaction.*

### Instances of Newton's Laws of Motion

#### First law of Motion

- A magician pulls a tablecloth out from under dishes and glasses on a table without disturbing them.
- A person's body is thrown outward as a car rounds a curve on a highway.

#### Second law of Motion

- Pushing a child on a swing is easier than pushing an adult on the same swing, because the adult has more inertia.
- A soccer player kicks a ball with his foot and the toes are left stinging.
- Two students are in a baseball game. The first student hits a ball very hard and it has a greater acceleration than the second student who bunts the ball lightly.

#### Third law of Motion

- Rockets are launched into space using jet propulsion where exhaust accelerates out from the rocket and the rocket accelerates in an opposite direction.

### CIRCULAR MOTION

- *Motion of a body along a circular path is called circular motion.*
- **Centripetal force** - while a body is moving along a circular path an external force required to act radially inward. This force is called centripetal force. Centripetal force  $F_c = \frac{mv^2}{r}$   
where  $r$  = radius of circular path.  
A pseudo force that is equal and opposite to the centripetal force is called **centrifugal force**.  
**Cream separator**, centrifugal dryer, etc, work on the principle of centrifugal force.

## FRICTION

Friction is a force that is created whenever two surfaces move or try to move across each other.

- Friction always opposes the motion or attempted motion of one surface across another surface.
- Friction is dependent on the texture of both surfaces.
- Friction is also dependent on the amount of contact force pushing the two surfaces together.

### Instances where friction is important

1. Walking
2. Driving
3. Picking something up
4. Car brakes
5. Erosion in the environment
6. Burning up meteors in the atmosphere before they hit Earth.
7. Striking a match/building a fire.
8. Rubbing your hands together when it's cold.
9. Friction keeps knots from coming undone (like in shoelaces)

## WORK & ENERGY

- **Work** refers to an activity involving a force and movement in the direction of the force.

Work done  $w = Fs \cos\theta$

**Positive work** : If  $\theta < 90^\circ$

**Zero work** : If  $\theta = 90^\circ$

**Negative work** : If  $\theta > 90^\circ$

- A force of 20 newtons pushing an object 5 meters in the direction of the force does 100 joules of work.
- The **SI unit** of work is the **joule (J)**,
- Capacity of doing work is called *energy*.
- It may exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms.
- To do 100 joules of work, you must expend 100 joules of energy.
- Energy cannot be created or destroyed. It can only be transferred to other objects or converted into different forms. This is **Law of Conservation of energy**.
- The SI unit of energy is joule.
- It is a scalar quantity.
- The energy associated with motion is called **kinetic energy (K)**.  
 $K = \frac{1}{2}MV^2$  where M is mass and V is the velocity.
- The energy associated with position is called **potential energy (U)**.  
 $U = mgh$ ; where g is acceleration due to gravity and h is height of the object.

Conversion of Energy from one form to another :

**Dynamo** : Mechanical Energy into Electrical Energy.

**Electric Motor** : Electrical Energy into - Mechanical Energy.

**Microphone** : Sound Energy into Electrical Energy.

**Loud Speaker** : Electrical Energy into Sound Energy.

**Electric Bulb** : Electrical Energy into Light and Heat Energy.

**Solar Cell** : Solar energy into electrical energy.

**Candle** : Chemical Energy into light and heat energy.

**Sitar** : Mechanical Energy into Sound energy.

## POWER

- **Power** is the rate of doing work.
  - **Power = Work / time**
  - It is equivalent to an amount of energy consumed per unit time.
  - The **SI unit** of **power** is **joule/second**.
  - **One horse power** is equivalent of **746 watt**.
  - **Board of Trade Unit (B.O.T.U.)** : **kwh** (Kilo watt hour)  
1 kwh = 1 Unit  
 $= 3.6 \times 10^6$  joule
- This is to measure domestic electric energy consumption.

## GRAVITATION

- **Gravitation** is a natural phenomenon by which all physical bodies attract each other.
- On Earth, gravity gives weight to physical objects employing a downward force to keep them grounded.
- Gravitational force is always attractive. For example, earth always attracts us but never repels.
- It is **weakest force** among the four natural forces in nature i.e. electromagnetic, weak and strong nuclear force.
- If there are two objects of mass  $m_1$  and  $m_2$  and they are placed at distance  $r$  apart. Then force between them will be:  
 $F = G(m_1m_2)/r^2$   
where G is the universal gravitational constant.  
This is called **Newton's Universal Gravitational law**.
- $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$
- Gravitational force is a central and conservative force.
- They can operate over a very long distances.
- According to Newton's theory, the gravitational attraction between the planets and the sun holds the planets in elliptical orbits around the sun.
- The earth's moon and moons of the other planets are held in orbits by the attraction between the moons and the planets.
- The force of gravity depends upon the **object's mass** or the amount of matter in the object.
- The weight ( $w$ ) of an object is equal to the mass of the object multiplied by the acceleration due to gravity( $g$ ).  
 $W = mg$
- $g_{\text{maximum}}$  at poles and  $g_{\text{minimum}}$  at equator.
- $g_{\text{moon}} = \frac{1}{6} g_{\text{earth}}$
- The value of 'g' decreases with altitude, depth from the earth's surface.
- **g** decreases due to rotation of earth.

### Weight of a body in a lift

- (i) If lift is stationary or moving with uniform speed (either upward or downward), the apparent weight of a body is equal to its true weight.
- (ii) If lift is going up with acceleration, the apparent weight of a body is more than the true weight.
- (iii) If lift is going down with acceleration, the apparent weight of a body is less than the true weight.
- (iv) If the cord of the lift is broken, it falls freely. In this situation the weight of a body in the lift becomes zero. This is the situation of weightlessness.

- (v) While going down, if the acceleration of lift is more than acceleration due to gravity, a body in the lift goes in contact of the ceiling of lift.
- **Escape speed (ve)** is the minimum speed with which an object just crosses the earth's gravitational field and never comes back.

$$V_e = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$$

- The escape velocity of Earth is about 11.2 kilometres per second and on moon it is 2.4 km/sec.

## SATELLITES

- A **satellite** is a smaller object in space which orbits around a larger object Planet in space.
- It can be either artificial, like the communication or weather satellites that orbit the Earth, or they can be natural, like our Moon.
- A **geostationary satellite** is an earth-orbiting satellite, placed at an altitude of approximately 35,800 kilometres (22,300 miles) directly over the equator.
- Geostationary satellite revolves in the same direction the earth rotates (west to east). Its time period is 24 hours.
- It is used for Communication, television broadcasting, weather forecasting, defence and intelligence.
- **Polar orbiting satellites** closely parallel the earth's meridian lines, thus having a highly inclined orbit close to 90°.
- They pass over the North and South poles each revolution.
- They are used for weather forecasting, earth-mapping, earth observation, etc.

## MECHANICAL PROPERTIES OF SOLIDS AND FLUIDS

- **Elasticity and plasticity:** The property by virtue of which the body regains its original shape after the removal of deforming force is called **elasticity**. And if the body retains its deformed shape after the removal of deforming force is called **plasticity**.
- **Rubber** is less elastic than steel.
- **Hooke's law:** Within elastic limit stress is directly proportional to strain, i.e. stress  $\propto$  strain or stress = Y strain

$$\text{or, } Y = \frac{\text{stress}}{\text{strain}}$$

where Y = Young's Modulus of elasticity

- **Pressure** is defined as force acting normally on an unit area of the surface.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Its unit is  $\text{N/m}^2$ . It is a scalar quantity.

- **Atmospheric pressure** is measured by an instrument called the **barometer**.
- **Sudden fall** in barometric reading is the indication of **storm**.
- **Slow fall** in barometric reading is the indication of **rain**.

- Slow rise in the barometric reading is the indication of **clear weather**.
- The pressure exerted by liquid column at the surface given as  $p = hdg$ , where  $d$  is the density of liquid,  $h$  is height of liquid column.
- In a static liquid at same horizontal level, pressure is same at all the points.

**Pascal's Law of Pressure :** If gravitational attraction is negligible in equilibrium condition, pressure is same at all points in a liquid.

- The pressure exerted anywhere at a point of confined liquid is transmitted equally and undiminished in all directions throughout the liquid.
- **Hydraulic lift**, hydraulic **press** and hydraulic **breaks** are based on the **Pascal's law of pressure**.

**Atmospheric pressure decreases with altitude.**

**That is why**

- It is difficult to cook on the mountain.
- The **fountain pen** of a passenger leaks in aeroplane.
- **Bleeding** occurs from the nose of the man.
- It is difficult to breath on higher altitude due to less amount of air.
- **Water** starts to boil below **100°C**.

**Surface Tension (T) :** It is the force ( $F$ ) acting normally on unit length ( $l$ ) of imaginary line drawn on the surface of liquid

$$\text{i.e. } T = \frac{F}{l}$$

- Its unit is N/m.
- The surface tension **decreases** with rise in temperature and becomes zero at the critical temperature.
- Due to the surface tension, **rain drops** are spherical in shape.

**Archimedes' Principle :** When a body is immersed partly or wholly in a liquid, there is an apparent loss in the weight of the body, which is equal to the weight of liquid displaced by the body.

- All objects placed in a liquid experience an upward force which allows the body to float if it displaces water with weight equal to the weight of the body. This upward force is called the **buoyant force** and the law is called the **law of buoyancy**.
- The weight of water displaced by an iron ball is less than its own weight. Whereas water displaced by the immersed portion of a ship is equal to its weight. So, small ball of iron ball sink in water, but large ship float.
- **Hydrogen** filled ballon float in air because hydrogen is lighter than air.

**Law of Floatation:** A body floats in a liquid if

- The density of material of body is less than or equal to the density of liquid.
- When body floats in neutral equilibrium, the weight of the body is equal to the weight of displaced liquid. The centre of gravity of the body and centre of gravity of the displaced liquid should be in one vertical line for the condition.
- **Density (d):** It is the mass per unit volume.

$$d = \frac{M}{V}$$

- **Density of water** is maximum at **4°C**.
- **Capillarity:** The phenomenon of rise or fall of liquids in a capillary tubes.

- The oil in the wick of a lamp rises due to capillary action.
  - **Viscosity:** The property of a fluid by virtue of which an internal frictional force acts between its different layers when it is in motion.
  - **Bernoulli's theorem:** For a non-viscous, incompressible fluids flowing streamline from one point to another point, then at every point of its path, pressure, energy, potential energy and kinetic energy per unit volume remains constant.
- Blowing of roofs** by storms, sprayer action of carburetor, etc. are based on Bernoulli's principle.

## HEAT

- **Heat** is a form of energy which causes sensation of hotness or coldness.  
Its unit is joule or calorie.
- 1 cal = 4.2 joule
- It always flows from a substance at a higher temperature to the substance at a lower temperature.

**Temperature :** It indicates the degree of hotness or coldness of a body.

- Temperature is measured by **thermometer**.
- Temperature measuring units are Kelvin, °C or °F.

**Relation between Temperature on different scales.**

$$\frac{C-0}{100} = \frac{F-32}{180} = \frac{R-0}{80} = \frac{K-273}{100} = \frac{Ra-492}{180}$$

OR

$$\frac{C}{5} = \frac{F-32}{9} = \frac{R}{4} = \frac{K-273}{5} = \frac{Ra-492}{9}$$

- The normal temperature of a human body is 37°C or 98.6°F.
- At -40° temperature, celsius and fahrenheit thermometers read the same.
- **Thermal expansion :** Increase in length, area or volume on heating.

### Methods of Heat Transfer

- **Conduction:** It is that mode of transmission of heat in solid where heat is transferred from a region of higher temperature to a region of lower temperature by the aid of particles of the body without their actual migration.
- **Convection:** It requires a medium and is the process in which heat is transferred from one place to other by actual movement of heated substance (usually molecule of fluid).
- Radiation has the following properties:
  - (a) Radiant energy travels in straight lines and when some object is placed in the path, its shadow is formed at the detector.
  - (b) It is reflected and refracted or can be made to interfere. The reflection or refraction are exactly as in case of light.
  - (c) It can travel through vacuum.
  - (d) Intensity of radiation follows the law of inverse square.
  - (e) Thermal radiation can be polarised in the same way as light by transmission through a nicol.

### Latent Heat

- The amount of heat required to change phase (liquid to gas or liquid to solid etc.) without change in temperature is called **latent heat**.  $Q = mL$  where, L = latent heat

- Why are steam burns more severe than hot water burns. It is because latent heat of steam is more than hot water.
- Latent heat of fusion of ice is 80 cal/g
- Latent heat of steam is 538 cal/g.

### Specific Heat

- The amount of heat that is required to raise the temperature of a unit mass of a substance by one degree (14.5°C to 15.5°C) is known as **Specific heat**.

### Specific heat of Different materials

Material	Specific heat (J/Kg K)
Water	4200
Ice	2100
Iron	460
Kerosene oil	210
Mercury	140
Lead	130

- (i) Cooking utensils are made of aluminum, brass & steel because of their low specific heat and high conductivity.
- (ii) Due to low specific heat of sand, deserts are hot in day and cool in night.

### Newton's law of cooling

The rate of loss of heat by a body is directly proportional to the difference in temperature between the body and its surrounding.

$$\text{i.e., } \frac{dT}{dt} = E \propto (T - T_0)$$

where T and  $T_0$  are the temperature of body and surroundings.

**Sublimation :** It is the process of conversion of a solid directly into vapour, e.g., Iodine (dark solid), Dry ice (solid  $CO_2$ ), etc.

**Hoar Frost:** It is just the reverse process of sublimation. e.g. Frost and snowflakes.

## WAVES

- A **wave** is a kind of oscillation (disturbance) that travels through space and matter.
- Wave motions transfer energy, not matter from one place to another.
- **Transverse wave:** In it the vibrations of particles are perpendicular  $\perp$  to the direction of travel of the wave. It has crests and troughs.
- **Longitudinal wave:** In it the vibrations of particles are parallel to the direction of travel of wave. It has compressions and rarefactions.
- The repetition of sound due to reflection of sound waves, is called an **echo**.
- **Intensity** is defined as the amount of energy passing per unit area held around that point per unit time.
- **Quality** is that characteristics of sound which differentiate between two sounds of same intensity and same frequency.
- **Sonar:** It stands for **sound navigation and ranging**. It is used to measure the depth of a sea to locate the enemy submarines and shipwrecks.

### Sounds

- Sound is transmitted through gases, plasma, and liquids as longitudinal waves, also called **compression waves**.

- It requires a medium to propagate.
- Through solids, however, sound can be transmitted as both longitudinal waves and transverse waves.
- Audible sound for human is from **20 Hz** to about **20000 Hz**.
- **Pitch** is the property of sound that we perceive as higher and lower tones.
- Sound can be produced at a desired frequency by different methods.
- The amplitude of a sound wave is the degree of motion of air molecules within the wave which corresponds to the change in air pressure that accompanies the wave.
- The distance at which a sound can be heard depends on its intensity.
- Sounds higher than **20000 Hz** are called **ultrasonics**.
- Sounds less than 20 Hz are called **infrasonics**.
- When temperature is increased the speed of sound is increased.
- Speed of sound in air is 330 m/s.

#### Speed of Sound in Different Mediums

Medium	Speed of sound (In m/s)
Air(0°C)	332
Air (20°C)	343
Steam (at 100°C)	405
Mercury	1450
Water (20°C)	1482
Sea water	1533
Iron	5130
Glass	5640

## LIGHT

- **Light** is a form of energy which produces sensation of vision on our eyes.
- Light is made of discrete packets of energy called **photons**.
- **Photons** carry momentum, have no mass, and travel at the speed of light, i.e. **300,000 km/sec**.
- All light has both particle and wave like properties. For example–
  - Particle like; use of detectors in digital camera for the detection and storage of image data.
  - Wave like; use of instrument for diffraction of light into a spectrum for analysis.
- It is a **transverse wave**.
- One of the physical properties of light is that it can be **polarized**.
- Sun's light reaches to earth in **8 minutes** 19 seconds (i.e. 499 seconds).
- **Roemer** was the person who measured speed of light in AD 1678.
- The light reflected from moon reaches to earth in **1.28** second.
- Objects, which emit light by themselves are called **Luminous bodies**, eg. sun, stars, electric bulb, etc. **Non-luminous** bodies do not emit light themselves but reflect light falling on them, eg. planets, moon, etc.

#### Transparent, translucent and opaque matter

Matter	Nature	Example
Transparent	It allows most of light to pass through.	glass, water, etc.
Translucent	It allows a part of light falling on it to pass through.	oiled paper
Opaque	It does not allow the incident light to pass through.	mirror, metal, wood, etc.

#### Speed of light in different mediums

Medium	Speed of light
Glass	$2 \times 10^8$ m/sec
Turpentine oil	$2.04 \times 10^8$ m/sec
Water	$2.25 \times 10^8$ m/sec
Vacuum	$3 \times 10^8$ m/sec

- **Ultraviolet radiation** is an electromagnetic radiation that has wavelength from 400 nm to 10 nm, shorter than that of visible light but longer than X-rays. It is used in water purification.
- **Infrared radiation** is emission of energy as electromagnetic waves in the portion of the spectrum just beyond the limit of the red portion of visible radiation.
- Range between  $10^{-6}$  m and  $10^{-3}$  m. It is used to treat muscular strain, in green house etc.
- **X-rays** are electromagnetic radiation having a shorter wavelength and produced by bombarding a target made of tungsten, with high speed electrons. Uses in medical diagnosis.
- **Microwaves** are short, high frequency waves lying roughly between very high frequency (infrared) waves and conventional radio waves.
- Their wavelength range -  $10^{-3}$  m to  $10^{-2}$  m. It is used in microwave oven.
- **Electromagnetic wave and Dis-coverers.**

Waves	Discoverer
$\gamma$ -Rays	Henry
X-Rays	W. Roentgen
Ultra-Violet rays	Ritter
Visible radiation	Newton
Infrared rays	Herschel
Short radio waves or (Hertz Hertzian Waves)	Heinrich
Long radio waves	Marcony

#### Reflection of light

It is the turning back of light in the same medium.

#### Laws of Reflection

There are two laws of reflection

- The angle of incidence is equal to the angle of reflection. ( $\angle i = \angle r$ )
- The incident ray, the normal and the reflected ray lie in the same plane.

### Reflection by Plane Mirror

- The image formed by the plane mirror is always erect, of the same size and at the same distance as the object is.
- To see the full image in a plane mirror, its length is just half the height of the man and it has to be kept in specific position.
- When two plane mirrors are held at angle  $\theta$  with their reflecting surfaces facing each other and an object is placed between them, images are formed by successive reflections.

$$\text{Number of image for med } n = \frac{360^\circ}{\theta}$$

- If  $n$  is fractional number, number of images will be whole part of this number.
- If  $n$  is whole number
  - (Even whole number), then Number of images =  $n - 1$
  - (Odd whole number)
    - For symmetrical object number of images =  $n - 1$
    - For asymmetrical object (number of images =  $n$ )

### Mirror formula

If an object is placed at a distance  $u$  from the pole of a mirror and its image is formed at a distance  $v$  (from the pole) then  $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

### Spherical mirror

Spherical mirrors are of two types

- Concave mirror
- Convex mirror

### Uses of concave mirror

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

### Uses of convex mirror

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

### Refraction of Light

The bending of the light ray from its path in passing from one medium to the other medium is called refraction of light.

- If the refracted ray bends towards the normal relative to the incident ray, then the second medium is said to be **denser** than the first medium. But if the refracted ray bends away from the normal, then the second medium is said to be **rarer** than the first medium.

**Relative Refractive Index** : When light passes from one medium to the other, the refractive index of medium 2 relative to 1 is written as  ${}_1\mu_2$  and is defined as

$${}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{(c/v_2)}{(c/v_1)} = \frac{v_1}{v_2}$$

where  $c$  = speed of light in air or vacuum =  $3 \times 10^8$  m/s.

### Laws of Refraction

- The incident ray, the normal to the refracting surface at the point of incidence and the refracted ray all lie in the same plane called the plane of incidence or plane of refraction.
- $\frac{\sin i}{\sin r} = \text{constant}$

For any two given media and for light of a given wavelength. This is known as **Snell's law**.

$$\text{Also, } \frac{\sin i}{\sin r} = {}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

where  ${}_1\mu_2$  = Refractive index of the second medium with respect to the first medium.

### Some Phenomena based on Refraction

- Twinkling** of stars
- Oval Shape** of sun in the morning and evening.
- Rivers appear **shallow**
- Coins appear **raised** in glass filled with water.
- Pencils appear **broken** in the beaker filled with water.
- Sun appears **above horizon** at sunset and sunrise.
- Writing on a paper appears **lifted** on putting glass slab on it.
- An object in a denser medium appears to be **nearer** when seen from a rarer medium, eg. fish in water, a coin at the base of a water filled vessel.

## HUMAN EYE

The normal range of vision for a healthy human eye is from 25 cm (least distance of distinct vision to infinity (for point).

### Defects of Vision & Remedies

#### Myopia or Near(short) sightedness:

- A person suffering from Myopia can't see the far (distant) object clearly but can see nearby object clearly.

#### Causes:

- The eye ball is too long (i.e. elongated) so image is formed before retina.
- Lens being too curved for the length of the eye ball.
- Combination of above, i.e. elongated eyeball & curved lens.
- Shortening of focal length of eye lens.
- Over stretching of ciliary muscles.

**Remedy:** Concave lens is used to diverge the rays at retina.

Hyperopia or Hypermetropia (long (far) sightedness)

- A person suffering from it can't see near object clearly but can see distant object clearly.

#### Causes:

- The eye ball is too short so image is formed beyond the retina.
- Cornea is not curved enough,
- Eye lens is farther back in the eye.
- Increase in the focal length of eye lens.
- Stiffening of ciliary muscles.

**Remedy:** Convex lens is used to converge the rays at retina.

#### Target group

- It can affect both children and adults.
- People whose parents are farsighted,
- It can be confused with presbyopia (i.e. "after 40" vision).

## Astigmatism

Astigmatism is the most common refractive problem responsible for **blurry vision**. **Cylindrical** lens is used to correct astigmatism.

## Presbyopia (“after 40” vision)

After age 40, and most noticeably after age 45, the human eye is affected by presbyopia, which results in greater difficulty maintaining a clear focus at a near distance with an eye which sees clearly at a far away distance.

## Cataract

- It is the clouding of the lens of the eye that prevent a person to see.  
Because light rays can't pass through the cloudy lens, Vision of a person becomes cloudy, blurry, foggy, or filmy.

### Causes:

- Protein builds up in the eye lens & make it cloudy.
- Cloudy protein layers prevent rays to pass through eye lens.
- New lens cells form on the outside of the lens, making older cells compacted into the center of the lens to form cataract.

### Remedy:

- It can be corrected with suitable eye glasses (lenses).
- Cataract surgery is performed when eye glass does not suit.

### Dispersion of light:

- The splitting of white ray of light into its seven constituents colours (VIBGYOR) is called **dispersion of light**.
- The band of seven constituents colours is called **spectrum**.

### Microscope

- It is used to see magnified image of a tiny objects.

### Telescope

- It is used to increase the visual angle of distant object.
- It is used to see far off objects clearly.

## ELECTRICITY

- Electricity** is the set of physical phenomena associated with the presence and flow of electric charge.
- Electric charge** is a property of some subatomic particles, which determines their electromagnetic interactions.  
The **SI unit** of charge is **coulomb (c)**.
- Electric current (I)** is a movement or flow of electrically charged particle electronic per unit time. Typically measured in **ampere (A)**.  
 $I = Q/t$
- Moving charges produce a magnetic field.
- Electrical currents generate magnetic fields, and changing magnetic fields generate electrical currents.  
**Conductors** are the substances which allow the passage of electric charge with low resistance. E.g., silver, copper etc.  
**Silver** is the best conductor of electricity followed by **copper**.  
**Insulators** are substances which do not allow passage of electric charge, rubber, wood, mica, glass, ebonite etc.
- Ohm's law** : The electric current  $I$  flowing through a conductor is proportional to the voltage  $V$  across its ends, i.e.  $V \propto I$  or  $V = RI$ , where  $R$  is the **resistance** of the substance.

- The **resistance** is the obstruction offered to the flow of electric current.

It is directly proportional to its length and inversely proportional to its cross-sectional area ( $A$ ), i.e.  $R \propto \frac{L}{A}$

The unit of resistance is **ohm ( $\Omega$ )** :  $1\Omega = 1 \text{ VA}^{-1}$ .

or,  $R = \frac{\rho \ell}{A}$ , where  $\rho$  is called resistivity of the material.

**Coulomb's Law:** The electrostatic force of interaction (repulsion or attraction) between two electric charges  $q_1$  and  $q_2$  separated by a distance  $r$ , is directly proportional to the product of charges, i.e.  $q_1 \times q_2$  and inversely proportional to the square of distance between them, i.e.

$$F \propto q_1 q_2 \text{ and } F \propto \frac{1}{r^2}$$

$$\Rightarrow F = K \frac{q_1 q_2}{r^2} \quad K = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$$

**Electric Field:** The region around an electric charge in which the electric effect (attraction or repulsion) can be experienced with another charge is called the electric field.

$$F = qE$$

where **E = electric field**.

**Electric cell:** It is the device used to convert chemical energy into electrical energy.

**Emf of cell (E):** It is the potential difference across the terminals of a cell when it is not in use.

### Potentiometer

It is used to measure the exact potential difference between two points of an electric circuit or electromotive force (emf) of a cell.

**Internal resistance of cell :** It is the resistance offered by the electrolyte.

- One **kilowatt (kW)** = 1,000 watts
- One **megawatt (MW)** = 1,000 kilowatts = 1,000,000 watts
- One **gigawatt (GW)** = 1,000 megawatts = 1 billion watts.
- Ammeter** : Measures current
- Voltmeter** : Measures the potential difference between two points in a circuit.
- Fuse** is a safety device that protects an **electric circuit** from becoming overloaded.

### Transformer

- Transformer is a device which converts low voltage AC into high voltage AC and vice-versa.
- It is based on **electromagnetic induction**.

**Application /uses:** As voltage regulators for –

- T.V, refrigerator, computer, air conditioner, etc.
- Induction furnaces.
- for welding purposes.

### AC Generator/Dynamo/Alternator

- It is an electric device used to convert mechanical energy into electrical energy.
- It works on the principle of electromagnetic induction.

### D.C. Motor

- It converts direct current energy from a battery into mechanical energy of rotation.

- **Its uses**

- In D.C. fans, exhaust, ceiling, table fans, etc.
- In pumping water.
- In running tram-cars, trains, etc.

### MODERN PHYSICS

- The nucleus of an consists of protons and neutrons together called nucleons. Size of the nucleus RADIUS of the nucleus  $R = R_0 A^{1/3}$  where  $R_0 = 1.1 \times 10^{-15} \text{m}$ ,  $A = \text{atomic mass}$ .

#### Difference between stable and unstable nucleus

Stable nucleus	Unstable nucleus
Low atomic number	High atomic number
Low mass number	High mass number
Nucleus of small size	Nucleus of bigger size
$\frac{n}{p} = 1$	$\frac{n}{p} > 1$

- **Photoelectric effect** : It is the phenomenon of emission of electrons by metals when illuminated by light of suitable frequency.

Einstein's photoelectric equation:

$$(E_K)_{\max} = \frac{1}{2} m v_{\max}^2 = eV_0$$

- **Photoelectric current depends on:**

- the intensity of incident light,
- the potential difference applied between the two electrodes, and
- the nature of the emitting material.

### X-Rays

X-rays are electromagnetic radiations of very short wavelength (0.1 Å to 100 Å) and high energy which are emitted when fast moving electrons or cathode rays strike a target of high atomic mass.

#### Properties of X-Rays :

- These are highly **penetrating rays** and can pass through several materials which are opaque to ordinary light.
- They **ionize the gas** through which they pass. While passing through a gas, they knock out electrons from several of the neutral atoms, leaving these atoms with +ve charge.
- They cause **fluorescence** in several materials. A plate coated with barium platinocyanide, ZnS (zinc sulphide), etc becomes **luminous** when exposed to X-rays.
- They affect **photographic plates** especially designed for the purpose.
- They are not deflected by electric and magnetic fields, showing that they are not charged particles.

### Radioactivity

It is the phenomenon in which nuclei of a given species transform by giving out  $\alpha$  or  $\beta$  or  $\gamma$ -rays;

$\alpha$ -rays are helium nuclei;

$\beta$ -rays are electrons and  $\gamma$ -rays are electromagnetic radiation of wavelengths shorter than X-rays.

### Nuclear Fission

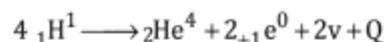
The process of splitting of a heavy nucleus into two nuclei of comparable size and release of large energy is called **fission**.

$U^{235}$  nucleus captures a thermal neutron. This forms a compound nucleus  $U^{236}$  in excited state.

- **Atom bomb** is based on nuclear fission.

### Nuclear Fusion

The process in which two or more lighter nuclei combine to form a heavy nucleus is known as nuclear fusion.



- The binding energy per nucleon of product is greater than the reactants. The energy released per nucleon is large  $\sim 6.75 \text{ MeV}$ .
- Fusion is possible at high pressure ( $\sim 10^6 \text{ atm}$ ) and high temperature ( $\sim 10^8 \text{ }^\circ\text{C}$ ).
- **Hydrogen bomb** is based on nuclear fusion.

### Nuclear Reactor or Atomic Pile

- Nuclear reactor is an arrangement, in which controlled nuclear fission reaction takes place.
- First nuclear reactor was established in Chicago University under the supervision of Prof **Enrico Fermi**.
- Heavy water, graphite and beryllium oxide are used to slow down the fast moving neutrons. They are called **moderator**.
- The cold water, liquid oxygen, etc. are used as coolant to remove heat generated.
- Cadmium or boron rods are good absorber of neutrons and called the control rods.

### Uses of Nuclear Reactor

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

There are several components of nuclear reactor which are as follows

- **Fissionable Fuel**  $U^{235}$  or  $U^{239}$  is used.
- **Moderator** Moderator decreases the energy of neutrons, so that they can be further used for fission reaction. **Heavy water** and **graphite** are used as moderator.
- **Control Rod** Rods of cadmium or boron are used to absorb the excess neutrons produced in fission of uranium nucleus, so that the chain reaction continues to be controlled.
- **Coolant** A large amount of heat is produced during fission. Coolant absorbs that heat and prevents excessive rise in the temperature. The coolant may be water, heavy water or a gas like He or  $\text{CO}_2$ .

# CHEMISTRY

- Chemistry is the branch of science which deals with study of matter and various changes it undergoes.

## Classification of Matter

- Matter** is defined as anything that occupies space and has mass.
- At a given temperature, an element is in one of the three states of matter- **Solid, Liquid** or **Vapour** (Gas).

### Solids

- Solids possess definite shape and volume.
- They have strongest intermolecular interactions.
- They are generally hard and rigid.
- Examples – Metals, bricks, wood, etc

### Liquids

- They possess definite volume but no definite shape.
- They have intermediate intermolecular forces between constituent particles.
- They can flow, so they are called fluids, e.g. water, milk, mercury, oil, etc.

### Gases

- Gases have neither a definite volume nor definite shape.
- They take the volume and shape of the container.
- They are highly compressible and have minimum intermolecular interactions.
- E.g.– air, oxygen, hydrogen, etc.

## ATOM

- An **atom** is the **smallest unit** of an element.
- An atom has a central **nucleus** which is very small compared to the rest of the atom and contains majority of the atomic mass.
- The nucleus carries a **positive charge**.
- The **nucleus** of an atom consists of **protons** and **neutrons**.
- Atoms consist of protons, neutrons, and electrons.
- Electrons revolve around the nucleus.
- Protons** have a **positive charge**.
- Electrons** have a **negative charge**.
- Neutrons** have **no charge**.
- In a neutral atom total charge on proton is equal in magnitude to total charge on electrons.
- Since opposite charges attract protons and electrons attract each other.

## ISOTOPES AND ISOBARS

- Isotopes** are atoms that have **same atomic number** but different mass numbers.
- Isotopes have the same atomic number because the number of protons inside their nuclei remains the same. They have different mass numbers because they have different numbers of neutrons.
- For instance,  $^{35}_{17}\text{Cl}$  and  $^{37}_{17}\text{Cl}$  are isotopes.
- Isobars** are atoms that have **same atomic mass** but different atomic numbers.
- Isobars have different atomic numbers because they have different numbers of protons. They have the same atomic mass because they have just enough neutrons to make the same total of nucleons.
- For instance,  $^{76}_{32}\text{Ge}$  and  $^{76}_{34}\text{Se}$  are isobars.

## ELEMENTS AND COMPOUNDS

- Everything in the universe is made of a combination of a few basic substances called **elements**.
- The element is the simplest form of matter composed of atoms having identical number of protons in each nucleus. Elements of the periodic table are majority divided into s-block, p-block, d-block and f-block
- A compound is made up of different elements but looks and behaves quite differently.
- A **compound** is a pure substance that contains atoms of two or more chemical elements in definite proportions that cannot be separated by physical means and are held together by chemical bonds.

## AIR AND WATER

Air is colorless, odorless, tasteless, gaseous mixture, mainly contains nitrogen (approximately 78 %) and oxygen (approximately 21 %) with lesser amounts of argon, carbon dioxide, hydrogen, neon, helium, and other gases.

- Water** consists of hydrogen and oxygen in the ratio of 2:1 by volume and 1:8 by mass.
- Hard water** has bicarbonates, chlorides sulphates of Ca and Mg. This water is unfit for washing and use in industrial boilers.
- Heavy water is deuterium oxide** ( $\text{D}_2\text{O}$ ), molecular mass = 20). It is called heavy due to the presence of deuterium, the heavy hydrogen.

## SUBSTANCES & CHEMICAL COMPOSITIONS

Common Name	Chemical Name	Composition	Formula
Alum	Potash	Potassium, Sulphur, Aluminium, Hydrogen and Oxygen	$\text{K}_2\text{SO}_4\text{Al}_2(\text{SO}_4)_3$
Bleaching Powder	Calcium hypochlorite	Calcium, Chlorine and Oxygen	$\text{CaCl}(\text{OCl})$
Blue Vitriol	Copper sulphate	Copper, Sulphur and Oxygen	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
Caustic Potash	Potassium hydroxide	Potassium Hydrogen, and Oxygen	$\text{KOH}$

Chalk	Calcium carbonate	Calcium, Carbon and Oxygen	CaCO <sub>3</sub>
Caustic Soda	Sodium hydroxide	Sodium, Hydrogen and Oxygen	NaOH
Baking Soda	Sodium bicarbonate	Sodium, Hydrogen, Carbon and Oxygen	NaHCO <sub>3</sub>
Common Salt	Sodium chloride	Sodium and Chlorine	NaCl
Epsom Salt	Magnesium sulphate	Magnesium, Sulphur, and Oxygen	MgSO <sub>4</sub> .7H <sub>2</sub> O
Galena	Lead sulphide	Lead and Sulphur	PbS
Green Vitriol	Iron sulphate	Iron, Sulphur and Oxygen	FeSO <sub>4</sub> .7H <sub>2</sub> O
Glauber's salt Gypsum	Sodium sulphate Calcium Sulphate dihydrate	Sodium, Sulphur, Oxygen and hydrogen	Na <sub>2</sub> SO <sub>4</sub> .10H <sub>2</sub> O CaSO <sub>4</sub> .2H <sub>2</sub> O
Laughing gas	Nitrous oxide	Nitrogen and Oxygen	N <sub>2</sub> O
Lime water	Calcium hydroxide	Calcium, Hydrogen, and Oxygen	Ca(OH) <sub>2</sub>
Litharge	Lead monoxide	Lead and Oxygen	PbO
Plaster of Paris	Calcium sulphate hemihydrate	Calcium, Sulphur, Hydrogen and Oxygen	2CaSO <sub>4</sub> .H <sub>2</sub> O
Quartz	Sodium silicate	Sodium, Silica and Oxygen	Na <sub>2</sub> SiO <sub>3</sub>
Quick lime	Calcium oxide	Calcium and Oxygen	CaO
Red lead	Triplumbic	Lead and Oxygen	Pb <sub>3</sub> O <sub>4</sub>
Sal ammoniac	Ammonium Chloride	Nitrogen, Hydrogen and chlorine	NH <sub>4</sub> Cl
Soda ash or washing soda	Sodium carbonate	Sodium, Carbon, Hydrogen and Oxygen	Na <sub>2</sub> CO <sub>3</sub> .10H <sub>2</sub> O
Soda bicarbonate	Sodium bicarbonate	Sodium hydrogen, Carbon and Oxygen	NaHCO <sub>3</sub>
White vitriol	Zinc sulphate	Zinc, Sulphur, Hydrogen and Oxygen	ZnSO <sub>4</sub> .7H <sub>2</sub> O

## METALS AND NON-METALS

- There are two types of elements- metals and non- metals.
- About 80% known elements are metals.

### Metals

- Elements which are hard, ductile, brittle, and malleable, possess lustre and conduct heat and electricity are termed **metals**.
- Except **Mercury and gallium**, all metals are solid.
- **Metals** have usually high melting points and boiling points.

### Non-Metals

- Non metals are electronegative elements which have a tendency to gain one or more electrons to form negative ions called **anions**.
- Non metals are **non-lustrous** and bad conductors of heat and electricity.

### Occurrence of Metals

- **Minerals** are naturally occurring chemical compounds of fixed composition and characteristics, physical form and properties.
- The most common groups of minerals are **silicates, oxides, sulphides, and carbonates** etc.

### Uses of Some Metals and Non-Metals Compounds

- Silver Nitrate** (AgNO<sub>3</sub>) is called **lunar caustic** and is used to prepare the ink used during voting.
- Hydrogen Peroxide** (H<sub>2</sub>O<sub>2</sub>) is used as an oxidising agent, bleaching agent, as an insecticide and for washing old oil paintings.

- Ferrous Oxide** (FeO) is used to prepare ferrous salts and green glass.
- Ferric Oxide** (Fe<sub>2</sub>O<sub>3</sub>) is used in jeweller's rouge.
- Silver Iodide** (AgI) is used for artificial rain.
- Mercuric Chloride** (HgCl<sub>2</sub>) is used to prepare calomel and as a poison.

### Catalyst

A catalyst is a material that is added to a reaction mixture to accelerate the process but is itself not consumed.

### Fuels

- The substance, which produce heat and light on combustion are called **fuels**.
- **LPG** (Liquified petroleum gas) is a mixture of hydrocarbons containing three or four carbon atoms, such as propane, butane and pentane.  
A strong foul smelling substance, called ethyl mercaptan (C<sub>2</sub>H<sub>5</sub>SH) is added to LPG to detect its leakage as LPG is odourless gas.

### COAL

- Coal is made up of **carbon**.
- The common varieties of coal are **anthracite, bitumen; lignite and peat** containing 95, 70, 40 and 10-20 percent carbon respectively.
- CNG, gasoline or diesel is obtained by fractional distillation of crude oil.

### Some Important Fuels and their Compositions

Fuel	Composition	Sources
<i>Water Gas</i>	Carbon monoxide (CO) + Hydrogen (H <sub>2</sub> )	By passing steam over red hot coke
<i>Producer Gas</i>	Carbon monoxide (CO) + Nitrogen (N <sub>2</sub> )	By passing insufficient air over red hot coke
<i>Coal Gas</i>	Hydrogen + Methane + Ethylene (C <sub>2</sub> H <sub>4</sub> ) + Acetylene (C <sub>2</sub> H <sub>2</sub> ) + CO + Nitrogen	By fractional distillation of wood
<i>Natural Gas</i>	Methane (83%) + Ethane	From petroleum
<i>Liquefied Petroleum Gas (LPG)</i>	Butane (C <sub>4</sub> H <sub>10</sub> ) + Propane (C <sub>3</sub> H <sub>8</sub> )	From oil wells
<i>Compressed Natural Gas (CNG)</i>	Methane (CH <sub>4</sub> ) 95%	From petroleum
<i>Biogas or Gobar Gas</i>	Methane (CH <sub>4</sub> ) + Carbon dioxide (CO <sub>2</sub> ) + Hydrogen (H <sub>2</sub> ) + Nitrogen (N <sub>2</sub> )	From organic wastes

### ACIDS, BASES AND pH SCALE

- **Acids** are chemical compounds that taste sour, turn blue litmus red, and often react with some metals to produce hydrogen gas.
- Acids- HNO<sub>3</sub>, HNO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, H<sub>3</sub>PO<sub>4</sub>, H<sub>3</sub>PO<sub>3</sub>, H<sub>2</sub>CO<sub>3</sub>, etc.
- **Bases** are chemical compounds that taste bitter, turn red litmus blue and feel **slippery**. Base: (NaOH), (Ca(OH)<sub>2</sub>), (KOH), (RbOH), etc.
- When aqueous (water) solutions of an acid and a base are combined, a neutralization reaction occurs.
- The **pH** of a solution measures the hydrogen ion concentration in that solution.
- Anything above pH 7 is alkaline, anything below pH 7 is considered acidic.
- **Human blood** pH should be slightly **alkaline** (7.35 – 7.45).

#### Uses of Some Acids and Bases

Acids	Uses
Nitric acid, oxalic acid	Photography
Sulphuric acid	Petroleum exploration
Hydrochloric acid	Leather industry

Benzoic acid, formic acid, citric acid, acetic acid etc.	Preservation for food stuff
Bases	
Calcium hydroxide and calcium oxide	Manufacture of bleaching powder
Magnesium hydroxide	Antacid in sugar industries
Sodium hydroxide	Manufacture of hard soaps and drugs, paper and textile industry, Petroleum refining
Potassium hydroxide	Manufacture of soft soaps

#### Sources of Some Naturally Occurring Acids

Acid	Source
Citric acid	Lemon, orange, grapes
Maleic acid	Unripe apple
Tartaric acid	Tamarind
Acetic acid	Vinegar
Lactic acid	Milk
Hydrochloric acid	Stomach
Oxalic acid	Tomato

#### Acidic & basic nature of some household substances

Acidic		Basic (Alkaline)	
1.	Bathroom acid	1.	Milk of magnesia (Antacids)
2.	Vitamin C tablets (Ascorbic acid)	2.	Toothpaste
3.	Lemon juice	3.	Soap solution or detergent solution.
4.	Orange juice	4.	Solution of washing soda.
5.	Tomato juice	5.	Slaked lime & white wash
6.	Vinegar		
7.	Fizzy drinks (Colas & Sodawater)		

## pH VALUE OF SOME IMPORTANT SUBSTANCES

Sodium Hydroxide: Alkaline	14.0
Ammonia	11.0
Baking Soda	8.3
Human Blood	7.4
Pure Water: Neutral	7.0
Milk: Acid	6.6
Tomatoes	4.5
Wine and Beer	4.0
Apples	3.0
Vinegar	2.2
Lemon Juice	2.0
Battery Acid	1.0
Urine(Human)	5.5 to 7.5
Tears	7.4
Sea water	8.5
Milk (Cow)	6.3 to 6.6
Coffee	5.0
Tooth paste	9.0

- **Plastics** consist of very long molecules, each composed of carbon atoms linked into chains.
- Polythene is composed of over 200000 carbon atoms.
- Although some plastics are made from plant oils, the majority are made from fossil fuels.
- **Polymers** are large long chain like molecules formed by the chemical linking of many smaller molecules.
- The small molecular building units are called **monomers**.
- **Monomers** are joined into chains by a process of repeated linking known as **polymerization**.
- **Starch** and **wool**- Natural polymers
- **Nylon** and polyethylene- Synthetic polymers
- Natural **rubber** is obtained from milky white fluid **Latex**.
- The simplest unit of rubber is **isoprene** (C<sub>5</sub>H<sub>8</sub>).
- **Vulcanization** gives strength, hardness, and elasticity to rubber.

## RADIOACTIVITY

- **Radioactivity** is discovered by French physicist **Henry de Becquerel** in 1896, who observed that uranium mineral gave off invisible radiation.
- **Pierre and Madam Curie** showed similar phenomenon in other metals like polonium, francium and radium.
- Radiations are of three kinds: Alpha, Beta and Gamma
- **Alpha particles** Each particle contains a pair of neutrons and a pair of protons.

- It is **positively charged helium atom** that has very little penetrating power.
- **Beta Particles** These are negatively charged light particles. Their penetrating power is greater than that of alpha particle.
- **Gamma Particles** These are **electromagnetic radiations** of low wavelength, high frequency, and high energy.
- Their **penetrating power** is very great as they can pass through several centimetres of lead.
- With the **emission of an  $\alpha$ -particle**, atomic number of an element is decreased by 2 and mass number is decreased by 4.
- With the **emission of a  $\beta$ -particle** atomic number of an element is increased by 1 and mass number does not change.

## NUCLEAR REACTIONS AND ATOMIC ENERGY

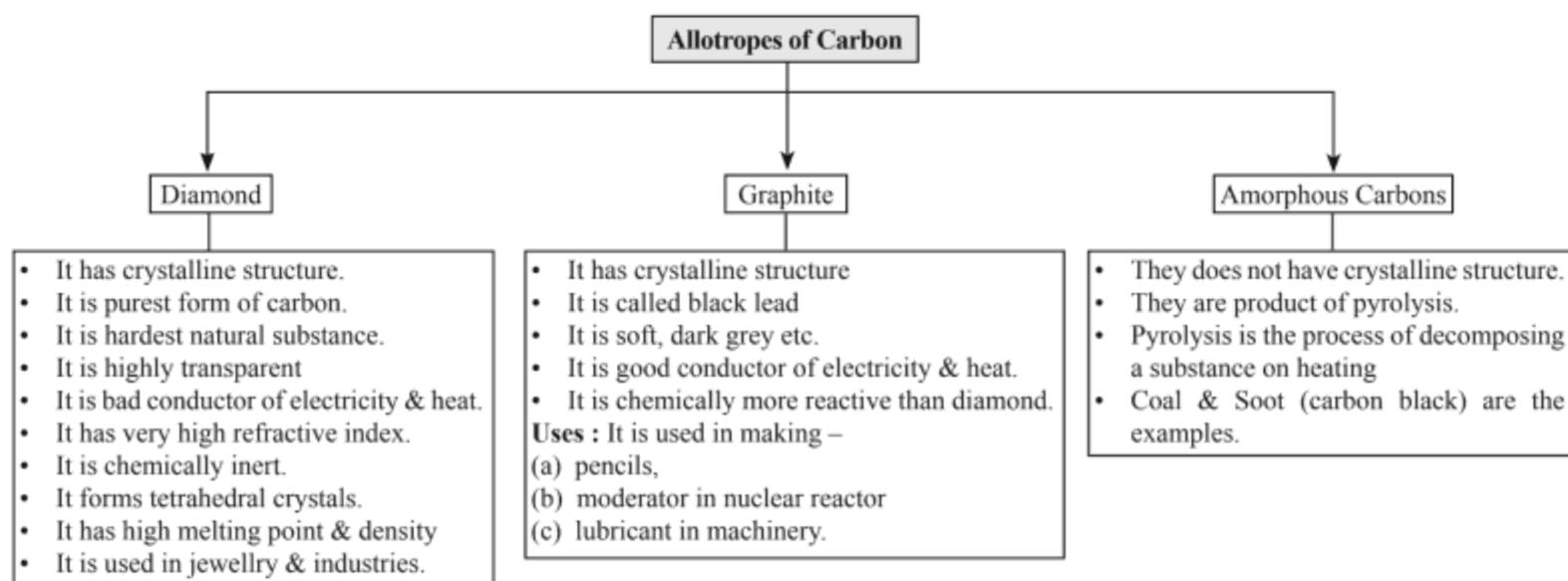
- A nuclear reaction is a process in which two nuclei or nuclear particles collide, to produce different nuclei than the initial particles.
- Nuclear reactions are of two types : Nuclear **fission** and Nuclear **fusion**.
- **Nuclear fission** is the fragmentation of a large nucleus into two smaller nuclei and the liberation of a large amount of energy.
- **Atom bomb** is based on nuclear fission. U<sup>235</sup> and P<sub>u</sub><sup>239</sup> are used as fissionable material.
- Atom bomb was discovered by **Otto Hahn**.
- On **6 august 1945**, an atom bomb was dropped on **Hiroshima** city in Japan. The second was dropped on **Nagasaki**. The bomb was made of **Plutonium-239**
- **Nuclear Fusion**  
It is a nuclear reaction in which lighter nuclei fuse to form a nucleus of greater mass. In this reaction also an enormous amount of heat is produced.
- **Hydrogen bomb** is based on nuclear fusion.
- **Atomic energy** Energy produced by nuclear fission and nuclear fusion is called nuclear energy or Atomic energy.
- In this process the loss of mass is converted into energy.

## CARBON AND ITS COMPOUNDS

- All organic compounds contain carbon, and the vast majority also contains hydrogen bonded to carbon.
- It is non-metal.
- Its atomic number is 6 & A mass is 12.
- Carbon which formed the back bone of organic chemistry exhibit allotropy.

### Allotropes

- Allotropes are substances which have same chemical properties but different physical properties.
- They have different crystalline modifications.
- Above properties of substances are called allotropy.



- **Diamond, graphite, charcoal, coke, coal** etc. are different forms of carbon.

### GLASS

Glass is a mixture of an alkali silicate with the silicate of a base, that is, silica, sodium silicate and calcium or lead silicate.

#### Type & Uses

- (i) **Milky Glass** is prepared by adding tin oxide ( $\text{SnO}_2$ ), calcium phosphate  $[(\text{Ca}_3(\text{PO}_4)_2)]$  or cryolite ( $\text{Na}_3\text{AlF}_6$ ) to the melt glass.
- (ii) **Flint Glass** contains lead oxide ( $\text{PbO}$ ) and used in optical instruments like lenses, prisms.
- (iii) **Soda or Soft Glass** is sodium calcium silicate ( $\text{Na}_2\text{O} \cdot \text{CaO} \cdot 6\text{SiO}_2$ ). It is the ordinary glass and used for making bottles, window panes, etc.
- (iv) **Potash Glass or Hard Glass** contains potassium carbonate ( $\text{K}_2\text{CO}_3$ ). It has higher softening temperature. It is used for making beakers, flasks, funnel, etc.
- (v) **Crown Glass** contains potassium oxide ( $\text{K}_2\text{O}$ ), Barium oxide ( $\text{BaO}$ ), boric oxide ( $\text{B}_2\text{O}_3$ ) and silica ( $\text{SiO}_2$ ). It is used for **optical** apparatus.
- (vi) **Crook's Glass** contains cesium oxides. It is used for **spectacles** as it absorbs UV rays.
- (vii) **Glass Laminates** is made by fixing polymer sheet between layers of glass. It is used to make windows and screens of cars, trains and aircraft.
- (viii) **Jena Glass** contains  $\text{B}_2\text{O}_3$  and alumina. It is resistant to acids and alkalis. It is used for making laboratory bottles, for keeping acids and alkalis.

#### Some Chemical Substances and Their Uses

**Soaps and Detergents:** Soaps are the sodium or potassium salts of fatty acids. They are made by the saponification of fats. Detergents are made from some petroleum products.

**Antibiotic:** Medicinal compounds produced by moulds and bacteria, capable of destroying or preventing the growth of bacteria in animal systems. For example penicillin, chloramphenicol etc.

**Antibody:** Kinds of substances formed in the blood, tending to inhibit or destroy harmful pathogens, etc.

**Antigen:** Substance capable of stimulating formation of antibodies in a host. It is the foreign substance which enters the host and use its system to sustain. For example bacteria, virus etc.

**Antipyretic:** A substance used to lower body temperature.

**Pesticides:** They are used to kill pests. Pests are living organism, who destroy crops or eat away grains.

**Insecticides:** They are used to kill insects for example D.D.T aluminium phosphate gammexene.

**Fungicide:** They are used to kill fungus. For example. Copper sulphate, Bordeaux mixture.

**Rodenticides:** They are used to kill rodents. For example, Aluminium phosphide, Thallium sulphate.

**Herbicides:** They are used to kill weeds Benzipram, benzadox.

**Sulphadruugs:** Alternatives of antibiotics, sulphanilamide, sulphadiazine, Sulpha gunamidine.

**Antacids:** Substances which neutralise the excess acid and raise the pH to appropriate level in stomach are called antacids.

**Epsom salt:** Hydrated magnesium sulphate ( $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ ), used in medicines to empty bowels.

**Chloroform:** A sweetish, colourless liquid. It is used as a solvent and anaesthetic.

**Saccharin:** A white crystalline solid which is 550 times sweeter than sugar, but does not have any food value. It is used by diabetic patients.

**DDT:** Dichloro diphenyl trichloro ethane, a white powder used as an insecticide.

# BIOLOGY

## INTRODUCTION

Biology is the study of life and living organism, including their structure, function, evolution, distribution, identification and Taxonomy

- **Aristotle** is often called “the father of biology”.
- **Leeuwenhoek** invented a simple microscope and studied living cells.
- **Alexander Flemming** discovered Penicillin.
- **Carolus Linnaeus** introduced Binomial Nomenclature for naming plants and animals.
- **Charles Robert Darwin** proposed the theory of Pangenesis to explain inheritance and also proposed Origin of species by Natural Selection.
- **Gregor Johann Mendel** discovered principles of inheritance.
- **Lamarck** discarded the idea of fixity of species.
- **Louis Pasteur** proposed ‘Germ theory of disease. He also proposed pasteurization for sterilization.
- **Robert Hooke** assembled a compound microscope and discovered cells in cork.
- **William Harvey** discovered blood circulation.
- **T.H. Morgan** laid foundation of gene theory.
- **David Baltimore** is known for his discovery of reverse transcriptase.
- **Charles Darwin** is famous for the theory of Natural selection.
- **Hippocrates** is considered to be the “*father of western medicine*”.
- **Edward Jenner** is famous for creating the first effective vaccine for smallpox- (*father of immunology*)
- **Joseph Lister** is famous for using antiseptics for cleaning and sterilizing wounds.
- **Robert Brown** discovered the cell nucleus.
- **William Watson (1909)** introduced the term Genetics.
- **Watson and Crick** gave the model of DNA.
- **In 1866 Ernst Haeckel** coined word “ecology”.
- **Hippocrates and Aristotle** laid the foundation of ecology.
- **Camillo golgi** discovered golgi body.
- **Salim Ali** known as the “*birdman of India*”.
- **Har Gobind Khorana** is a biochemist who won the Nobel Prize in 1968 for demonstrating how the *nucleotides in nucleic acids control the synthesis of proteins.*

### Cells

- All living organism are constituted of structural and functional units called cells.
- **Robert Hook** coined the term ‘*cell*’ in 1665.
- Cells are grouped into tissues, tissues into organ and organs into organ system.
- Smallest cells- **Mycoplasmas**.
- Largest isolated single cell- egg of an ostrich

## Prokaryotic Cells

- Morphologically most primitive cells.
- It is without nucleus.
- A single membrane surrounds the cell.
- It is found in bacteria, blue green algae, mycoplasma.
- The plasma membrane is semi permeable in nature.
- Many prokaryotes have small circular DNA molecules called *plasmids*.
- Cell division occurs by fission or budding.

## Eukaryotic Cells

- The eukaryotic cells occur in all protists, fungi, plants and the animals.
- Eukaryotic cells are typically composed of plasma membrane, cytoplasm and its organelles viz. mitochondria, endoplasmic reticulum, golgi complex a true **nucleus**, etc.

### Cell Wall

- Cell wall is present in plants.
- Cell division occurs by mitosis and meiosis.
- Cell wall is unique feature of plant cell which is made up of *cellulose* and is totally absent in animals.

### Cell Membrane

- Cell membrane is composed of lipids.
- The function of plasma membrane is the transport of the molecules across it.

### Fluid mosaic model of plasma membrane

- S.J. Singer and G. Nicolson in 1972 proposed the most accepted model of membrane structure.
- Lipids are amphipathic.
- One of the most important function of plasma membrane is the transport of the molecules across it.
- **Plastids** are found in plants and are also found in protists, euglena.
- **Lysosomes** are popularly called “suicide bags”

### Ribosomes

- Ribosomes were first observed by *Palade*.
- 70s in prokaryotes and 80s in eukaryotes
- Ribosomes are present only in grandular endoplasmic reticulum.
- Except mammalian RBC in all living cells have ribosomes.

### Nucleus

- It is centrally located spherical and largest component of all eukaryotic cell. Nucleolus is present in nucleus.
- *Robert Brown* named it Nucleus.
- A typical nucleus consists of four structures:
  - (i) nuclear membrane,
  - (ii) nucleoplasm
  - (iii) chromatin and
  - (iv) the nucleolus.

### Mitochondria

- These are also called “*Powerhouse of cells*”.

## CLASSIFICATION OF ORGANISM

- Most acceptable classification was given by R. H. Whittaker (1969). These are Monera, protista, Fungi, Plantae, Animalia.
- (a) **Monera**
- All prokaryotes (cell without nucleus) such as Bacteria, Cyanobacteria, archiobacteria.
  - All are microscopic and filamentous bacteria is also present in this kingdom.
- (b) **Protista**
- All are unicellular.
  - Autotrophic, parasitic and saprophytic mode of nutrition.
  - Ex-euglena, paramaecium, etc.
- (c) **Fungi**
- Non green plants.
  - Saprophytic mode of nutrition.
  - Chitin is present in cell wall.
  - Ex-Mucor, Albugo, etc.
- (d) **Plantae**
- All plants except some algae, fungi, diatoms.
  - Multicellular.
  - Autotrophic, i.e. can make their own food.
- (e) **Animalia**
- Multicellular, Eukaryotic (cell with nucleus) organism.
  - Considered as largest kingdom.
  - Heterotrophs, i.e., depend on other organism for their food.

## GENETICS

- Study of genes is known as **genetics**.

### Gene

- It is a segment of DNA and *basic unit of heredity*. These are located on chromosomes.
- **DNA** is found in nucleus, and also found in mitochondria and chloroplast.
- It stands for **deoxyribonucleic acid (DNA)**.
- It is double stranded.
- It consists of Nitrogenous bases-**Adenine, Thymine, Cytosine** or **Guanine**, 5-carbon sugar and a phosphate molecule.
- **RNA** is single stranded.
- It consists of phosphate, ribose sugar, nitrogenous bases-**Adenine, Uracil, Cytosine**, and **Guanine**.
- **Mendel** conducted cross hybridization experiments on green pea plant (*Pisum sativum*).

### Mutation

- Sudden change in the sequence of DNA is known as mutation.
- There are various chemical and physical factors that induce mutation is known as mutagens. Such as – UV radiation, carcinogenic chemical like – nicotine, nitric oxides, etc.

### Sex Determination

- X and Y are the sex chromosomes which are responsible for the determination of sex. 46 chromosomes are present in human body cell. In which 22 pairs of these are *autosomes* & 23rd is sex chromosomes, i.e., x & y.

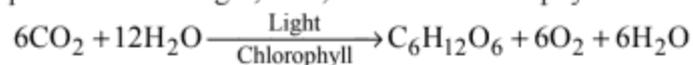
### Genetic disorder

- It is caused due to abnormality in an individual DNA.

## PLANT PHYSIOLOGY

### Photosynthesis

- It is the process by which plants makes their food in the presence of sunlight, CO<sup>2</sup>, water and chlorophyll.



### Respiration

- It is the process of oxidation which occurs in three steps. Glycolysis, Krebs Cycle and Electron transport system. It occurs in Cytoplasm (Glycolysis) and rest cycle in Mitochondria.



### Transpiration

- Loss of water in the form of water vapour from plant through a small pore **stomata** is known as Transpiration.
- Plants obtains nitrogen from soil in the form of nitrites, nitrates and salts.

### Nitrogen assimilation

- It is carried out by Ammonification, Nitrification and Denitrification.

### Growth regulators

- There are some growth regulators. e.g.;-auxin, gibberllines, Cytokinins, Ethylene, Abscisic acid, etc.

### Human Physiology

- Human physiology is the science of the functioning of human organs and the cells that compose them. It studies the mechanical, physical and biochemical functions that determine the health of an individual.
- Human physiology is based on four functional levels of body units. The most basic is *molecular level* which includes chemicals that are necessary for cells to function. The next levels are tissue, organ and system physiology.

### Animals & their teeth

Man (Child)	20
Man (adult)	32
Horse	44
Dog	42
Cow & Sheep	32
Cat	30
Rabbit	28
Mouse	16

## DIGESTION OF FOOD

Name of the Digestive juice	Name of the enzymes	Substrate	End product
Saliva	Ptyalin (Salivary amylase)	Starch	Maltose
Pancreatic juice	Amylopsin (pancreatic amylase)	Starch, Glycogen	Maltose and Glucose
Intestinal juice	Sucrase (invertase), Maltase, Lactase	Sucrose; Maltose, Lactose	Glucose and fructose, Glucose, and galactose
Gastric Juice	Pepsin, Rennin	Proteins, Casein	Proteoses and peptones, Calcium caseinate
Pancreatic Juice	Trypsin, Chymotrypsin, Carboxyl peptidases	Proteins, Peptides	Proteoses and Peptides Amino acid.
Intestinal juice	Amino peptidase, Dipeptidase	Peptides	Amino acids

## VITAMIN REQUIRED BY THE BODY

- FG Hopkins discovered vitamins, however the term, "vitamin" was coined by C. Funk.
- Vitamins are divided into two groups:
  - (a) Fat soluble vitamins - Vitamin A, D, E, and K.
  - (b) Water soluble vitamins - Vitamin B and C.

Vitamin	Chemical Name	Function in Body	Deficiency Disease	Sources
B <sub>1</sub>	Thiamine pyrophosphate	Part of coenzyme for respiration	<b>Beri-beri:</b> nerve and heart disorders	Found in whole grain cereals, etc.
B <sub>2</sub>	Riboflavin	Part of coenzyme FAD needed for respiration	<b>Ariboflavinosis:</b> skin and eye disorders	Milk, yogurt, etc.
B <sub>12</sub>	Cyanoco-balamin	Coenzyme needed for making red blood cells, etc.	<b>Pernicious anaemia</b>	Animal products etc.
B <sub>5</sub>	Nicotinic acid ('niacin')	Part of coenzymes NAD, NADP used in respiration	<b>Pellagra:</b> skin, gut and nerve disorders	Widespread in foods.
C	Ascorbic acid	Not precisely known	<b>Scurvy:</b> degeneration of skin teeth and blood vessels.	Lemon, orange, etc.
A	Retinol	Visual pigment, rhodopsin	<b>Xerophthalmia:</b> 'dry eyes'	Milk, eggs, etc.
D	Cholecalciferol	Stimulates calcium absorption by small intestine, needed for proper bone growth	<b>Rickets:</b> bone deformity	Found in dairy products, etc.
E	Tocopherol	Not precisely known	<b>Infertility</b>	Found primarily in plant oils, green, leafy vegetables, etc.
K	Phylloquinone	Involved in blood clotting	<b>Possible haemorrhage</b>	Green, leafy vegetables, etc.

### Minerals required by the body

Minerals	Source	Function
Sodium (Na)	Table salt large amounts is present in processed foods, etc.	for proper fluid balance, etc.
Chloride	Table salt, large amounts is present in processed foods, etc.	for proper fluid balance, etc.
Potassium	Meats, milk, etc.	for proper fluid balance, etc.
Calcium	Milk and milk products, etc.	Important for healthy bones and teeth, etc.
Phosphorus	Meat, fish, poultry, eggs, milk, processed foods.	Important for healthy bones and teeth, etc.
Magnesium	Nuts and seeds; etc.	Found in bones, etc.
Sulfur	Occurs in foods as part of protein, meats, etc.	Found in protein molecules.
Iron	Organ meats; etc.	found in red blood cells.
Iodine	Seafood, foods grown in iodine-rich soil, etc.	Found in thyroid hormone.

### PROTEIN DEFICIENCY DISEASES

- **Marasmus** is produced by a simultaneous deficiency of proteins and calories.
- **Kwashiorkar** is produced by protein deficiency.

### Respiratory System

- The organ system which aids in the process of respiration is called the Respiratory system.

Respiratory Organ	Animals
Lungs	Mammals, Birds, Reptiles and Amphibians
Gills	Fish, Crabs, Tadpole larva of Frog
Skin	Earthworm, Leech, Amphibians
Trachea	Insects

### Hormones and their action

S. No.	Endocrine gland	Hormone	Action
1	<b>Pituitary (Master gland)</b>	Growth hormones, Anti-diuretic hormone Adeno – Corticotrophic hormone	Regulates the growth of bone and tissue. Controls the amount of water reabsorbed by the water. Defending the body against physiological stress e.g. exposure to cold. Follicle stimulating hormone stimulates ovary to produce female hormone.
2	<b>Pineal</b>	Melatonin	Regulates, circadian and sexual cycle
3	<b>Thyroid</b>	Thyroxine	Regulates rate of growth and metabolism. Too little-over weight and sluggishness. Too much-thin and over active.
4	<b>Thymus</b>	Thymosin	Helps in production of lymphocytes

### Human respiratory system

- Human respiratory system consists of external nostrils, nasal cavity, nasopharynx, larynx, trachea, bronchiole and lungs.

### Circulatory System

- These are of two types open circulatory system and closed circulatory system.

### Open Circulatory System

- Generally present in arthropods and molluscs.

### Closed Circulatory System

- Annelids and chordates have a closed circulatory.

### Heart beat and pulse

- The human heart beats at the rate of about 72-80 per minute in the resting condition.

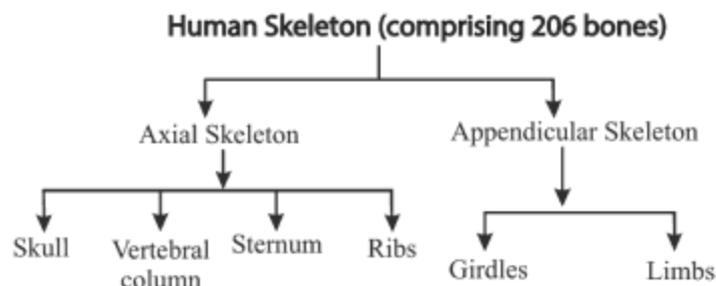
### Electrocardiograph

ECG stands for Electrocardiogram. It is the graphic record of electronic current produced by the excitation of cardiac muscles.

### Excretion

- It is process of removal of undigested wastes from the body.
- Kidney plays a major role in the elimination of water waste in the form of urine.
- Urine contains ammonia, urea, uric acid, etc.

### SKELETAL SYSTEM



### ENDOCRINE SYSTEM

Endocrine system is the collection of ductless glands that produce hormones directly into blood. These hormones regulate metabolism, growth and development, tissue function, sexual function, reproductions sleep and mood among other things.

5	<b>Adrenal</b>	Cortisone	Aids in conversion of proteins to sugar, cortex of this gland produces the hormone.
6	<b>Pancreas</b>	Insulin	Regulates sugar metabolism. Too little insulin leads to high sugar level in blood and weakness (a condition called <b>diabetes</b> )
7	<b>Ovary</b>	Estrogen	Development of secondary sexual characters e.g. development of breasts in female.
8	<b>Testis</b>	Testosterone	Development of many masculine features such as growth of moustaches and beard

#### Diseases related to Endocrine System

- Hormone levels that are too high too low cause diseases.
- Hormonal diseases also occur if body does not respond to hormones.
- Stress, Infection and changes in the blood's fluid and electrolyte balance can also influence hormone levels.
- The most common endocrine diseases are diabetes, hypo/ chyperthyroidism, hypoglycemia,

#### Important facts of human body

Blood volume	5 to 5.5 L (in 70 kg body)
Blood platelets	2,00,000 - 4,00,000 per cubic mm
Blood clotting time	2-5 minutes
Longest bone	Femur (Thigh bone)
Smallest bone	Ear-ossicle and stapes
Normal body temperature	98.6° F or 37°C
Weight of brain	1424 g
Total number of bones in the human body	206
Total number of muscles in the body	639
WBC	5000-7000/cub.ml
RBC	5m/cub.ml OR 50,00000/cub.ml
Largest muscle in the body	Gluteus maximus (Buttock muscle)
Largest organ of human body	Skin
Largest endocrine gland	Thyroid
Menopause age	40-50 years
Minimum regeneration power	In brain cells
Thinnest skin	Conjunctiva
Number of cells in body	75 trillion
Hb (Hemoglobin) content in body	(i) 12-17 g/dl (male) (ii) 12-15 g/dl (Female) (iii) New born: 14-24 g/dl (vi) Child: 11-16g/dl
Normal BP	120/80 mm Hg
Pulse rate	72/minute

Breathing rate	16-20/minute
ESR (Erythrocyte Sedimentation Rate)	4-10 mm/hour
Normal sperms count	200-350 million/ejaculation & 40-300 million/ml

#### AND DEFENCE MECHANISM IMMUNITY

- The term **immunity** refers to the specific resistance exhibited by the host towards infections by micro-organisms (*pathogens*) and their products.

#### Innate immunity

- It is developed in an individual without having the disease or immunization, e.g.,

#### Acquired Immunity

- The resistance against infectious disease that an individual acquires during life is known as acquired immunity.

**MERS:** Middle East Respiratory Syndrome (MERS) is new viral disease related to respiratory illness.

**Ebola:** Ebola hemorrhagic fever (Ebola HF) is a severe, often-fatal disease in humans and non-human primates (monkeys, gorillas, and chimpanzees).

**AIDS:** Acquired Immuno Deficiency Syndrome (AIDS) is caused by Human Deficiency Virus (HIV).

#### COMMON HEART DISEASES

- **Coronary artery disease or Arthrosclerosis**
- **Angina** (angina pectoris):
- **Heart Failure** (congestive heart failure)

#### COMMON LUNG DISEASES

- **Asthma**
- **Bronchitis (Inflammation of the Bronchi):**

#### COMMON BRAIN DISEASES

- **Epilepsy:** Epilepsy is a condition where a person has recurrent seizures, abnormal discharge of electrical activity in the brain cells

**Cancer:** Cancer is a complex genetical disease which occurs due to the environmental factors. Cancer causing agent (*carcinogen*) may be present in food and water, in air in sunlight and in chemicals.

## BACTERIAL DISEASES

Disease	Pathogen	Affected Organ	Symptom
<b>Anthrax</b>	Bacillus anthracis	Skin and intestine	Skin ulcer, sore throat, nausea, fever, breathlessness
<b>Cholera</b>	Vibrio cholerae	Intestine	Vomiting, acute diarrhoea, muscular cramps, dehydration etc.
<b>Diphtheria</b>	Corynebacterium diphtheriae	Respiratory tract	Difficulty in respiration (mainly in child of age 2-5 yrs).
<b>Gonorrhoea</b> (sexual disease)	Neisseria gonorrhoea	Urinary tract	Swelling in urinary tract.
<b>Leprosy or Hansen's disease</b>	Mycobacterium leprae	Chronic infection of skin and nerve	Ulcers, nodules, scaly scabs (the infected part of the body becomes senseless).
Plague (i) Bubonic plague	Pasteurella, Yersinia pestis	Blood disease	High fever, weakness and haemorrhage which turn black.
(ii) Pneumonic plague	"	Lungs	Haemorrhage of bronchi, lungs.
(iii) Septicemic plague	"	Blood	Anaemia, fever, chills leading to death with in two days.
Tetanus (lock jaw)	Clostridium tetani	Central nervous system	Painful contraction of neck and jaw muscles followed by paralysis of thoracic muscles.
Tuberculosis	Mycobacterium tuberculosis	Lungs	Repeated coughing, high fever.
Whooping cough or Pertussis	Bacillus pertussis	Respiratory system	Continuous coughing.
Pneumonia	Diplococcus pneumoniae	Lungs	Sudden chill, chest pain, cough, high fever.
Typhoid	Salmonella typhi	intestine	High fever, diarrhoea and headache.

## VIRAL DISEASES

Disease	Pathogen	Affected Part	Symptom
<b>AIDS</b> (Acquired Immuno Deficiency Syndrome)	HIV (Human Immuno Deficiency Virus)	White blood cells	Weak immune system.
<b>Chicken pox</b>	Varicella virus	Whole body	High fever, reddish eruption on body
<b>Small pox</b>	Variola virus	Whole body	Light fever, eruption of blood on body
<b>Dengue fever</b>	RNA containing dengue virus	Whole body, particularly head, eyes and joints	High fever, backache, headache, retro-orbital pain behind the eye ball.
<b>Ebola virus disease</b>	Ebola Virus (filovirus)	Whole body	Fatal hemorrhagic fever, liver and kidney disfunction vomiting, headache.
<b>Hepatitis</b> (Epidemic Jaundice) (i) Hepatitis - A (ii) Hepatitis - B	Hepatitis virus Hepatitis - A virus Hepatitis - B virus	Liver	Loss of appetite, nausea, whitish stool and jaundice. Not fatal Fatal
<b>Herpes</b>	Herpes virus	Skin	Swelling of skin.
<b>Influenza (flu)</b>	Influenza virus	Whole body	Inflammation of upper respiratory tract, nose throat and eyes.

<b>Measles German</b>	Rubella virus	Whole body	Loss of appetite, reddish eruption on the body.
<b>Polio or poliomyelitis</b>	Polio virus	Throat, backbone and nerve	Fever, backbone and intestine wall cells are destroyed. It leads to paralysis.
<b>Rabies (hydrophobia)</b>	RNA virus called rabies virus	Nervous system	Encephalitis, fear of water, high fever, headache, spasm of throat and chest leading to death.
<b>Swine influenza (flu)</b>	H <sub>1</sub> N <sub>1</sub> flu virus	Whole body (muscles)	Headache, tiredness, sore throat, vomiting, breathing problems.

### PROTOZOAN DISEASES, THEIR VECTORS AND AFFECTED PART DISEASES

Disease	Pathogen (Causative agent)	Vector	Parts Affected and Symptoms
<b>African trypanosomiasis</b>	<i>Trypanosoma gambienses</i>	Tsetse fly ( <i>Glossina palpalis</i> )	Blood and nervous tissue. Man feels sleepy, may cause death.
<b>Amoebic dysentery (Amoebiasis)</b>	<i>Entamoeba histolytica</i>	None, Infection by contamination	Colon (intestine). Develop loose motion with blood, pain in abdomen
<b>Diarrhoea</b>	<i>Giardia</i>	None, infection by contamination	Digestive system causes loose motions, vomiting
<b>Filaria or elephantiasis</b>	<i>Wuchereria bancrofti</i>	Culex mosquito	Swelling of legs, testes and other body parts.
<b>Kala azar or dum dum fever</b>	<i>Leishmania donovani</i>	Sand flies ( <i>Phlebotomus</i> )	Spleen and liver enlarge and high fever develops.
<b>Malaria</b>	<i>Plasmodium Vivex</i>	Female Anopheles mosquito	Periodical attacks of high fever, pain in joints accompanied by chill, heavy perspiration and fast pulse.

### FUNGAL DISEASES IN HUMAN BEINGS

Disease	Pathogen (fungi)	Symptoms
<b>Asthma or aspergillosis</b>	<i>Aspergillus fumigatus</i>	Obstruction in the functioning of lungs.
<b>Baldness</b>	<i>Tinea capitis</i>	Hair fall
<b>Athlete's foot</b>	<i>Tinea pedis</i>	Skin disease, cracking of feet.
<b>Ringworm</b>	<i>Tricophyton Verrucosum</i>	Round red spot on skin
<b>Scabies</b>	<i>Acarus scabiei</i>	Skin itching and white spot on the skin.

### SOME VIRAL DISEASES IN ANIMALS

Animal	Virus	Disease
Buffalo	Pox virido orthopox	Small pox
Cow	Herpes virus	Herpes
Cow	Variola vera	Small pox
Cow	Blue tongue virus	Blue tongue
Dog	Street rabies virus	Rabies

### BLOOD

- **Blood** is a liquid connective tissue.
- Blood has a fluid matrix called plasma.
- **Plasma** is a pale coloured fluid which contributes 55% of blood volume. Plasma contains 90 to 92 % of water.
- Blood corpuscles are of three types: Red blood corpuscles (RBCs), white blood corpuscles (WBCs) and Blood platelets.
- RBC's are formed in the red bone-marrow.
- RBC lack, nucleus.
- **Life span of RBCs** (Erythrocytes) is about 120 days.
- **WBCs (Leucocytes)** are responsible for immunity.
- **WBCs** are manufactured in bone marrow.
- **Neutrophils** and monocytes are phagocytic cells (destroy foreign bodies)
- **Basophils** are involved in inflammatory reactions.
- **Eosinophils** are associated with allergic reactions.
- **Lymphocytes** are responsible for immune response.
- **Platelets** (thrombocytes) are responsible for clotting of blood during accidents.
- For a healthy adult person the average **systolic/diastolic pressure** is 120/80 mm of Hg in arteries near heart.
- **Blood pressure** is measured by sphygmomanometer.

- **The Rh factor** is a type of protein on the surface of red blood cells. Most people who have the **Rh factor** are **Rh-positive**. Those who do not have the **Rh factor** are **Rh-negative**.

### BLOOD GROUP

- **Karl Landsteiner** (1900) discovered the blood group in human.
- There are four groups of blood A, B, AB and O.
- **Universal Donor** : 'O' blood group person is '**universal donor**', i.e can give blood to all the four blood groups (O, A, B, and AB).
- **Universal Recipient** : 'AB' blood group person is '**universal recipient**', i.e can take blood from all the four groups (AB, A, B, O).

### VACCINES AND THEIR DOSES

Age	Vaccination	Dose
Birth to 12 months	<ul style="list-style-type: none"> <li>• <b>DPT</b> (triple vaccine, against diphtheria, whooping cough/pertussis and tetanus)</li> <li>• <b>Polio</b> (Sabin's oral, previously Salk's injectible)</li> <li>• <b>BCG</b> (Bacillus Calmette Guerin)</li> </ul>	<ul style="list-style-type: none"> <li>• Three doses (commonly oral) at intervals of 4-6 weeks.</li> <li>• Three doses at intervals of 4-6 weeks.</li> <li>• Intradermal and one vaccine</li> </ul>
8-24 months	<ul style="list-style-type: none"> <li>• <b>DPT</b></li> <li>• <b>Polio</b> (oral)</li> <li>• <b>Cholera</b> vaccine (can be repeated every year before summer)</li> </ul>	<ul style="list-style-type: none"> <li>• Booster dose</li> <li>• Booster dose</li> <li>• One</li> </ul>
9-15 months	<ul style="list-style-type: none"> <li>• <b>Measles</b> vaccine (MMR or Measles, Mumps and Rubella)</li> </ul>	<ul style="list-style-type: none"> <li>• one dose</li> </ul>
5-6 years	<ul style="list-style-type: none"> <li>• <b>DT</b> (Bivalent vaccine against diphtheria and tetanus)</li> <li>• <b>TAB</b> (vaccine against Salmonella typhi, S. paratyphi A and S paratyphi B) or Typhoid Paratyphoid vaccine</li> </ul>	<ul style="list-style-type: none"> <li>• Booster dose</li> <li>• Two doses at intervals of 1-2 months</li> </ul>
10 years	<ul style="list-style-type: none"> <li>• Tetanus, TAB (typhoid)</li> </ul>	<ul style="list-style-type: none"> <li>• Booster dose</li> </ul>
16 years	<ul style="list-style-type: none"> <li>• Tetanus, TAB</li> </ul>	<ul style="list-style-type: none"> <li>• Booster dose</li> </ul>

### VACCINES AND INVENTORS

Vaccine	Developed by	Country	Year
Small Pox	Edward Jenner	England	1796
Cholera	Louis Pasteur	France	1880
Diphtheria and Tetanus	Emil Adolf Von Behring and Shibasaburo Kitasato	Germany/ Japan	1891

TB Vaccine	Albert Calmette and Camille Guerin	France	1922
Polio Vaccine	Jonas E. Salk	US	1952
Oral Polio Vaccine	Albert Bruce Sabin	US	1955
Measles Vaccine	John F. Enders, Thomas peeble	US	1953
Rabies Vaccine	Louis Pasteur	France	1885
Typhus Vaccine	Charles Nicolle	France	1909
Rubella Vaccine	Paul D. Parkman & Harry M. Meyer jr		1966
Scurvy Vaccine	James Lind		1753

### MEDICAL SCIENCE DISCOVERIES

Invention	Inventor	Year
• Anesthetic	William Morton	1846
• Anthrax vaccine	Louis Pasteur	1881
• Antiseptic	Joseph Lister (Scotland)	1867
• Artificial heart	Denton Cooley	1969
• Artificial hip	John Charnley	1972 (perfected)
• Artificial skin	Dr. John F. Burke and Ioannis Yannas	1979
• Birth control pill	Gregory Pincus, John Rock and Min-Chueh Chang	1960 (approved by FDA)
• Cholera and T.B. Germs	Robert Koch (Germany)	1883
• Blood	William Harvey (Britain)	1628 (published)
• Blood transfusion (modern)	Dr. Thomas Blundell	1818
• Cholera vaccine	Louis Pasteur	1880
• Contact lenses (glass)	Adolf Fick	1887
• Corneal transplants	Eduard Zirm	1905
• Cough drops	James Smith and sons	1847
• Disposable syringe	Colin Murdoch	1956
• DNA	Frances Crick, James Watson and Rosalind Franklin	1953
• Gas mask	Garrett Augustus Morgan	1912
• Genetics	Johann Gregor Mendel	1865
• Heart transplant	Christiaan Barnard	1967
• Insulin (discovery)	Frederick Banting and Charles Best	1921

• Iron lung	Philip Drinker	1929
• Pacemaker (human)	Wilson Greatbatch	1960 (first use)
• Pasteurisation	Louis Pasteur	1864
• Pathology	Giovanni Battista Morgagni	1761
• Penicillin	Alexander Fleming	1928
• Plastic surgery	Archibald Hector McIndoe	1940s
• Polio vaccine	Jonas Salk	1953
• Quinine	Pierre Joseph Pelletier and Joseph Bienaime Caventou	1820

## Biology in human welfare

### Animal Husbandry

- It deals with the care, breeding & management of domesticated animals that are useful to humans.

### Poultry Farming

- Poultry is a rearing of domesticated fowls, ducks, geese, turkeys, guinea fowls and pigeons.

### Fisheries

- **Pisciculture** is the rearing, breeding and catching of fishes.

### Apiculture

- Apiculture is rearing and breeding of honeybees for the production of **honey**.

### Animal Breeding

- Animal breeding is the production of new breeds of domesticated animals with improved traits.

## Plant Breeding

- Plant breeding refers to the modification and improvement of genetic material of plants resulting in the development of crops which are more beneficial to human beings.

Crop	Variety	Resistance to diseases
Wheat	Himgiri	Hill bunt & leaf and stripe rust.
Cauliflower	Pusa snowball K-1 Pusa shubra	Blight black rot, Black rot and curl.
Brassica	Pusa Swarnim (Karan rai)	White rust.
Cowpea	Pusa Komal	Bacterial blight.
Chilli	Pusa Sadabahar	Chilly mosaic virus, Tobacco mosaic virus and leaf curl.

## Biotechnology and its application

- It deals with large scale production and marketing of products and processes using living organism, cells or enzymes. This technology has application in agriculture, food processing industry, bioremediation, medicine diagnostics, waste treatment and energy production.

## Genetically Modified Plants

- Golden Rice: It is a genetically modified variety of Rice.
- Bt Cotton : *Bacillus thuringiensis*
- Flavr savr variety of tomato: Flavr savr is the first genetically engineered crop in which tomatoes have longer shelf life.

## Benefits of Transgenic Animals

- Transgenic animals are used to study gene regulation
- Biological products

# EXERCISE

- Mass is the measure of  
(a) matter contained (b) weight  
(c) force (d) none of these
- The mass is measured by  
(a) a beam balance (b) a spring balance  
(c) micro balance (d) none of these
- A hydrometer is used to measure –  
(a) density (b) mass  
(c) weight (d) R.D.
- Among the following the derived quantity is  
(a) mass (b) length (c) density (d) time
- The SI unit of current is  
(a) kelvin (b) ampere  
(c) newton (d) volt
- One micron equals to  
(a)  $10^{-3}$  m (b)  $10^{-9}$  m  
(c)  $10^{-6}$  m (d)  $10^{-2}$  m
- The SI unit of density  
(a) gram/metre<sup>3</sup> (b) kilogram/metre<sup>3</sup>  
(c) gram/cm<sup>3</sup> (d) kg/cm<sup>3</sup>
- Which of the following is not a fundamental unit?  
(a) newton (b) kilogram  
(c) metre (d) second
- The unit of ..... is a derived unit –  
(a) temperature (b) length  
(c) velocity (d) luminous intensity
- The SI unit of weight is :  
(a) kilogram (b) newton  
(c) newton metre (d) kilo metre
- When a substance is heated its density  
(a) increases (b) decreases  
(c) remains same (d) none of these
- In SI units, candela is the unit of  
(a) current (b) temperature  
(c) luminous intensity (d) none of the above
- Practical unit of heat is  
(a) Calorie (b) Horse power  
(c) Joule (d) Watt
- If force and displacement of particle in direction of force are doubled. Work would be –  
(a) Double (b) 4 times  
(c) Half (d) 1/4 times
- If velocity of a body is twice of previous velocity, then kinetic energy will become –  
(a) 2 times (b) 1/2 times  
(c) 4 times (d) 1 times
- The unit of work is  
(a) newton (b) joule  
(c) metre (d) second
- 1 kilowatt hour is equal to –  
(a) 1 joule (b) 100 joule  
(c) 36 joule (d)  $3.6 \times 10^3$  kilo joule
- When a stone is thrown upward to a certain height, it possesses –  
(a) potential energy (b) kinetic energy  
(c) wind energy (d) sound energy
- kilowatt hour is the unit of –  
(a) time (b) power  
(c) energy (d) force
- A fast wind can turn the blades of a windmill because it possesses  
(a) potential energy (b) kinetic energy  
(c) chemical energy (d) heat energy
- The stability of a pond ecosystem depends on  
(a) micro-organisms and fishes  
(b) micro-organisms and zoo planktons  
(c) fishes and reptiles  
(d) producers and consumers
- The main factor which determines the balance of nature is  
(a) human activities  
(b) Rabbit and habitat  
(c) environmental conditions  
(d) availability of food
- The golgi bodies are related to  
(a) Respiration (b) Excretion  
(c) Secretion (d) Circulation
- The most abundant compound in cytoplasm is  
(a) fat (b) water  
(c) protein (d) carbohydrates
- Mitochondria usually occur in  
(a) Vegetative cells  
(b) Reproductive cells  
(c) Both vegetative and reproductive cells  
(d) None of these
- Which of the following is not a renewable resource?  
(a) Thorium (b) Geothermal heat  
(c) Tidal power (d) Radiant energy
- Which one of the following pairs is not correctly matched?  
(a) Hevea Tree—Brazil  
(b) Sumatra Storm—Malaysia  
(c) Kajan River—Borneo  
(d) Dekke Toba fish—Brazil
- Which of the following resources is renewable one?  
(a) Uranium (b) Coal  
(c) Timber (d) Natural Gas

29. How many neck canal cells are found in the archegonium of a fern?  
 (a) One (b) Two  
 (c) Three (d) Four
30. Which angiosperm is vesselless?  
 (a) Hydrilla (b) Trochodendron  
 (c) Maize (d) Wheat
31. Myrmecology is study of  
 (a) Insects (b) Ants  
 (c) Crustaceans (d) Arthropods
32. HIV often changes its shape due to the presence of an enzyme called  
 (a) Reverse Transcriptase  
 (b) Enterokinase  
 (c) Nucleotidase  
 (d) Nucleoditase
33. The cells which are closely associated and interacting with guard cells are  
 (a) Transfusion tissue  
 (b) Complementary cells  
 (c) Subsidiary cells  
 (d) Hypodermal cells
34. Conversion of starch to sugar is essential for  
 (a) Stomatal opening  
 (b) Stomatal closing  
 (c) Stomatal formation  
 (d) Stomatal growth
35. Soil erosion can be prevented by  
 (a) Increasing bird population  
 (b) Afforestation  
 (c) Removal of vegetation  
 (d) Overgrazing
36. Natural sources of air pollution are  
 (a) Forest fires  
 (b) Volcanic eruptions  
 (c) Dust storm  
 (d) Smoke from burning dry leaves
37. Which of the following Genetically Modified vegetable is recently being made available in Indian market?  
 (a) Carrot (b) Radish  
 (c) Brinjal (d) Potato
38. The smallest organelle in the cell is  
 (a) Lysosome (b) Ribosome  
 (c) Mitochondria (d) Peroxisome
39. Cyanobacteria have-  
 (a) A well-defined nucleus and chloroplast.  
 (b) A well-defined nucleus but no chloroplast.  
 (c) Incipient nucleus and vesicles containing chlorophyll.  
 (d) Incipient nucleus but no chloroplast or pigment.
40. Which of the following cellular components can be used to distinguish a prokaryotic cell from a eukaryotic cell?  
 (a) Nucleus (b) Plasma membrane  
 (c) DNA (d) Proteins
41. Active transport through the plasma membrane occurs through the action of  
 (a) diffusion (b) membrane proteins  
 (c) DNA (d) water
42. Zinc is  
 (a) non-malleable. (b) brittle.  
 (c) ductile. (d) (a) and (b).
43. The only non-metal that has luster is  
 (a) Sulphur (b) Phosphorus  
 (c) Silicon (d) Iodine
44. Which of the following is a liquid metal?  
 (a) Mercury (b) Bromine  
 (c) Water (d) Sodium
45. The property of metals to be hammered into their sheets is called  
 (a) malleability (b) ductility  
 (c) tensile strength (d) sonorous nature
46. Select the metal that is soft  
 (a) Aluminium (b) Copper  
 (c) Sodium (d) Lead
47. The process of protecting iron, from rusting, by coating with zinc is called  
 (a) Rusting (b) Roasting  
 (c) Smelting (d) Galvanizing
48. Graphite is a/an –  
 (a) alloy (b) metal  
 (c) metalloid (d) non metal
49. The white phosphorus is stored –  
 (a) in air (b) under water  
 (c) under kerosene (d) under CS<sub>2</sub>
50. The chief ore of aluminium is –  
 (a) bauxite (b) cryolite  
 (c) alunite (d) feldspar
51. Which is the best variety of coal?  
 (a) Peat (b) Lignite  
 (c) Anthracite (d) Bituminous
52. Which is a fossil fuel?  
 (a) Natural gas (b) Biogas  
 (c) Producer gas (d) None of these
53. Which of the following cells do not have a nucleus ?  
 (a) Brain cell  
 (b) Cardiac muscle fibres  
 (c) Paramecium  
 (d) Mature human RBC
54. Which cell organelle is known as the control centre of the cell?  
 (a) Nucleus (b) Chloroplast  
 (c) Mitochondria (d) Endoplasmic reticulum
55. Energy currency of the cell is –  
 (a) AMP (b) GTP  
 (c) ATP (d) All

56. Which of the following organelles are semiautonomous organelle ?  
 (a) Mitochondria (b) Ribosomes  
 (c) Chloroplast (d) Both (a) and (c)
57. In the mitochondrion energy is stored in the form of  
 (a) adenosine triphosphate (ATP)  
 (b) adenosine monophosphate (AMP)  
 (c) citric acid  
 (d) adenosine diphosphate (ADP)
58. The site of protein synthesis in plants is the  
 (a) Chloroplast (b) Ribosomes  
 (c) Pyrenoids (d) Mitochondria
59. Synthesis of any protein in a cell is determined by  
 (a) type of ribosomes  
 (b) mitochondria  
 (c) sequence of nucleotides in DNA  
 (d) sugar and phosphate of DNA
60. The plasma membrane is  
 (a) permeable (b) semipermeable  
 (c) differentially permeable (d) impermeable
61. A form of condensation that reduces visibility and causes breathing problems is  
 (a) Dew (b) Frost  
 (c) Smog (d) Mist

## Hints & Solutions

1. (a) 2. (a) 3. (a) 4. (c) 5. (b) 6. (c)  
 7. (b) 8. (a) 9. (c) 10. (b) 11. (b) 12. (c)  
 13. (a) 14. (b) 15. (c) 16. (b) 17. (d) 18. (a)  
 19. (c) 20. (a) 21. (d) 22. (a) 23. (c) 24. (b)  
 25. (c) 26. (a) 27. (d) 28. (c) 29. (a) 30. (b)  
 31. (b) 32. (a) 33. (c) 34. (a) 35. (a) 36. (c)  
 37. (c) 38. (b) 39. (c) 40. (a) 41. (b) 42. (d)  
 43. (d) 44. (a) 45. (a) 46. (c) 47. (d) 48. (a)  
 49. (b) 50. (a) 51. (c) 52. (a) 53. (d) 54. (a)  
 55. (c) 56. (d) 57. (a) 58. (b) 59. (c) 60. (b)  
 61. (c)