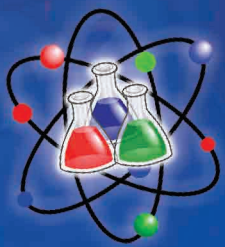
General Knowledge

Physics, Chemistry Biology & Computers

- Work and Energy
- Motion and Wave
- Current Electricity
- Nuclear Physics
- Atomic Structure
- Behaviour of Gases
- Oxidation and Reduction



- Electrolysis and Metallurgy
- Classification of Organisms
- Plant Morphology
- Ecology and Nitrogen Cycle
- System of Human Body
- Generations of Computers
- Networking and Internet



Useful for the aspirants of Civil Services, SSC, Banking, Railways, Defence Services, and various other Competitive & Entrance Exams

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Compiled & Edited
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V&S PUBLISHERS

Published by:



V&S PUBLISHERS

F-2/16, Ansari road, Daryaganj, New Delhi-110002
☎ 23240026, 23240027 • *Fax:* 011-23240028
Email: info@vspublishers.com • *Website:* www.vspublishers.com

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Branch Office : Mumbai
Jaywant Industrial Estate, 1st Floor–108, Tardeo Road
Opposite Sobo Central Mall, Mumbai – 400 034
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ISBN 978-93-505794-0-4

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PUBLISHER'S NOTE

V&S Publishers is constant in its effort to identify the problems faced by the aspirants of various competitive examinations held at state and national levels, and to sort out those problems effectively. After a thorough search in the market, we realised that there are a few books available on comprehensive General Knowledge, which are too costly and too large to go through in short span of time during preparation. The present book, **'General Knowledge'** with all genres of general awareness has been designed to meet the specific needs of the contestants of various entrance exams and competitive exams as well. Not only does the book spreads awareness, but also can be a facilitator of change in life.

The book has been strategically planned in order to be user friendly. It covers up-to-date knowledge on *Physics, Chemistry, Biology & Computers.* The primary goal is to fulfil the quest for knowledge on various topics of study at national and international levels.

The book is recommended for various competitive examinations such as:

- Civil Services
- Staff Selection Commission (SSC)
- Institute of Banking Personnel Selection (IBPS)
- Defence Services – CDSE, NDA and other defence services
- Management Aptitude Test (MAT), Common Admission Test (CAT), and Graduate Management Admission Test (GMAT)
- Indian Engineering Services
- Railway Recruitment Services
- Test of English as a Foreign Language (TOEFL)
- International English Language Testing System (IELTS)

We hope that the book will be of immense help to the readers to up-grade their knowledge on various topics of general knowledge. A regular revision of all the topics covered in the book is advised to get up-to-date with the required information. We wish all aspirants good luck for their future endeavours.

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Physics, Chemistry Biology & Computers

GENERAL SCIENCE

Physics

1. Unit

Unit : The chosen standard used for measuring a physical quantity is called unit.

Unit should be :

(i) well defined (ii) easy to reproduce

(iii) easy to compare (v) internationally accepted

(iv) independent of changes in physical conditions

Units are of two types– (i) Fundamental unit; (i) Derived unit

System of Units– Units depend on choice. Each choice of units leads to a new system (set) of units. The internationally accepted systems are (i) CGS system, (ii) MKS system (iii) FPS system (iv) SI units.

In SI Units, there are seven fundamental units given in the following table:

Physical Quantity	SI Unit	Symbol	Physical Quantity	SI Unit	Symbol
Length	metre	*m*	Temperature	kelvin	*K*
Mass	kilogram	*kg*	Luminuous intensity	candela	*Cd*
Time	second	*s*	Amount of substance	mole	*mol*
Electric Current	ampere	*A*			

Besides these seven fundamental units, two supplementary units are also defined, viz., radian [rad] for plane angle and steradian (sr) for solid angle.

➪ All the units which are defined/expressed in terms of fundamental units are called derived units.

Some important derived units are:

S. No.	Physical Quantity	CGS units	SI unit	Relation
1.	Force	dyne	newton	1 newton = 10^5 dyne
2.	work	erg	joule	1 joule = 10^7 erg

Some practical units of length, mass and time

Length	Mass	Time
Light year = distance travelled by light in one year in vaccum. 1 ly = 9.46×10^{15} cm 1 astronomical unit (A.U.) $= 1.5 \times 10^{11}$ m 1 parsec = 3.26 ly $= 3.08 \times 10^{16}$ m 1 nautical mile or seamile = 6020 ft. 1 micron= 1 μm =10^{-6} m 1 angstron (A°) = 10^{-15} m	1 quintal = 10^2 kg 1 metric ton = 10^3 kg 1 atomic mass unit (amu) or dalton = 1.66×10^{-27} kg 1 slug = 1459 kg 1 pound = 0.4537 kg 1 Chandrashekhar limit = 1.4 times the mass of sun = 2.8×10^{30} kg	1 solar day = 86400 sec. 1 year = 365 solar days 1 lunar month = 27.3 solar days. **Tropical year** = It is the year in which total solar eclipse occurs. **Leap year** = It is the year in which the month of February is of 29 days.

Prefixes used in metric system

Prefix	Symbol	Multiplier	Prefix	Symbol	Multiplier
deci	d	10^{-1}	deca	da	10^1
centi	c	10^{-2}	hecto	n	10^2
milli	m	10^{-3}	kilo	k	10^3
micro	μ	10^{-6}	mega	M	10^6
nano	n	10^{-9}	giga	G	10^9
pico	n	10^{-12}	tera	T	10^{12}
femto	f	10^{-15}	peta	P	10^{15}
atto	a	10^{-18}	exa	E	10^{18}
zepto	z	10^{-21}	zetta	Z	10^{21}
yocto	y	10^{-24}	yotta	Y	10^{24}

2. Motion

Scalar Quantities : Physical quantities which have magnitude only and no direction are called *scalar quantities*.

Example : Mass, speed, volume, work, time, power, energy etc.

Vector Quantities : Physical quantities which have magnitude and direction both and which obey triangle law are called *vector quantities*.

Example : Displacement, velocity, acceleration, force, momentum, torque etc.

Electric current, though has a direction, is a scalar quantity because it does not obey triangle law.

Moment of inertia, pressure, refractive index, stress are tensor quantities.

Distance : Distance is the length of actual path covered by a moving object in a given time interval.

Displacement: Shortest distance covered by a body in a definite direction is called *displacement*.

- Distance is a scalar quantity whereas displacement is a vector quantity both having the same unit (metre).
- Displacement may be positive, negative or zero whereas distance is always positive.
- In general, magnitude of displacement ≤ distance

Speed : Distance travelled by the moving object in unit time interval is called speed i.e. speed = Distance/Time

It is a scalar quantity and its SI unit is metre/second (m/s).

Velocity : Velocity of a moving object is defined as the displacement of the object in unit time interval i.e. velocity = Displacement/Time

It is a vector quantity and its SI unit is metre/second.

Acceleration : Acceleration of an object is defined as the rate of change of velocity of the object i.e. acceleration = Change in Velocity/Time

It is a vector quantity and its SI units is metre/second^2 (m/s^2)

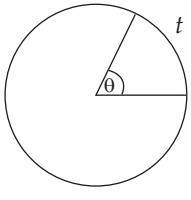
If velocity decreases with time then acceleration is negative and is called retardation.

Circular Motion : It an object describes a circular path (circle) its motion is called circular motion. If the object moves with uniform speed, its motion is uniform circular motion.

Uniform circular motion is an accelerated motion because the direction of velocity changes continuously.

Angular Velocity : The angle subtended by the line joining the object from the origin of circle in unit time interval is called angular velocity.

It is generally denoted by ω and $\omega = \theta/t$



If T = time period = time taken by the object to complete one revolution, n = frequency = no. of revolutions in one second.

then $\boxed{nT = 1}$ & $\omega = 2\pi/T = 2\pi n$

- In one revolution, the object travels $2\pi r$ distance.

Linear speed = ωr = angular speed × radius

Newton's laws of motion: Newton, the father of physics established the laws of motion in his book "principia" in 1667.

Newton's first law of motion: Every body maintains its initial state of rest or motion with uniform speed on a straight line unless an external force acts on it.

- First law is also called law of *Galileo* or *law of inertia*.
- **Inertia:** Inertia is the property of a body by virtue of which the body opposes change in its initial state of rest or motion with uniform speed on a straight line.

Inertia is of two types (i) Inertia of rest (ii) Inertia of motion

Some examples of Inertia :

(i) When a car or train starts suddenly, the passengers bends backward.

(ii) When a running horse stops suddenly, the rider bends forward.

(iii) When a coat/blanket is beaten by a stick, the dust particles are removed.

- First law gives the definition of force.
- **Force :** Force is that external cause which when acts on a body changes or tries to change the initial state of the body.

Momentum : Momentum is the property of a moving body and is defined as the product of mass and velocity of the body i.e.

momentum = mass × velocity.

It is a vector quantity. Its SI unit is kgm/s.

Newton's second law of motion: The rate of change in momentum of a body is directly proportional to the applied force on the body and takes place in the direction of force:

If F = force applied, a = acceleration produced and

m = mass of body the $nF = ma$.

- Newton's second law gives the magnitude of force.
- Newton's first law is contained in the second law.

Newton's Third Law of Motion: To every action, there is an equal and opposite reaction.

Examples of third law-(i) Recoil of a gun (ii) Motion of rocket (iii) Swimming (iv) While drawing water from the well, if the string breaks up the man drawing water falls back.

Principle of conservation of linear momentum : If no external force acts on a system of bodies, the total linear momentum of the system of bodies remains constant.

As a consequence, the total momentum of bodies before and after collision remains the same.

Impulse : When a large force acts on a body for very small time, then force is called impulsive force. Impulse is defined as the product of force and time.

Impulse = force × time = change in momentum.

- It is a vector quantity and its direction is the direction of force. Its SI unit is newton second (Ns).

Centripetal Force: When a body travels along a circular path, its velocity changes continuously. Naturally an external force always acts on the body towards the centre of the path.

The external force required to maintain the circular motion of the body is called *centripetal force*.

If a body of mass m is moving on a circular path of radius R with uniform speed v, then the required centripetal force, $F = mv^2/R$

Centrifugal Force: In applying the Newton's laws of motion, we have to consider some forces which can not be assigned to any object in the surrounding. These forces are called pseudo force or inertial force.

Centrifugal force is such a pseudo force. It is equal and opposite to centripetal force.

- Cream separator, centrifugal drier work on the principle of centrifugal force.
- Centrifugal force should not be confused as the reaction to centripetal force because *forces of action and reaction act on different bodies*.

Moment of force : The rotational effect of a force on a body about an axis of rotation is described in terms of moment of force.

Moment of a force about an axis of rotation is measured as the product of magnitude of force and the perpendicular distance of direction of force from the axis of rotation.

i.e., Moment of force = Force × moment arm

- It is a vector quantity.
- Its SI unit is newton metre (Nm)

Centre of Gravity : The centre of gravity of a body is that point through which the entire weight of body acts. The centre of gravity of a body does not change with the change in orientation of body in space.

The weight of a body acts through centre of gravity in the downward direction. Hence a body can be brought to equilibrium by applying a force equal to its weight in the vertically upward direction through centre of gravity.

Equilibrium : If the resultant of all the forces acting on a body is zero then the body is said to be in equilibrium.

If a body is in equilibrium, it will be either at rest or in uniform motion.

If it is at rest, the equilibrium is called static, otherwise dynamic.

Static equilibrium is of the following three types :

(i) Stable Equilibrium : If on slight displacement from equilibrium position, a body has tendency to regain its original position, it is said to be in stable equilibrium.

(ii) Unstable Equilibrium : If on slight displacement from equilibrium position, a body moves in the direction of displacement and does not regain its original position, the equilibrium is said to unstable equilibrium . In this equilibrium, the centre of gravity of the body is at the highest position.

(iii) Neutral Equilibrium : If on slight displacement from equilibrium position a body has no tendency to come back to its original position or to move in the direction of displacement, it is said to be in neutral equilibrium. In neutral equilibrium, the centre of gravity always remains at the same height.

Conditions for Stable Equilibrium : For stable equilibrium of a body, the following two conditions should be fulfilled.

(i) The centre of gravity of the body should be at the minimum height.

(ii) The vertical line passing through the centre of gravity of the body should pass through the base of the body.

3. Work, Energy and Power

Work : If a body gets displaced when a force acts on it, work is said to be done. Work is measured by the product of force and displacement of the body along the direction of force.

If a body gets displaced by S when a force F acts on it,

then the work $W = F\ S \cos\theta$

where θ = angle between force and displacement

If both force and displacement are in the same direction, then $W = FS$

Work is a scalar quantity and its SI unit is joule.

Energy : Capacity of doing work by a body is called its energy.

- Energy is a scalar quantity and its SI unit is joule.
- Energy developed in a body due to work done on it is called mechanical energy. Mechanical energy is of two types :

(i) Potential Energy (ii) Kinetic Energy

Potential Energy : The capacity of doing work developed in a body due to its position or configuration is called its potential energy.

Example : (i) energy of stretched or compressed spring (ii) energy of water collected at a height (iii) energy of spring in a watch.

PE of a body in the gravitational field of earth is mgh.

where m = mass, g = acceleration due to gravity, h = height of the body from surface of the earth.

Kinetic Energy : Energy possess by a body due to its motion is called Kinetic Energy of the body.

If a body of mass m is moving with speed v, then kinetic energy of the body is $\frac{1}{2} mv^2$

Principle of Conservation of Energy

Energy can neither be created nor can be destroyed. Only energy can be transformed from one form to another form. Whenever energy is utilized in one form, equal amount of energy is produced in other form. Hence total energy of the universe always remains the same. This is called the principle of conservation of energy.

Some Equipments used to Transform Energy

S. No.	Equipment	Energy Transformed
1.	Dynamo	Mechanical energy into electrical energy
2.	Candle	Chemical energy into light and heat energy.
3.	Microphone	Sound energy into electrical energy.
4.	Loud speaker	Electrical energy into sound energy.
5.	Solar cell	Solar energy into electrical energy.
6.	Tube light	Electrical energy into light energy.
7.	Electric bulb	Electrical energy into light and heat energy.
8.	Battery	Chemical energy into electrical energy.
9.	Electric motor	Electrical energy into mechanical energy.
10.	Sitar	Mechanical energy into sound energy.

Relation between Momentum and Kinetic Energy

$$\text{K.E.} = \frac{p^2}{2m}$$ where p = momentum = mv

Clearly when momentum is doubled, kinetic energy becomes four times.

Power : Rate of doing work is called power.

➪ It an agent does W work in time t, then power of agent = $\frac{W}{t}$

SI unit of power is watt named as a respect to the scientist James Watt.

watt = joule/sec.

1 kW = 10^3 watt

1 MW = 10^6 watt

Horse power is a practical unit of power. 1 H.P. = 746 watt.

1 watt second = 1 watt × 1 second = 1 joule.

1 watt hour (Wh) = 3600 joule

1 kilowatt hour (kWh) = 3.6×10^6 joule.

W, kW, MW & H.P. are units of power.

Ws, Wh, kWh are units of work and energy.

4. Gravitation

Gravitation : Every body attracts other body by a force called force of gravitation.

Newton's law of Gravitation : The force of gravitational attraction between two point bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Consider two point bodies of masses m_1 and m_2 are plaqed at a distance r. The force of gravitational attraction between them, $F = G\frac{m_1 m_2}{r^2}$

Here G is constant called universal gravitational constant. The value of G is 6.67×10^{-11} Nm^2/kg^2.

Gravity : The gravitational force of earth is called gravity i.e. gravity is the force by which earth pulls a body towards its centre.

The acceleration produced in a body due to force of gravity is called acceleration due to gravity (denoted as g) and its value is 9.8 m/s^2

➪ Acceleration due to gravity is independent of shape, size and mass of the body.

Variation in g

(i) value of g decreases with height or depth from earth's surface.

(ii) g is maximum at poles.

(iii) g is minimum at equator.

(iv) g decreases due to rotation of earth.

(v) g decreases if angular speed of earth increases and increases if angular speed of earth decreases.

➪ If angular speed of earth becomes 17 times its present value, a body on the equator becomes weightless.

Weight of a body in a lift

(i) If lift is stationary or moving with uniform speed (either upward or down ward), 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 weight lessness.

(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.

Kepler's Laws of planetary motion

(i) All planets move around the sun in elliptical orbits, with the sun being at rest at one focus of the orbit.

(ii) The position vector of the planet with sun at the origin sweeps out equal area in equal time i.e. The areal yelocity of planet around the sun always remains constant.

A consequence of this law is that the speed of planet increases when the planet is closer to the sun and decreases when the planet is far away from sun.

Speed of a planet is maximum when it is at perigee and minimum when it is at apogee.

(iii) The square of the period of revolution of a planet around the sun is directly proportional to the cube of mean distance of planet from the sun.

If T is period of revolution and r is the mean distance of planet from sun then $T^2 \propto r^3$.

Clearly distant planets have larger period of revolution. The time period of nearest planet Mercury is 88 days where as time period of farthest planet Pluto is 247.7 years.

Satellite : Satellites are natural or artificial bodies revolving around a planet under its gravitational attraction. Moon is a natural satellite while INSAT-IB is an artificial satellite of earth.

Orbital speed of a satellite

(i) Orbital speed of a satellite is independent of its mass. Hence satellites of different masses revolving in the orbit of same radius have same orbital speed.

(ii) Orbital speed of a satellite depends upon the radius of orbit (height of satellite from the surface of earth). Greater the radius of orbit, lesser will be the orbital speed.

➪ The orbital speed of a satellite revolving near the surface of earth is 7.9 km/sec.

Period of Revolution of a satellite : Time taken by a satellite to complete one revolution in its orbit is called its period of revolution.

$$\text{i.e. period of revolution} = \frac{\text{circumference of orbit}}{\text{orbital speed}}$$

(i) Period of revolution of a satellite depends upon the height of satellite from the surface of earth. Greater the height, more will be the period of revolution.

(ii) Period of revolution of a satellite is independent of its mass.

➪ The period of revolution of satellite revolving near the surface of earth is 1 hour 24 minute (84 minute)

Geo-Stationary Satellite : If a satellite revolves in equatorial plane in the direction of earth's rotation i.e. from west to east with a period of revolution equal to time period of rotation of earth on its own axis i.e. 24 hours, then the satellite will appear stationary relative to earth. Such a satellite is called Geo-*stationary satellite*. Such a satellite revolves around the earth at a height of 36000 km. The orbit of Geo stationary satellite is called *parking orbit*. *Arthur C. Clarck* was first to predict that a communication satellite can be stationed in the geo synchronous orbit.

Escape velocity : Escape velocity is that minimum velocity with which a body should be projected from the surface of earth so as it goes out of gravitational field of earth and never return to earth.

- Escape velocity is independent of the mass, shape and size of the body and its direction of projection.
- Escape velocity is also called second cosmic velocity.
- For earth, escape velocity= 11.2 km/s.
  For moon, escape velocity= 2.4 km/s.

Orbital velocity of a satellite $V_0 = \sqrt{g}\,R$ and escape velocity $V_e = \sqrt{2gR}$

where R = Radius of earth i.e. $V_e = \sqrt{2}\,V_0$ i.e. escape velocity is √2. times the orbital velocity.

Therefore if the orbital velocity of a satellite is increased to √2 times (increased by 41%), the satellite will leave the orbit and escape.

5. Pressure

Pressure : Pressure is defined as force acting normally on unit area of the surface.

$$\text{Pressure (P)} = \frac{F}{A} = \frac{\text{Normal force on the surface}}{\text{Area of the surface}}$$

SI unit of pressure is N/m^2 also called pascal (Pa). Pressure is a scalar quantity.

Atmospheric Pressure : Atmospheric pressure is that pressure which is exerted by a mercury column of 76 cm length at 0°C at 45° latitude at the sea-level. It is equal to weight of 76 cm column of mercury of cross sectional area 1 cm^2. Generally it is measured in bar. 1 bar = 10^5 N/m^2

Atmospheric pressure 1 atm = 1.01 bar = 1.01 × 10^5 N/m^2 = 760 torr

- One torr is the pressure exerted by a mercury column of 1mm length.
- Atmospheric pressure decreases with altitude (height from earth's surface). This is why (i) It is difficult to cook on the mountain (ii) The fountain pen of a passenger leaks in aeroplane at height.
- Atmospheric pressure is measured by barometer. With the help of barometer, weather forecast can be made.
- 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.

Pressure in liquid : Force exerted on unit area of wall or base of the container by the molecules of liquid is the pressure of liquid .

The pressure exerted by liquid at depth h below the surface of liquid is given as $p = hdg$ where d is the density of liquid.

- Regarding pressure, the following points are worth noting :
  (i) In a static liquid at same horizontal level, pressure is same at all points.
  (ii) Pressure at a point in a static liquid has same value in all directions.
  (iii) Pressure at a point in a liquid is proportional to the depth of the point from the free surface.