

Target Mission 67th BPSC/CDPO Science-Chakra



PHYSICS

WORK

- Work is said to be done, if force acting on a body is able to actually move it through some distance in the direction of the force. Its SI unit is a **joule**.

ENERGY

- Energy is a scalar quantity and its unit is **Joule**.
- The sum of all kinds of energies in an isolated system remains constant at all times. This is the law of conservation of energy.

POWER

Its unit is **watt**.

- **1 watt hour** = 3600 Joule
- **1 kilowatt hour** = 3.6×10^6 joule
- **1HP** = 746 watt

GRAVITATION

- Everybody in the universe attracts other body by a force called force of gravitation.
- The gravitational force of the earth is called **gravity**.
- The acceleration produced in a body due to force of gravity is called **acceleration** due to gravity (g) and its value is **9.8 m/s'**
- Acceleration due to gravity is independent of shape, size and mass of the body.
- Escape velocity is the minimum velocity with, which an object just crosses the Earth's gravitational field and never returns. Escape velocity at the Earth's surface is **11.2 km/s**.
- Escape velocity at the **Moon's** surface is **2.4 km/s**. Due to low escape velocity there is no atmosphere on the moon.
- Value of g decreases with height or depth from Earth surface.
 - g is maximum at **poles**.
 - g is minimum at **equator**.
 - g decreases due to **rotation of Earth**.
 - g decreases if angular speed of Earth increases and increases if angular speed of Earth decreases.
- The acceleration due to gravity at the moon is **one-sixth** that of the Earth. So, the weight of a person on the surface of the moon will be **1/6** of his actual weight on the Earth.

SATELLITE

- Satellites are natural or artificial bodies revolving around a planet under its gravitational force of attraction.
- **Moon** is a **natural satellite**, while **INSAT-B** is an artificial satellite of Earth.
- The period of revolution of satellite revolving near the surface of earth is 1 hour 24 minutes (34 minutes).
- Geo-stationary satellite revolves around the Earth at a height 36000 km (approx).
- Time period of rotation of geo-stationary satellite is 24 hours.
- The Earth rotates on its axis from **West to East**. This rotation makes the Sun and the stars appear to be moving across the sky from **East to West**.

- A **geosynchronous satellite** is a satellite in geosynchronous orbit, with an orbital period the same as the Earth's rotation period.
- A special case of geosynchronous satellite is the **geostationary satellite**, which has a geostationary orbit – a circular geosynchronous orbit directly above the Earth's equator.
- **Geo-stationary satellite is used** to telecast. TV programmes from one part of the world to another, in weather forecasting, in predictions of floods and droughts.
- Polar Satellite Revolves around the earth in polar orbit at a height of **800km** (app.) Time periods of these satellites is **84 min**.

ATOMIC AND NUCLEAR PHYSICS

Cathode Rays

Cathode rays, discovered by Sir William Crooke and its properties are

- travel in **straight lines**.
- Produce fluorescence.
- can penetrate through thin foils of metal and deflected by both electric and magnetic fields.
- have velocity ranging **1/30th** to **1/10th** of the velocity of light.

Positive or Canal Rays

- These rays were discovered by **Goldstein**.
- The positive ray consists of **positively charged particles**.
- These rays travel in **straight line**.
- These rays are deflected by **electric and magnetic fields**.
- These rays can produce ionization in gases.

X-Rays

- X-rays are electromagnetic waves with wavelength **range 0.1 A-100 A**.
- X-rays were discovered by **Roentgen**.
- X-rays travels in **straight line**.
- Long exposures of X – rays in injurious for human body.
- X – rays shows **photoelectric effect**.

Uses of X-Rays

- **In medical sciences** X-rays are used in surgery for the detection of fracture, diseased organs, foreign matter like bullet, stones etc. They are used in treatment of cancer and in skin diseases.
- **In Engineering**, X-rays are used in detecting faults, cracks, flaws and gas pockets in the finished metal products and in heavy metal sheets.
- **In Scientific Work**, X-rays are used in studying crystal structure and complex molecules.
- **In Custom Department** X-rays are used in custom department for detection of banned materials kept hidden.

Radioactivity

- Radioactivity was discovered by **Henry Becquerel, Madame Curie and Pierre Curie** for which they jointly won Nobel Prize.

Nuclear Fission

- Atom Bomb is based on nuclear fission. U^{235} and Pu^{239} are used as fissionable material.
- Nuclear fission was first demonstrated by Halin and Fritz Strassmann.

Nuclear Fusion

- When two or more light nuclei combined together to form a heavier nucleus is called as **nuclear fusion**.
- For the nuclear fusion, a temperature of the order of **10^8 K** is required.
- **Hydrogen Bomb** was made by the American Scientist in **1952**. This is based on **nuclear fusion**. It is **1000** times more powerful than atom bomb.

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 moderate.

Uses of Nuclear Reactor

(i) To produce electrical energy from the energy released during fission.

(ii) To produce different isotopes, this can be used 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 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.

NEWTON'S LAWS OF MOTION

- **First Law:** Everybody maintains its initial state of rest or motion with uniform speed on a straight line unless an external force acts on it. It is also called Galileo's law or law of inertia.

Example: While jumping from a slowly moving train/bus one must run for short distance, in the direction of motion.

- **Second Law:** The force acting on an object is directly proportioned to the product of the mass of the object and the acceleration produced on it.
- **Third Law:** To every action, there is an equal and opposite reaction.

Example : Bogies of the trains are provided with buffers to avoid severe jerks during shunting of trains. Rocket moves up due to reaction of downward ejection of gas.

CIRCULAR MOTION

- When an object moves along a circular path, its motion is called circular motion.
- The external force required to act radially inward over the circular motion of the body is called **Centripetal force**.

- **Centrifugal force** is such a pseudo force that is equal and opposite to **Centripetal force**.
- Cream separator, centrifugal dryer work on the principle of centrifugal force.

FRICTION

- In the opposing force that is set-up between the surfaces of contact, when one body slides or rolls or tends to do so on the surface of another body.
- Due to friction, we are able to move on the surface of Earth.
- While applying brakes in automobiles, it stops only due to friction.

Pascal's Law of Pressure

- Hydraulic lift, hydraulic press and hydraulic brakes are based on the **Pascal's law of pressure**.

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.
- 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.
- A fat person will quickly learn the swimming as compared to a slim person because he will displace more water. So, it will be more balanced.
- Hydrogen filled balloon float in air because hydrogen is lighter than air. A person can lift more weight in water.

WAVE

A wave is a disturbance, which propagates energy from one place to the other without the transportation of matter.

Waves are broadly of two types:

- Mechanical wave (longitudinal wave and transverse wave)
- Electromagnetic wave
- Following are the electromagnetic (Non-mechanical) waves-

a. Gama rays (**Highest frequency**)

b. X-rays

c. UV rays

d. Visible radiation

e. infra-red rays

f. short radio waves

g. Long radio waves (**Lowest frequency**)

All are in decreasing order of the frequency

Following waves are not electromagnetic.

a. Cathode rays

b. Canal rays

c. alpha rays

d. beta rays

- e. sound wave
- f. ultrasonic wave

Longitudinal Waves

- In this wave the particles of the medium vibrate in the direction of propagation of wave.
- Waves on springs or sound waves in air are examples of longitudinal waves.

Transverse Waves

- In this wave, the particles of the medium vibrate perpendicular to the direction of propagation of wave.
- Waves on strings under tension, waves on the surface of water are the examples of transverse waves.

Electromagnetic Waves

- The waves, which do not require medium for their propagation i.e., which can propagate even through the vacuum are called electromagnetic waves.
- Light radio waves, X-rays etc are the examples of electromagnetic wave. These waves propagate with the velocity of light in vacuum.

Sound Waves

Sound waves are longitudinal mechanical waves. Eased on their frequency range sound waves are divided into following categories.

- The sound waves which lie in the frequency range 20 Hz to 20000 Hz are called audible waves.
- The sound waves having frequencies less than 20 Hz are called infrasonic
- The sound waves having frequencies greater than 20000 Hz are called ultrasonic waves.
- Ultrasonic waves are used for sending signals, measuring the depth of sea, cleaning clothes and machinery parts, remaining lamp short from chimney of factories and in ultrasonography.

Speed of Sound

- Speed of sound is **maximum in** solids **minimum in** gases.
- When sound goes from one medium to another medium, its speed and wave length changes, but frequency remain unchanged. The speed of sound remains unchanged by the increase or decrease of pressure.
- The speed of sound increases with the increase of temperature of the medium.
- The speed of sound is more in humid air than in dry air because the density of humid air is less than the density.

Echo: The repetition of sound due to reflection of sound waves is called an echo.

Intensity: It is defined as amount of energy passing normally per unit area held around that point per source unit time.

Pitch: The sensation of a frequency is commonly referred to as the pitch of a sound.

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.

LIGHT

- Light is a form of energy, which is propagated as an electromagnetic **wave**.
- It is the radiation which makes our eyes able to 'see' the object. Its speed is **3×10^8 m/s**. It is the form of energy. It is a **transverse wave**.
- It takes **8 min 19s** to reach on the earth from the sun and the light reflected from moon takes **1.28s** to reach earth.
- **Primary Colours**- Blue, Red, Green
- **Secondary Colours**- The coloured produced by mixing any two primary colors
- **Complementary Colours**- Any two colours when added produce white light.
- Blue colour of the sky is due to scattering of light.
- The brilliant red colour of rising and setting sun is due to scattering of light.

Human Eye

- Least distance of distinct vision is 25 cm.
- Myopia or short sightedness- far objects cannot see clear
- Hyperopia or hypermetropia or Long-sightedness- Near objects cannot see clear
- **Presbyopia**- in elder person, both far and near cannot see clear

Reflection of Light

- When a ray of light falls on a boundary separating two media comes back into the same media, then this phenomenon is called reflection of light.

Spherical Mirror

Spherical mirrors are of two types

1. **Concave mirror**
2. **Convex mirror**

- Image formed by a convex mirror is always virtual, erect and diminished.
- Image formed by a concave mirror is generally real and inverted.

Uses of Concave Mirror

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

Uses of Convex Mirror

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

Refraction of Light

- The bending of the ray of light passing from one medium to other medium is called refraction. When a ray of light enters from one medium to other medium, its frequency and phase do not change, but wavelength and velocity change. Due to refraction from Earth's atmosphere, the stars appear to twinkle.

Total Internal Reflection

- Sparkling of diamond, mirage and looming, shinning of air bubble in water and optical Fiber are examples of total internal reflection.

Power of a lens

- Power of a lens is its capacity to deviate a ray. It is measured as the reciprocal of the focal length in meters.
- SI Unit of Power is diopter.

ELECTRICITY AND MAGNETISM

Charge

Charge is the basic property associated with matter due to which it produces and experiences electrical and magnetic effects. Similar charges repel each other and opposite charges attract each other. The SI unit of charge is **coulomb**.

Conductor: Conductors are those materials, which allow electricity to pass through them. Metals like silver, iron, copper and earth acts like a conductor. Silver is the best conductor.

Insulator: Insulators are those materials which do not allow electricity to flow through them. Metals like wood, paper, mica, glass, ebonite are insulators.

Electric Current

- Its unit is Ampere. It is a scalar quantity.
- **An electric bulb makes a bang when it is broken** because there is a vacuum inside the electric bulb, when the bulb is broken air rushes at great speed from all sides to fill the vacuum. The rushing of air produces a noise generally referred to as the bang.
- A Galvanometer can be converted into an ammeter by connecting a shunt parallel to it.
- The sodium and mercury street lamps light up due to atomic emission.
- The purpose of choke coil in fluorescent is to produce high voltage to ionize the gas in the tube required for high current to flow through filament.

Magnetism

- Diamagnetic substance- when placed in magnetic field, acquire feeble magnetism opposite to the direction of the magnetic field.
- Examples- Gold, Diamond, Copper, Water, Mercury etc.
- Paramagnetic substance- when placed in magnetic field, acquire feeble magnetism in the direction of the magnetic field.
- Example- Al, Na, Mn etc.
- Ferromagnetic substance-when placed in magnetic field, are strongly magnetized in the direction of the magnetic field.
- Examples- Iron, Cobalt, Nickle
- Curie temp- the Curie temperature (TC), or Curie point, is the temperature at which certain materials lose their permanent magnetic properties, to be replaced by induced magnetism.

- **Isogonic lines** are lines on the Earth's surface along which the declination has the same constant value, and lines along which the declination is zero are called **agonic lines**.
- **Isoclinic lines** are imaginary lines on the earth's surface connecting points where the earth's magnetic field has the same angle.
- **The aclinic line** is the magnetic equator, where the magnetic field is inclined neither north or south, so it's a special case of an isoclinic line.
- **Isodynamic line-** A line on a map connecting points of equal strength of the earth's magnetic field.

Surface Tension and capillary

- Lubricating oil spread easily on all parts because of their low surface tension.
- Dirt get removed when detergents are added while washing clothes because surface tension of water is reduced.
- The absorption of ink by a blotting paper is due to capillary action
- The supply of water to the leaves at the top of even a tall tree is through capillary rise.

Heat

- Unit of heat-
C.G.S- Calorie
F.P.S- British Thermal Unit (B. Th. U)
- Absolute Zero Temp- minus 273 K (-273 K)
- 1 calorie= 4.2 J
- The specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius.
- **Newton's Law of Cooling** states that the rate of change of the temperature of an object is proportional to the difference between its own temperature and the ambient temperature (i.e. the temperature of its surroundings).
- **Hoar Frost**-is the reverse process of sublimation.

MEASUREMENT UNITS

- **Angstrom** : For measuring length of light waves
- **Barrel** : For measuring liquids. One barrel is equal to 31½ gallons or 7,326.5 cubic inches
- **Cable**: For measuring length of cables. It is about 183m. in length
- **Carat** : Used for measuring precious stones. It is also a measure for the purity of gold alloy
- **Fathom** : It is used for measuring depth of water. One fathom is equal to 4 inches
- **Knot**: For measuring speed of ships

SOME CONVERSION FACTORS

Mass and Density

- 1 Kg = 1000 g = 6.02 u
- 1 Slug = 14.6 kg
- 1 u = 1.66 kg

Length and Volume

- 1 m = 100 cm = 39.4 inch = 3.28 ft
- 1 mile = 1.61 km = 5280 ft
- 1 inch = 2.54 cm
- 1 nm = m = 10 A
- 1 pm = m = 1000 fm
- 1 light year = 9.46 m
- 1 = 1000 L = 35.3 = 264 gal

Angular Measure

- 1 m/s = 3.28 ft/ s = 2.24 mi / h
- 1 km / h = 0.621 mi / h = 0.278 m/s

Force and Pressure

- 1 lb = 4.45 N
- 1 ton = 2000 lb
- 1 Pa = 1 N/ = 10 dyne/ = 1.45 lb/
- 1 atm = 1.01 x 10⁵ Pa = 14.7 lb/ = 76 cm – Hg

SOME IMPORTANT SCIENTIFIC INSTRUMENTS

Accumulator: Electrical energy is stored

- **Altimeter:** Used in aircraft for measuring altitudes
- **Ammeter:** Measuring the electrical current in amperes
- **Anemometer:** Measuring the strength of winds
- **Audiometer:** Measuring intensity of wind
- **Audiophone:** It is used for improving imperfect sense of hearing.
- **Barometer:** Measuring atmospheric pressure
- **Binocular:** An optical instrument designed for magnified view of distant objects by both eyes simultaneously
- **Bolometer:** To measure heat radiation
- **Cardiogram:** For recording the heart movements
- **Calorimeter:** Measuring of quantities of heat
- **Chronometer:** A clock that keeps very accurate time as the one that is used to determine longitude at sea.
- **Colorimeter:** An instrument for comparing intensities of colour.
- **Commutator:** An instrument to change or remove the direction of an electric current, in dynamo used to convert alternating current into direct current.
- **Cyclotron:** Studying the properties of atoms by smashing them.
- **Dynamo:** A device for converting mechanical energy into electrical energy
- **Dynamometer:** An instrument for measuring the electrical power
- **Electroscope:** An instrument for detecting the presence of electric charge.
- **Endoscope:** To examine internal parts of the body
- **Fathometer:** Measure depth of the ocean
- **Galvanometer:** For detecting and measuring electric current
- **Hygrometer:** Measure level of humidity
- **Phonograph:** For reproducing sound

- **Pyrometer:** Measure very high temperature
- **Quartz Clock:** A highly accurate clock used in astronomical observations and other precision work
- **Radiometer:** An instrument for measuring the emission of radiant energy
- **Radio Micrometer:** An instrument for measuring heat radiations
- **Rain Gauge:** An instrument for measuring rainfall
- **Rectifier:** An instrument used for the conversion of AC into DC.
- **Refractometer:** An instrument used to measure the refractive index of a substance
- **Resistance Thermometer:** Used for determining the electrical resistance of conductors
- **Salinometer:** A type of hydrometer used to determine the concentration of salt solutions by measuring their densities
- **Seismometer (Seismograph):** An Apparatus for measuring and recording earthquake shock
- **Sextant:** For guiding ships or surveying land.
- **Spectroscope:** An instrument used for spectrum analysis
- **Speedometer:** It registers the speed at which the vehicle is moving
- **Spherometer:** For measuring curvature of surfaces
- **Sphygmomanometer:** An instrument used to detect blood pressure in a human body. It is also called B.P.Apparatus
- **Sphygmophone:** Instrument with the help of which, a pulse beat makes a sound
- **Spring Balance:** Useful for measuring weight
- **Stereoscope:** It is used to view two dimensional pictures.
- **Stethoscope:** An instrument which is used by the doctors to hear and analyze heart and lung sounds.
- **Stroboscope:** It is used to view rapidly moving objects.
- **Tachometer:** An instrument used in measuring speeds of aero planes and motor boats.
- **Teleprinter:** This instrument receives and sends typed messages from one place to another.
- **Telescope:** It views distant objects in space.
- **Theodolite:** It measures horizontal and vertical angles.
- **Transistor:** A small device which may be used to amplify currents and perform other functions usually performed by a thermionic valve
- **Viscometer:** For measuring viscosity
- **Voltmeter:** To measure potential difference between two points
- **Udometer:** Rain guage

CHEMISTRY

MATTER

- **In general it exists in 3 states i.e.,**

- (i) Solid
- (ii) liquid
- (iii) gas.

- Now-a-days there is a discussion on two more states of matter i.e., **Plasma** (Ionised gases containing super energetic and super excited particles and **Bose-Einstein** condensates or BEC (a gas at super low temperatures with extremely low density)).

Boiling Point

- The temperature at which liquid converts in to vapours is called its boiling point.
- Boiling point of **water is 100°C**.
- The boiling point **increases in the presence of impurities**. That's why boiling point of **sea water is more than the boiling point** of pure water (as the former contains impurity).
- **It usually decreases at high altitudes, that's why at high altitudes, the boiling point of water is less than 100°C and more time is required to cook a food.**

Melting Point

- It is a temperature at which a substance **converts from its solid state to liquid state**.
- Melting point of **ice is 0°C**; It decrease in the presence of impurity

Atom, Molecule and Element

- Atom is the smallest particle of a matter that takes part in chemical reactions, but cannot exist in free state.
- **Atom is made 43 of electrons**, protons and neutrons.
- Protons and neutrons reside in the nucleus (**at the centre of atom**) whereas electrons revolve around the nucleus.
- **Atoms combine to form molecules**, the smallest part of matter which can exist in free state.

Isotopes and Isobars

- **Isotopes have the same number of protons** (*i.e.*, atomic number), but different number of neutrons and mass number (atomic number + number of neutrons), *e.g.*, **1111, 1H2**.
- **Isobars have the same mass number** but different atomic number.
- **Example:** 18Ar40, 19K40

Dating Techniques

- **Radiocarbon** dating is used to **determine the age of carbon** bearing materials like wood, animal fossils etc.
- **Uranium** dating is used to **determine the age of Earth, minerals and rocks**.

Battery

- Battery is a device, used to convert **chemical energy into electrical energy** and is of two types
 - (i) **Primary batteries** (non-rechargeable) act as galvanic cell, e.g., dry cell, mercury cell etc.
 - (ii) **Secondary Batteries:** (rechargeable) Act as galvanic as well as voltaic cell E.g., lead storage battery, nickel cadmium battery etc.

Corrosion

- The oxidative deterioration of a metal surface by the action of environment is called **corrosion**, an electrochemical process.
- When **iron exposed in to air, iron surface turns brown** due to the formation of **hydrated ferric oxide ($\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$)** which is also called rust,
- **Silver - Surface turns black** due to the formation of **silver sulphide (Ag_2S)**

Renewable Non-renewable Natural Resources

- **Renewable resources are available in large excess, i.e., never ends, e.g, air, sunlight etc.**
- **Non-renewable resources are available in limited quantity and end, if used excessively, after a limited period of time. e.g., mineral, coal, petroleum, natural gas etc.**

Fuels

- The substance, which produce heat and light on combustion are called fuels.
- A strong foul smelling substance, called ethyl mercaptan is added to LPG to detect its leakage as LPG is an odourless gas.

Some important fuels and their compositions

Fuel	Composition	Sources
Water Gas	Carbon monoxide (co) + hydrogen(h ₂)	By passing steam over red hot coke
Producer Gas	Carbon monoxide (CO) + Nitrogen (N ₂)	By passing insufficient air over red hot coke
Coal Gas	Hydrogen + methane + Ethylene + Acetyene + CO +Nitrogen	By fractional distillation
Natural Gas	Methane(83%) + Ethane	From petroleum
Liquefied Petroleum Gas (LPG)	Butane (CH ₄) 95%	From petroleum
Compressed Natural Gas (CNG)	Methane (CH ₄) 95%	From petroleum
Biogas or Gobar Gas	Methane (CH ₄) + Carbon dioxide (CO ₂) + Hydrogen (H ₂) + Nitrogen (N ₂)	From organic wastes

Physical and Chemical Changes

- Physical changes are the change, which only affect the physical properties like colour, hardness, density, melting point etc. of matter, but do not affect the composition and chemical properties of matter.
- A physical change is temporary, while a chemical change is **permanent**.
- Crystallisation, sublimation, 'boiling, melting, vaporisation, cutting of trees, dissolving sugar or salt in water etc. are physical changes.
- Chemical changes affect the composition as well as chemical properties of matter and result in the formation of a new substance.
- Burning of fuel, burning of candle and paper, electrolysis of water, photo synthesis, ripening of fruits etc, are examples of chemical changes

- Coal is obtained by carbonization of vegetable matter and is available in different varieties:
 - **Peat**- 60% C
 - **Lignite or Brown Coal** – 70% C
 - **Bituminous** – 60 to 80 % C
 - Anthracite Coal – 90% C
 - Fame

Flame contains three parts

1. **Innermost Part**- which is black due to the presence of unburned carbon particles- has lowest temperature.
2. **Middle part** – is yellow due to incomplete of fuel.
3. **Outermost part**- which is blue due to complete combustion of fuel is the hottest and used by goldsmith to heat the gold.

Fire Extinguishers

- Water extinguishes fire because as it evaporates, the vapours surround the burning substance, cutting off the oxygen supply, thus inhibiting burning process.
- In case of electrical or oil (petrol) fires, water cannot be used as extinguisher. This is because water is a conductor of electricity and heavier than oil. Thus, oil floats over it and continues to burn.
- Carbon dioxide, which is generated by the reaction of baking soda with acid, is used to extinguish electrical or oil fires. Quality of petrol is measured in terms of octane number and that of diesel in terms of cetane number.

Safety Matches

- In safety matches, the stick consists of a mixture of antimony trisulphide and potassium chlorate at its one end. The box side contains a mixture of powdered glass and phosphorus.

Acids, Bases and Salts

Acids

- These are the substance, which **have sour taste** and turn blue litmus red.
- These are **good conductor of electricity** in aqueous solution.
- Pickles are always kept in glass jar because acid present in them reacts with metal to **produce hydrogen gas**.

Bases

- These are the substances, **which have bitter taste and turn red litmus**, blue.
- They give different colours in acid and base solutions.

Salts

- These are the product of neutralisation reaction between an acid and a base.
- pH is the measure of acidity/basicity.

INORGANIC AND ORGANIC CHEMISTRY

Carbon Dioxide

- It is an acidic oxide of carbon and is used by green plants for photosynthesis. It does not help in burning.

Air and our breath contain carbon dioxide. Thus, when lime water is kept in air or we pass our breath into it, the lime water turns milky.

Carbon Monoxide

- It is a neutral oxide of air and has more affinity towards haemoglobin than oxygen (about 200 times more). That's why in the environment of carbon monoxide – which is a non-poisonous gas - people die for the need of oxygen.

It is dangerous to sleep in an unventilated room with fire burning inside because the fire produces carbon monoxide and carbon dioxide gases.

Plaster of Paris

It is chemically calcium sulphate hemihydrate ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$) and is prepared by heating gypsum – which is calcium sulphate dehydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) at 373 K.

On Mixing with water, plaster of Paris further sets into a hard solid, called gypsum. Thus, it is used to plaster fractured bones, for making toys, materials for decoration and for making surfaces smooth.

Portland Cement

It is a complex mixture of silicates and aluminates of calcium with small amount of gypsum.

Raw materials used for the manufacture of Portland cement are **limestone and clay**.

The composition of Portland cement is calcium oxide (50-60%), alumina (5-10%), and magnesium oxide (2-3%). Gypsum is added to cement to decrease its rate of setting.

In cement, if lime is in excess, cement cracks during setting and if lime is less, cement is of weak strength.

Mortar a mixture of sand, cement and water is used for joining bricks and plastering walls.

Concrete—a mixture of gravel, sand, cement and water is used for flooring and making roads.

Reinforced Concrete Cement (RCC)— which is concrete with steel bars and wires is used for constructing roofs, bridges and pillars

Glass

Glass—an amorphous solid or super-cooled liquid—contains maintz silica (SiO_2).

Different substances are added to obtain glass of different colour

Colour	Substance Added
Red	Copper oxide (CuO)
Green	Chromium oxide (Cr ₂ O ₃)
Blue	Cobalt oxide (CoO)
Brown	Iron oxide (Fe ₂ O ₃)

Heavy water

- Heavy water is water that contains **heavy hydrogen or deuterium**. Deuterium differs from the hydrogen usually found in water, protium, in that each atom of deuterium contains a proton and a neutron. Heavy water may be deuterium oxide, **D₂O** or it may be deuterium protium oxide, DHO.
- Note: **Heavy water occurs naturally, although** it is much less common than regular water. **Approximately one water molecule per twenty million water molecules is heavy water.**

Hard Water

- The water in which soluble bicarbonates of calcium and magnesium are present, is called temporary hard water and in which soluble sulphates and chlorides of magnesium and calcium are present is called permanent hard water.
- The temporary hardness of water is removed by boiling or by adding calcium hydroxide, Ca(OH)₂—the **Clark's process**. The permanent hardness of water is removed by adding sodium carbonate (Na₂CO₃), or calgon (sodium hexametaphosphate, Na₂[Na₄(PO₃)₆]).

Hardening of Oil (Hydrogenation)

Oil, an unsaturated fat when heated with nickel catalyst and hydrogen gets converted into a solid mass, called ghee, a saturated fat. This process is called hardening of oil and is carried out through hydrogenation in the presence of nickel as a catalyst.

Some Important Ores of Metals

Ores - Those minerals from which the metals are extracted commercially and economically and with minimum effort are called Ores of Metals.

Name of Elements	Ores	Chemical Formulae

1. Aluminum (Al)	(a) Bauxite (b) Corundum (c) Kryolite	$Al_2O_3 \cdot 2H_2O$ Al_2O_3 Na_3AlF_6
2. Iron (Fe)	(a) Hematite (b) Magnetite (c) IronPyrite (d) Siderite	Fe_2O_3 Fe_3O_4 FeS_2 $FeCO_3$
3. Copper (Cu)	(a) Copper Pyrite (b) Copper Glance (c) Malachite	$CuFeS_2$ Cu_2S $2CuCO_3 \cdot Cu(OH)_2$
4. Zinc (Zn)	(a) Zinc Blende (b) Calamine	ZnS $ZnCO_3$
5. Sodium (Na)	(a) Rock Salt (b) Sodium Carbonate	$NaCl$ Na_2CO_3
6. Potassium (K)	(a) Karnalite (b) Salt Petre	$KCl \cdot MgCl_2 \cdot 6H_2O$ KNO_3
7. Lead (Pb)	(a) Galena (b) Anglesite	PbS $PbCl_2$
8. Tin (Sn)	(a) Tin Pyrites (b) Classiterite	Cu_2FeSnS_4 SnO_2
9. Silver (Ag)	(a) Silver Glance	Ag_2S
10. Gold (Au)	(a) Calve rite (b) Sybarite	$AuTe_2$ $AgAuTe_2$

11. Mercury (Hg)	(a) Cinnabar (b) Calomel	HgS Hg ₂ Cl ₂
12. Magnesium (Mg)	(a) Dolomite (b) Karnalite	
13. Calcium (Ca)	(a) Lime Stone (b) Dolomite	CaCO ₃ MgCO ₃ CaCO ₃
14. Phosphorous (P)	(a) Phosphorite (b) Floreopetite	Ca ₃ (PO ₄)CaFe ₂ 3Ca ₃ (PO ₄)CaFe ₂

BIOLOGY

Vitamins:

- Organic compound required in small amounts in the diet to maintain normal metabolic functions are known as 'Vitamins'.
- Many vitamins act as (or) are converted into coenzymes; they neither provide energy nor are incorporated into tissues.
- These also regulate the Bio-chemical processes in the body.

Vitamins are classified into two groups

1. **Fat soluble vitamins** (A, D, E, K). These are rich in liver cells.
2. **Water soluble vitamins** (C, B-complex). These are present in much smaller amounts in cells.

Fat soluble vitamins:

Vitamin A:

- Vitamin A is also known as '**Retinol**'.
- **Deficiency diseases:** Night blindness, redness in eyes (Exophthalmia), degeneration of lachrymal glands.

Vitamin D:

- Vitamin D is also known as 'Calciferol'.
- **Deficiency diseases:** Rickets in children, Osteomalacia in adults.

Vitamin E:

- Vitamin E is also known as 'Tocopherol'.
- Deficiency diseases: Sterility nutritional nuclear dystrophy, neurosis of heart muscles.

Vitamin K:

- Vitamin K is also known as '**Anti hemorrhagic**'.
- Deficiency diseases: Blood coagulation is prevented, continuous bleeding occurs.

Water soluble vitamins:

Vitamin 'B Complex': Vitamin B Complex is a mixture of B1, B2, B3, B5, B6, B7, B9, and B12.

Vitamin B1:

- Vitamin B1 is also known as **Thiamin**.
- **Deficiency diseases:** Beri Beri disease which affects the legs.

Vitamin B2:

- Vitamin B2 is also known as Riboflavin.
- **Deficiency diseases:** Dark red tongue, dermatitis, cheilosis occurs at the corners of mouth & lips.

Vitamin B3:

- Vitamin B3 is also known as **Pantothenic acid**.
- **Deficiency diseases:** Burning sensations of feet.

Vitamin B5:

- Vitamin B5 is also known as Nicotinic acid/Niacin.
- **Deficiency diseases:** Pellagra, dermatitis, diarrhea.

Vitamin B6:

- Vitamin B6 is also known as **Pyridoxine**.
- **Deficiency diseases:** Dermatitis and convulsions.

Vitamin B7:

- Vitamin B7 is also known as **Biotin** (also considered as vitamin H).
- **Deficiency diseases:** Dermatitis, blood cholesterol increases, loss of hair and paralysis.

Vitamin B9:

- Vitamin B9 is also known as Folic acid.
- **Deficiency diseases:** Anemia, inflammation of tongue, gastro intestinal disorders.

Vitamin B12:

- Vitamin B12 is also known as '**Cynocobal amine**'.
- **Deficiency diseases:** Pernicious anemia, hyperglycemia.

Vitamin C:

- Vitamin C is also known as '**Ascorbic acid**'.
- **Deficiency diseases:** Scurvy, delay in wound healing.

Human Diseases Caused by Fungi :-

- Ringworm caused by Microsporum, Trichophyton by direct contact from unbathed cats and dogs or objects handled by infected individuals.
- Athlete's foot caused by Trichophyton by Bad foot hygiene where skin remains warm and moist for long period, fungi finds optimal condition, invade dead outer layer of skin.

Human Diseases Caused by Viruses -

- **Smallpox** caused by Variola Virus by direct contact (droplets), indirect by infected articles.
- **Chicken pox** caused by Varicella virus by direct contact (droplets) indirect by infected objects.
- **Common cold** caused by Rhinovirus by contact.
- Influenza/Flu caused by Orthomixovirus by contact (droplets) virus transmitted through discharge from respiratory tracts of persons infected with disease
- **Mumps** caused by Mumps virus by direct contact, virus in Saliva and secretion of nose invades salivary glands.
- **Viral encephalitis** caused by Encephalitis virus (arbovirus) by some domestic animals' reservoir of virus, transmitted by mosquito bite to man.
- **Poliomyelitis** caused by Poliovirus by contact, houseflies, fleas, food and water.
- **Rabies** (Hydrophobia) caused by Rabies virus (Rhabdovirus) by Bite a mad (rabid) dog
- **Dengue fever** or breakbone fever caused by Dengue virus (arbovirus) by Mosquito (Aedes) bite.
- Acquired Immunodeficiency Syndrome (**AIDS**) caused by Human T-cell
- Leukemia virus (**HTLV-III**) also called LAV (Retrovirus) by blood and sperm among homosexuals, heterosexuals, intravenous drug users, haemophiliacs, promiscuous individuals and prostitutes.

Human Diseases Caused by Bacteria

- **Septic sore throat** caused by Streptococcus Sp by Bacteria infect throat and nasal membranes by droplets and direct contact.
- **Diphtheria** caused by Irregular rod (Corynebacterium diphtheria) by Bacteria infect respiratory tract by carrier, through contact, droplets and food items.
- **Pneumonia** caused by Diplococcus pneumoniae by Bacteria transmitted to respiratory tract, including the lungs by droplet infection.
- **Tuberculosis** caused by Irregular rod (Mycobacterium tuberculosis) by Bacteria transmitted to lungs, bones and other organs by direct contact droplet infection, food and milk.
- **Plague** or **Bubonic** caused by Short rod (Yersinia pestis) by Rat flea spreads disease from rat to man.

- **Tetanus** or **Lock-Jaw** caused by *Clostridium tetani* by Bacteria in soil, enters through wound.
- **Typhoid** or enteric fever caused by *Salmonella typhi* by Flies, food, faeces water and carriers.
- **Cholera** caused by *Vibrio cholerae* by Flies food, stools, water and carriers.
- **Bacillary** dysentery caused by short rod (*Shigella dysenteriae*) by Flies, food, faeces, water and carriers.
- **Whooping cough** caused by small short rod (*Hemophilus pertussis*) by Droplets protected during coughing and sneezing.
- Syphilis caused by Spiral-shaped organism (*Treponema pallidum*) by direct contact, chiefly sexual intercourse.
- **Leprosy** caused by *Mycobacterium Lepae* by long and close contact with infected persons
- **Botulism** caused by *Clostridium botulinum* by organism produces poison in food.

Human Diseases Caused by Protozoans

- Amoebic dysentery (Amoebiasis) caused by *Entamoeba histolytica* by Transmission from man to man through ingestion of cysts in drinking water vegetables and food contaminated with faeces.
- Diarrhea 'Giardiasis' caused by *Giardia intestinalis* by Transmission from man to man through ingestion of cysts in drinking water vegetables and food contaminated with faeces.
- Malaria caused by *Plasmodium vivax* by Transmitted to man by bite of an infected female *Anopheles* mosquito.
- Sleeping sickness (Trypanosomiasis) caused by *Trypanosoma brucei* by Transmitted by bite of tse-tse fly

Some Important Information & Facts Related to Biology

1. **Melvin Kelvin** was awarded Nobel Prize for his work on Photosynthesis
2. The **largest flower** in the world is *Rafflesia* and the **smallest one** is *Wolffia*.
3. **Penicillin** is obtained from *penicillium Notatum*.
4. Reserpine derived from the plant 'serpentine' is used to alleviate high blood pressure.
5. Plants, living in acidic soils, are called **oxalophytes**.
6. **Photosynthesis** is most **active** in **blue** and red light in which light energy is converted into chemical energy.
7. **The smallest bone**, lies **stapes** is found in the human ear.
8. **Enzymes** are basically **proteins**.
9. **Mitochondria** is called the '**power house of the cell**'
10. **Pancreas** is both an endocrine and **exocrine gland**.
11. Persons of blood group '**O**' are called '**Universal Donor**' while that of '**AB**' are called '**Universal Acceptors**'.
12. **Seedless** fruits are formed by **parthenogenesis**.
13. Simple plants that contain **no chlorophyll** are called **fungi**.
14. **Spirogyra** is commonly known as '**pond silk**'
15. The **longest muscle** in the human body is found in **thigh**.
16. In a leaf, the opening between two guard cells is **stomata**.
17. **Gibberellins** are responsible for cell elongation.
18. The chemical **name of chlorophyll** is magnesium Dihydro prophylin.
19. **Bile** is produced in liver and stored in **gall bladder**.
20. All arteries, except pulmonary artery carry oxygenated blood.

21. The main function of **W.B. C.** is to produce **antibodies**.
22. **Retina** in the eye, acts as a film in the **camera**.
23. Human tears contain a mild antibacterial agent, named **Lysozyme**.
24. The biggest bone in the human body is **femur**.
25. Vitamin **B12** is almost never found in plants.
26. **Agrostology** is the study of **grasses**.
27. **Phycology** is the study of a algae while the study of fossils is called paleontology
28. **Hydroponics** is cultivating plants without using soil.
29. Palco botany is the study of fossils of **botanical specimens**.
30. **Pepsin & Lactose** enzymes add proteins in the digestive system.
31. The water soluble vitamins are **vitamin B and C**
32. A chemical change in **DNA molecule** is called **mutation**.
33. **Glycogen** acts as a short -term food reserve in animals.
34. **Estrogen** is a female sex **hormone**.
35. The enzyme amylase aids in the digestion of starch.
36. **ATP** synthesis takes place in **mitochondria**.
37. **70%** of the body weight of a man is **water**.
38. The tough transparent membrane that protects the eye ball is called cornea.
39. Energy is produced in human body by Carbohydrates.
40. Sugar is the product of the dark reactions of photosynthesis.

List Of Scientific Laws and Theories

1. **Archimede's principle** - It states that a body when wholly or partially immersed in a liquid experience an upward thrust which is equal to the weight of the liquid displaced by it. Thus, the body appears to lose a part of its weight.
2. **Aufbau principle** - It states that in an unexcited atom, electrons reside in the lowest energy orbitals available to them.
3. **Avogadro's Law** - It states that equal volumes of all gases under similar conditions of temperature and pressure contain an equal number of molecules.
4. **Brownian motion** - It is a zigzag, irregular motion exhibited by small solid particles when suspended in a liquid or gas due to irregular bombardment by the liquid or gas molecules.
5. **Bernoulli's principle** - It states that as the speed of a moving fluid, liquid or gas, increases, the pressure within the fluid decreases. The aerodynamic lift on the wing of an aeroplane is also explained in part by this principle.
6. **Boyles's Law** - It states that temperature remaining constant, the volume of a given mass of a gas varies inversely with the pressure of the gas. Thus, $PV = K$ (constant), where, P = Pressure and V = Volume.
7. **Charles's Law** - It states that pressure remains constant, the volume of a given mass of gas increases or decreases by $\frac{1}{273}$ part of its volume at 0-degree Celsius for each degree Celsius rise or fall of its temperature.
8. **Coulomb's Law** - It states that the force of attraction or repulsion between two charges is proportional to the amount of charge on both charges and inversely proportional to the square of the distance between them.
9. **Heisenberg principle (uncertainty principle)** - It is impossible to determine with accuracy both the position and the momentum of a particle such as an electron simultaneously.

10. Gay-Lussac's Law of combining volumes - Gases react together in volumes which bear simple whole number ratios to one another and also to the volumes of the products, if gaseous — all the volumes being measured under similar conditions of temperature and pressure.
11. Graham's Law of Diffusion - It states that the rates of diffusion of gases are inversely proportional to the square roots of their densities under similar conditions of temperature and pressure.
12. Kepler's Law - Each planet revolves around the Sun in an elliptical orbit with the Sun at one focus. The straight line joining the Sun and the planet sweeps out equal areas in equal intervals. The squares of the orbital periods of planets are proportional to the cubes of their mean distance from the Sun.
13. Law of Floatation - For a body to float, the following conditions must be fulfilled:
 - The weight of the body should be equal to the weight of the water displaced.
 - The centre of gravity of the body and that of the liquid displaced should be in the same straight line.
14. Law of conservation of energy - It states that energy can neither be created nor destroyed but it can be transformed from one form to another. Since energy cannot be created or destroyed, the amount of energy present in the universe is always remain constant.
15. Newton's First Law of Motion - An object at rest tends to stay at rest, and an object in motion tends to stay in motion, with the same direction and speed in a straight line unless acted upon by some external force.
16. Newton's Second Law of Motion - The rate of change of momentum of a body is directly proportional to the force applied and takes place in the direction in which the force acts.
17. Newton's Third Law of Motion - To every action, there is an equal and opposite reaction.
18. Newton's Law of Gravitation - All particles of matter mutually attract each other by a force directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
19. Ohm's Law - It states that the current passing through a conductor between two points is directly proportional to the potential difference across the two points provided the physical state and temperature etc. of the conductor does not change.
20. Pauli exclusion principle - It explains that no two electrons in the same atom or molecule can have the same set of quantum numbers.
21. Raman effect - It is the change in wavelength that occurs when light is scattered by the atoms or molecules in a transparent medium.
22. Tyndall effect - The scattering of light by very small particles suspended in a gas or liquid.

Diseases and its Affected Area
Parts of the Body Affected by Diseases

Disease	Affected Body Part
Arthritis	<i>Joints</i>
Asthma	Bronchial Muscles
Cataract	Eyes
Diabetes	Pancreas
Diphtheria	Throat
Eczema	Skin
Glaucoma	Eyes
Goitre	Thyroid Gland
Jaundice	Liver
Leukemia	Blood
Malaria	Spleen

Meningitis	Brain and Spinal Cord
Otitis	Ears
Paralysis	Nerves
Pneumonia	Lungs
Polio	Legs
Pyorrhoea	Teeth and Gums
Rheumatism	Joints
Sinusitis	Inflammation of sinus linings
Tonsillitis	Tonsils
Trachoma	Eyes
Tuberculosis	Lungs
Typhoid	Intestines

Diseases and Causative Agents

Causative Agent	Disease
Bacteria	Diphtheria, Gonorrhoea, Meningitis, Cholera, Leprosy, Typhoid, Tetanus, Tuberculosis, Plague, Whooping Cough, Pneumonia
Virus	Chicken Pox, Small Pox, Measle, Mumps, AIDS, Yellow fever, Influenza, Dengue fever, Rabies, Polio-meritis, phlebotomus
Protozoans	Malaria, Sleeping sickness, Kala-azar, Leishmaniasis, Amoebic dysentery
Fungus	Athlete's foot, Ringworms, Madura foot, Dhobi's itch
Helminths	Filaria, Tapeworm and Hookworm transmission

Important Information about Human Body

- Biggest Organ: *Liver*
- Heart Beat: *72 times in a minute*
- Master Gland: *Pituitary*
- Number of Bone: *206*
- Number of Muscles: *640*
- Number of chromosomes: *46 or 23 pairs*
- Normal Blood Pressure: *80 to 120*
- Teeth: *32*
- The volume of Blood: *About 7 litres in normal body or about 7% of the total body weight.*
- Largest; Part of human Brain: *Cerebru*