

Definitions

Scalar

A quantity that has magnitude/size

Vector

A quantity that has magnitude/size and direction

Accuracy

How close a reading is to its true value. When readings are accurate, the peak / average value moves towards the true value

Precision

Smallest change in value that can be measured by an instrument. OR Spread of values / measurements (scatter between each data is relatively small/ lines are closer together / sharper peak)

Random errors

Readings have positive and negative values around the peak value / values are scattered / wide range. To reduce errors, take several readings to get an average value.

Systematic Error

The average / peak is not the true value / the readings are not centred around the true value. Look/check for zero error to avoid systematic error.

Uncertainty

The range of value within which a measurement is likely to be in.

Acceleration (vector)

Rate of change of velocity.

Displacement (vector)

is the straight line distance between start and finish points (in that direction) / minimum distance

Distance (scalar)

is the actual path travelled

Free Fall

The downward motion of an object under the influence of force of gravity with a constant acceleration ($g = 9.81 \text{ ms}^{-2}$).

Projectile motion

Objects acted upon by a force with a vector perpendicular to its horizontal velocity. Assume zero frictional forces. Trajectory of the object will result in a parabola.

Speed (scalar)

Distance travelled per unit time taken

Terminal velocity

Constant speed of object when resultant force is zero due to large air resistance.

Velocity (vector)

Rate of change of displacement

Conservation Of Momentum

Total momentum of (an isolated) system (of interacting bodies) remains constant, provided there are no resultant external forces (e.g. friction)

Elastic Collisions

Total momentum and total Kinetic Energy of a system is conserved. Relative speed of approach is equal to the relative speed of separation

Force

It is defined as the rate of change of momentum of a body

Impulse

It is the product of a force & the time during which the force is applied.

Inelastic Collisions

Total momentum of a system is conserved, but the total Kinetic Energy is not conserved. Speed before impact is not equal to speed

Linear Momentum

Product of an object's mass & velocity, with its direction always being the same as the direction of velocity.

Mass

It is a measure of inertia of a body or the property of a body that resists change in motion

Newton's 1st Law

A body remains at rest or constant velocity unless acted on by a resultant (external) force

Newton's 2nd Law

The (resultant) force is proportional to the rate of change of momentum

Newton's 3rd Law

If one body exerts a force on another, it will experience a force by the other body, which is equal in magnitude & opposite in direction. Both forces are of the same kind.

Weight

Weight is the force due to the gravitational field

Centre Of Gravity

The point on an object at which the entire weight of the body seemingly acts. It is the point at which the Earth actually applies the pull of gravity.

Density

Amount of mass per unit volume of a substance.

Equilibrium

Net / resultant force and moment is zero (OR sum of clockwise moments = sum of anticlockwise moments). If the triangle of forces is 'closed' then there is no resultant force and the object is in equilibrium.

Moment / Torque

Product of the force and the perpendicular distance to the pivot

Pressure

The perpendicular/normal force applied per unit area

Principle Of Moments

The sum of the clockwise moments about a point equals the sum of the anticlockwise moments (about the same point)

Torque Of A Couple

Product of one of the forces and perpendicular distance between forces. (The turning effect is caused by two equal & opposite forces when their line of actions are different.)

Upthrust

It is the resultant force on a submerged object due to the pressure difference between the higher pressure at the bottom of the object and the lower pressure at the top of the object immersed in a fluid.

Energy

It is the stored ability to do work.

Work Done

Product of a force & the distance moved in the direction of the force.

Gravitational Potential Energy

Energy stored due to height/position of mass

Internal Energy

It is the total of the microscopic Kinetic & Potential energies of particles of a material.

Kinetic Energy

Energy of an object due to its motion.

Potential Energy

Energy stored by an object to do work

Elastic Potential Energy

Energy stored due to deformation or change in shape of an object

Electric potential energy

Potential energy (stored) when charge moved due to work done in electric field

Power

Rate of work done

Efficiency

The fraction of the useful power output obtained from the total power input.

Brittle Materials

Materials which do not undergo plastic deformation. Force proportional to extension until it breaks

Ductile Materials

Materials which undergo plastic deformation after a considerable elastic deformation. Initially force proportional to extension then a large extension for small change in force

Elastic Deformation

Object returns to its original length (zero extension) when load is removed

Force-Extension Graph

The area under such a graph is the work done in stretching a material. For the straight-line portion of the graph, it is a measure of the elastic potential energy stored by the material, provided that the graph for decreasing loads is the same as that for increasing loads. It is also known as strain energy.

Hooke's Law

Force/load is proportional to extension/compression if proportionality limit is not exceeded.

Necking

When a sufficiently large force is applied, localized narrowing occurs at weak points, & the wire eventually breaks at one of these points.

Plastic Deformation

Wire/body object does not return to its original shape / length when load is removed

Polymeric Materials

Materials which can undergo great strain, & deform to a very great degree. E.g. rubber, glass, cement

Strain

Extension over original length (ratio). Stress is the cause & strain is the effect.

Stress

It is the force per unit cross-section area required to stretch a material.

Ultimate Tensile Strength

The maximum force / original cross-sectional area the wire is able to support before it breaks

Ultimate Tensile Stress

The maximum value of stress that an object can sustain before it breaks.

Young's Modulus

Ratio of stress to strain.

Progressive wave

The transfer or propagation of energy as a result of oscillations / vibrations

Transverse Waves

A wave in which displacement of particles is perpendicular to the direction of wave propagation, resulting in crests & troughs. Transverse waves have vibrations that are perpendicular / normal to the direction of energy travel

Longitudinal Waves

A wave in which displacement of particles is parallel to the direction of wave propagation. Longitudinal waves have vibrations that are parallel to the direction of energy travel

Wavelength

Distance moved by wave energy / wavefront during one cycle of the source or minimum distance between two points with the same phase or between adjacent crests or troughs.

Frequency (Hz)

Number of oscillations per unit time (not per second)

Period

The time taken to complete one oscillation/cycle. Or time between adjacent wave fronts.

Amplitude

Maximum displacement of a particle in the wave

Displacement

Distance (of point on wave) from rest / equilibrium position

Phase Difference

The difference in the relative positions of the crests or troughs of two waves of the same frequency expressed in radians or degrees.

(Wave) Intensity

The intensity of a wave is the energy passing through unit area per unit time.

(Wave) Speed

Speed at which energy is transferred / speed of wavefront. It is NOT the speed with which particles in the wave move.

Doppler Effect

Change in observed frequency when source moves relative to the observer

Electromagnetic Waves

electromagnetic waves (a transverse wave) can travel through a vacuum / free space. The displacement in the case of electromagnetic waves is a variation in the electric & magnetic fields perpendicular to each other.

Polarisation

Oscillations or vibrations are in one direction, perpendicular to direction of propagation.

Transfer of Energy

The transfer of energy is due to a progressive wave, NOT a standing/stationary wave.

Coherence

Two waves with a constant phase difference are said to be coherent.

Principle of Superposition

When two waves of the with similar frequency & meet/overlap, the resultant displacement is the sum of the individual displacement of each wave.

Node

Position along wave with no motion / zero amplitude

Antinode

Position along wave with maximum amplitude.

Constructive Interference

Two waves' path difference is either λ or $n\lambda$, OR phase difference is 360° or $n \times 360^\circ$ or $n2\pi$

Destructive Interference

Two waves' path difference is either $\lambda/2$ or $(n + \frac{1}{2})\lambda$ OR phase difference is odd multiple of either 180° or π rad

Stationary Waves

Two waves of same frequency/wavelength traveling (along the same line) in opposite directions overlap/meet. The resultant displacement is the sum of displacements of each wave / produces nodes and antinodes

Stationary Wave Properties

Does not transfer energy (no energy transfer). The amplitude of standing wave varies along its length/nodes and antinodes. Neighbouring points (in inter-nodal loop) vibrate in phase

Fringe Width/Separation

The separation between one bright fringe & the next bright fringe.

Interference

When two waves superpose/overlap, the resultant displacement is the sum of individual displacements of overlapping waves, forming alternating maxima and minima.

Diffraction

When a wave (front) passes by/incident on an edge/slit, the wave spreads into the geometrical shadow

Diffraction Grating

When waves pass through the gaps / slits in the grating, the wave bends/spreads (into the geometrical shadow)

Refraction

The change in direction of a wave due to change in speed.

Ampere

If a charge of 1 Coulomb passes through an electrical component per second, then the current maintained is 1 Ampere

Charge

Charge = current x time

Coulomb

The SI unit of electrical charge. A charge of 1C passes a point when a current of 1A flows for 1s.

Electric Current

It is the amount of charge flowing past a point per unit time. Or rate of flow of charged particles.

Ohm

volt/ampere

Ohm's Law

The current through a metallic conductor is proportional to the P.D across it provided that its temperature remains constant.

Potential Difference

Energy converted from electrical to other forms of energy per unit charge that passes through it.

Quantised

Charge only exists in discrete amounts. Charge on carriers is quantised.

Resistance

The ratio of P.D over the current for an electrical component

Resistivity

The resistivity of a wire of a particular material is its resistance for unit length.

Thermistor

A specific type of resistor, in which, as temperature increases, the magnitude of the resistor's resistance decreases, & vice versa.

Volt

P.D between two points in a circuit in which 1J of energy is converted when 1C of charge passes from one point to the other.

E.m.f & P.D

While e.m.f refers to the amount of energy converted into electrical energy per unit charge supplied, P.D refers to the amount of electrical energy converted into other forms of energy per unit charge supplied. The e.m.f of a source is equal to the potential difference across its terminals as the current approaches zero.

Electromotive Force

Energy converted from chemical into electrical energy per unit charge.

Internal Resistance

(resistance of the cell) causing loss of voltage or energy loss in cell

Kirchhoff's 1st Law

The sum of currents into a junction = sum of currents out of junction, Because charge cannot be created or destroyed (conservation of charge).

Kirchhoff's 2nd Law

Sum of e.m.f.'s = sum of p.d.'s around a loop/circuit. Because any gains in electrical energy of a charge must be balanced by corresponding losses of energy (conservation of energy).

Law of Conservation of Charge

Kirchhoff's First & Second Laws are in correspondence & actually are an appreciation of the Law of Conservation of Charge & the Law of Conservation of Energy respectively.

Output Power (Circuit)

A battery delivers the maximum power to a circuit when the load resistance of the circuit is equal to the internal resistance of the battery. When load resistance is zero, power dissipated by load is zero because $P=I^2R$. When load resistance is very large, power dissipated gets very small as the current through the load is reduced significantly.

Potentiometer

When a potential divider arrangement is used to compare e.m.fs of two sources, it is known as a potentiometer.

Alpha particle

Either helium nucleus OR particle containing two protons and two neutrons with mass 4u. Radiation can be deflected in electric/magnetic fields, and absorbed by thin paper or few cm of air. Radiation is highly ionizing.

Baryon

A type of hadron particle that is made up of three quarks (e.g. proton and neutron).

Beta Particle

Produced due to weak nuclear force/interaction. β -particles are fast moving electrons with a range of speeds up to 0.99c. This radiation can be deflected by electric and magnetic fields or negatively charged, and absorbed by a few (1 - 4) mm of aluminium. 0.5 to 2m for range in air.

Gamma Radiation

γ - radiation is part of the electromagnetic spectrum with wavelengths between $10^{(-11)}$ m and $10^{(-13)}$ m.

Hadron

Class of heavy particles made up of quarks held together by strong nuclear force. Hadron is not a fundamental particle.

Isotopes

Atoms (same element) which have the same proton number, but a different nucleon number / number of neutrons.

Meson

A type of hadron particle that is made up of two quarks.

Nucleon (mass) Number

The number of protons together with the number of neutrons in the nucleus is called the nucleon number (or mass number) A

Proton Number

The number of protons in the nucleus of an atom (aka atomic number) Z

The Atom

The simple model of the atom is made up of three sub-atomic particles: The proton (which is positively charged), the neutron (which is uncharged but equal in mass to the proton), & the electron (which is negatively charged & equal to the charge on the proton, but much smaller in size & mass).