A-Level Physics 9702

DEFINITIONS & FORMULAS

KEY:

Orange – given in data booklet
Purple – learn to derive

Best of Luck for Your Exams! :)

Definitions

- **Radian** → The angle subtended at the centre of a circle by an arc equal in length to the radius of the circle
- **Angular displacement** → The angle of arc through which the object has moved from its starting position
- **Angular velocity** → Angle swept out per unit time
- **Period** → Time taken to complete one full revolution of a circle
- **Angular frequency** → Number of revolutions completed per unit time
- **Tangential velocity** → The linear speed of any object moving along a circular path
- **Centripetal force** → A resultant force acting on an object moving in a circular path, always directed towards the centre of the circle
- **Centripetal acceleration** → Resultant acceleration directed towards the centre of the circular path, perpendicular to velocity
- **Minimum speed** → Least amount of speed necessary to maintain an object moving in a circular path
- **Maximum speed** → Maximum amount of speed an object moving in a circular path can possibly have

Formulas

- **Linear displacement** → S = θr
- **Angular velocity** → ω = Δθ / Δt
- **Angular frequency** → f = n / t (number of revolutions / total time)
- **Angular velocity (time period)** → ω = 2π / T
- **Angular velocity (frequency)** → ω = 2π x f
- **Linear velocity** → v = rω
- **Centripetal acceleration** → V^2 / r
- **Centripetal force (linear velocity)** → F_C = (m x V^2) / r
- **Centripetal force (angular velocity)** → F_C = $mr\omega^2$

Definitions

- **Gravitational force** → Force of attraction between two masses
- **Gravitational field** → A region of space around a (source) mass in which a another (test) mass experiences a force
- **Gravitational field lines** → Lines that represent direction of gravitational force exerted on a mass
- **Gravitational field strength** → Gravitational force exerted per unit test mass in a gravitational field
- **Newton's law of gravitation** → The gravitational force between two point masses is directly proportional to the product of the masses and inversely proportional to the square of distance between their centres
- **Apparent gravity / weight** → sensation of weight of an object, caused by the normal reaction force
- **Gravitational potential** → Amount of work done in bringing a unit test mass from infinity to a certain point inside the gravitational field
- **Gravitational potential energy** → Amount of work done in bringing a mass from infinity to a certain point inside the gravitational field
- **Escape velocity** → Minimum velocity with which an object *must be projected at*, so it could escape a gravitational field with no further energy input

Formulas

Upload Tag

- **Gravitational field strength (basic)** → g = F / m
- **Gravitational force** → $F = (Gm_1m_2) / r^2$
- **Gravitational field strength (above surface of earth)** → $g = GM / r^2$
- **Gravitational field strength (below surface of earth)** → $g = (4/3)\pi G\rho R$
- Linear velocity → $v = \sqrt{(GM / r)}$ (to derive)
- Angular velocity → $\omega = \sqrt{(GM / r^3)}$ (to derive)
- Kinetic energy → $E_K = GMm / 2r$ (to derive)
- Time period → $T^2 = (r^3 \times 4\pi^2) / GM$ (to derive)
- **Binary star system** → $m_1r_1\omega = m_2r_2\omega$
- **Centripetal force - at earth's equator** → $F_C = (GMm / r^2) - F_N$
- **Centripetal force - at earth's pole** → 0
- **Apparent weight - elevator at rest & at earth's pole** → $F_N = mg$
- **Apparent weight - elevator moving upwards** → $F_R = F_N - mg$
- **Apparent weight - elevator moving downwards** → $F_R = mg - F_N$
- **Apparent weight - elevator falls freely** → $F_R = mg$
- Gravitational potential → $\Phi = - GM / r$
- Gravitational potential Energy → $E_P = \Phi \times m$
- Total energy → $E_T = - GMm / 2r$ (to derive)
- Escape velocity → $V_{esc} = \sqrt{[(2GM) / R]}$ or $\sqrt{(2gR)}$ (to derive)

Definitions

- **Temperature** → Measure of average kinetic energy of molecules of a substance
- **Internal energy** → Sum of the kinetic and potential energies of randomly moving molecules of a substance
- **Thermal energy** → Energy transferred from one matter to another because of a difference in temperature
- **Thermodynamic equilibrium** → A state where two or more systems are at the same temperature, such that no net transfer of thermal energy occurs between them
- **Zeroth law of thermodynamics** → If two systems are in thermodynamic equilibrium with a third, the two systems are in thermodynamic equilibrium with each other
- **Absolute zero** → Equal to 0 K, this is the temperature at which a system's molecules have zero kinetic energy
- **Triple point of water** → Unique combination of temperature and pressure at which water coexists in all three of its states - solid, liquid and gas - in thermodynamic equilibrium; the triple point of water occurs at a temperature 273.15 K and pressure 611 Pa
- **Sensitivity of a thermometer** → Amount of change in a thermometric property of a substance per unit change in temperature; more sensitive thermometers could detect smaller changes in temperature
- **Linearity of a thermometer** → Thermometric property of a substance varies by the same amount per unit change in temperature
- **Range of a thermometer** → Difference the maximum and minimum temperatures a thermometer can accurately measure

- **Responsiveness of a thermometer** → Ability of a thermometer to accurately respond to changes in temperature and register new readings
- **Change in state** → Change of a substance from one state of matter to another, without a change in temperature
- **Sublimation** → Change in state of a substance directly from a solid to a gas without passing through the liquid phase
- **Deposition** → Change in state of a substance transitions directly from a gas to a solid without passing through the liquid phase
- **Specific heat capacity** → Amount of heat energy required to raise the temperature of a unit mass of a substance by one degree Celsius
- **Specific latent heat of fusion** → Amount of heat energy required to change a unit mass of a substance from solid to liquid at its melting point, without a change in temperature
- **Specific latent heat of vaporization** → Amount of heat energy required to change a unit mass of a substance from liquid to a gas at its boiling point, without a change in temperature
- **Mole** → Amount of substance that contains the same number of particles as there are atoms in 12 grams of carbon-12
- **Brownian motion** → Perpetual random motion due to collision of smoke particles with air molecules or pollen grains with water molecules
- **Pressure of gas** → Force exerted by a gas per unit area of the walls of a container due to the collisions of gas molecules with the walls of container
- **Motion of gas (kinetic theory)** → Random movement of gas molecules at constant velocity
- **Boyle's law** → The pressure exerted by a (fixed mass of) gas is inversely proportional to its volume, provided its temperature remains constant
- **Charles's law** → The volume occupied by a (fixed mass of) gas is proportional to its volume, provided its pressure remains constant

- **Avogadro's law** → Equal volumes of (fixed masses of) gases at the same temperature and pressure contain an equal number of molecules
- **Pressure gas law** → The pressure exerted by a (fixed mass of) gas is proportional to its absolute temperature, provided volume it occupies remains constant
- **Ideal gas law** → Any (fixed mass of) gas behaving in accordance to equation PV = nRT for all values of pressure, volume and temperature
- **First law of thermodynamics** → The increase in the internal energy of a system equals the sum of net transfer of thermal energy into the system and net work done on the system

Formulas

Upload Tag

- **Temperature - Kelvin to degrees Celsius** → T (K) = θ (°C) + 273.15
- **Temperature - as measured by a thermistor** → θ (°C) = $(R_\theta - R_0) / (R_{100} - R_0)$ ('R_θ' is resistance at unknown temperature, 'R_0' at 0 °C and 'R_{100}' at 100 °C
- **Temperature - as measured by a thermocouple** → $V_1 / \Delta\theta_{known} = V_2 / \Delta\theta_{unknown}$
- **Specific heat capacity** → c = Q / (mΔθ)
- **Specific latent heat of fusion** → l_f = Q / m ('m' is mass of liquid or solid melted)
- **Specific latent heat of vaporization** → l_v = Q / m ('m' is mass of gas or liquid boiled)
- **Specific latent heat of fusion / vaporization (heat lost to or gained from atmosphere considered)** → $l_f / l_v = [t (I_1V_1 - I_2V_2)] / [m_1 - m_2]$ (to derive)
- **Number of moles** → n = M / Mr or n = N / N_A
- **Boyle's law** → $P_1V_1 = P_2V_2$ (to derive)
- **Charles's law** → $T_1 / V_1 = T_2 / V_2$ (to derive)
- **Avogadro's law** → $P_1 / T_1 = P_2 / T_2$ (to derive)
- **Pressure gas law** → $V_1 / n_1 = V_2 / n_2$ (to derive)
- **Ideal gas law (number of moles)** → PV = nRT
- **Ideal gas law (number of molecules)** → PV = NKT (to derive)
- **Pressure exerted by gas** → $PV = (Nm < c^2 >) / 3V$ (AND to also derive)
- **Root mean square of speed of gas molecules** → $< c > = \sqrt{[(3P) / \rho]}$ (to derive)

- **Average translational kinetic energy of gas molecules** → E_{Kavg} = (3KT) / 2 (to derive)
- **Internal energy** → $E_U = E_K + E_P$
- **Work done on / by gas** → W = P x ΔV (to derive)
- **First law of thermodynamics** → (+/- ΔU) = (+/- ΔQ) + (+/- ΔW)

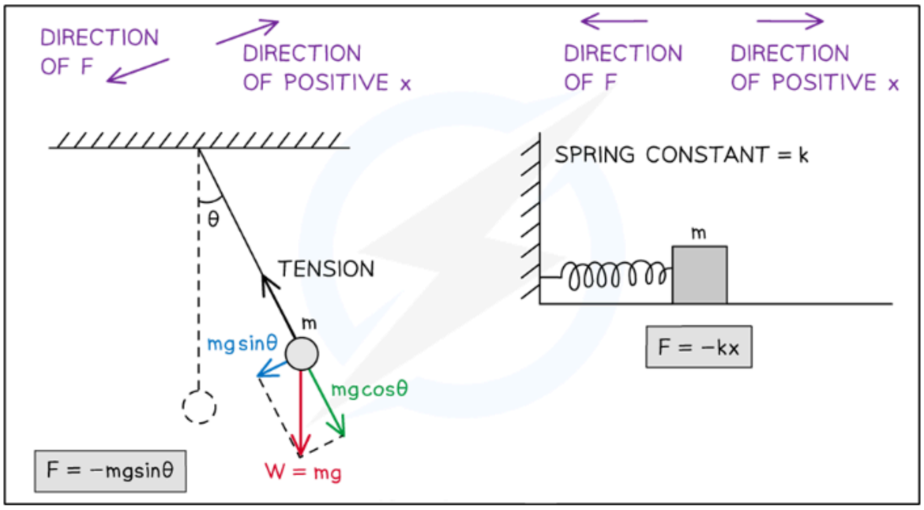
Definitions

- **Restoring Force** → The force that brings an object back to its mean position
- **Periodic Motion** → When a motion repeats itself after equal intervals of time
- **Oscillated motion** → Repeated back & forth movements on either side of any equilibrium position
- **One complete oscillation** → When an oscillator passes the equilibrium from one side and back again fully from the other side
- **Displacement** → The distance of an oscillator from its equilibrium position
- **Amplitude** → The maximum displacement of an oscillator from its equilibrium position
- **Time Period** → Time taken for one complete oscillation, in seconds
- **Frequency** → The number of oscillations completed per unit time
- **Phase Difference** → The difference in the phases of two oscillating particles, expressed in degrees or radians
- **Angular Frequency (for oscillation)** → Angular Frequency 'ω' = 2π divided by time period 'T' or Angular Frequency 'ω' = 2π multiplied by frequency 'f'
- **Simple Harmonic Motion** → The acceleration of an oscillating system is directly proportional to the displacement of the oscillating system but acts in a direction that is opposite to the displacement of the oscillating system **OR** and is always directed towards the mean position
- **Forced Oscillations** → Periodic forces which are applied externally in order to sustain an oscillating system

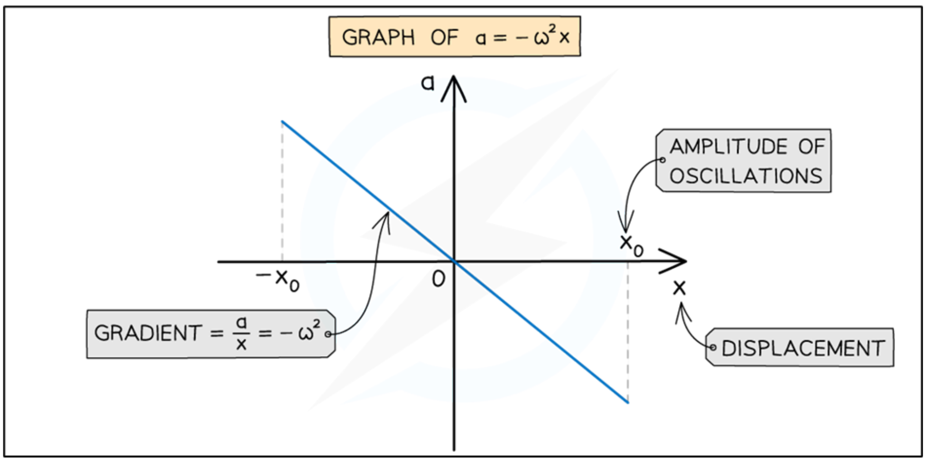
- **Free Oscillations** → Oscillated motion of a body in the absence of any external force
- **Forced Frequency** → The frequency obtained when an object is made to oscillate by the periodic application of an external force
- **Natural Frequency** → The frequency obtained when an object is allowed to oscillate/vibrate freely i.e. in the absence of any external force
- **Resonance** → The maximum amplitude of an oscillating system that is obtained when the driving frequency applied to an oscillating system is equal to its natural frequency
- **Resonant frequency** → Frequency at which response amplitude is relatively maximum
- **Light Damping** → The gradual decrease in the amplitude of an oscillating system, due to the loss of energy caused by the forces acting in opposite direction to the motion
- **Heavy Damping** → A displaced system takes a longer time to return to its equilibrium position without oscillating
- **Critical Damping** → When the damping force is much greater than the restoring force, the displaced system, will return to rest at its equilibrium position in the shortest possible time without oscillating

Formulas

- **Applied force** → F_a = k x (x is extension)
- **Restoring force** ↓
  - F_r = - k x

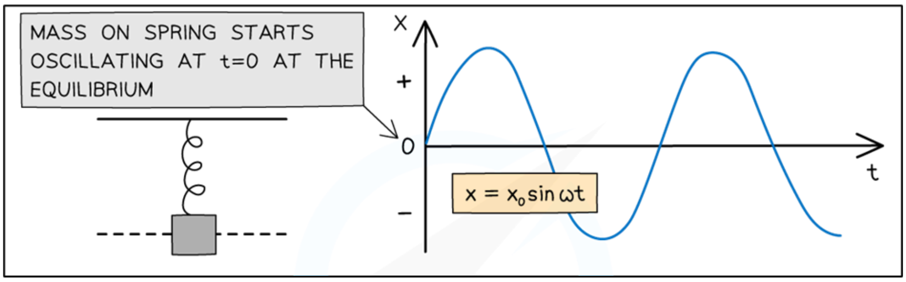


- **Net force** → F_{net} = 2 (k x)
- **Acceleration (Simple Harmonic Motion)** ↓
  - a = $-\omega^2 x$

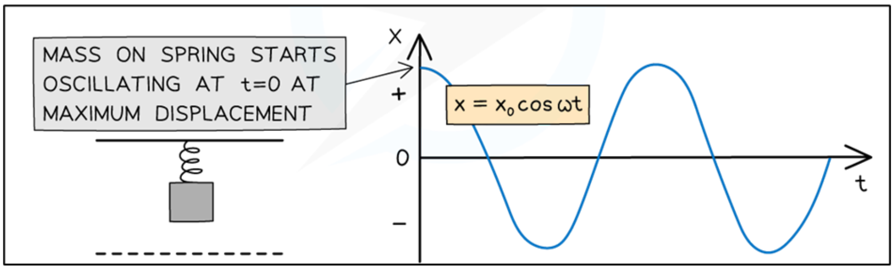


- **Acceleration (spring constant)** → a = (F_{net}) / m
- **Acceleration (length of pendulum)** → a = (-g x) / ℓ (to derive)

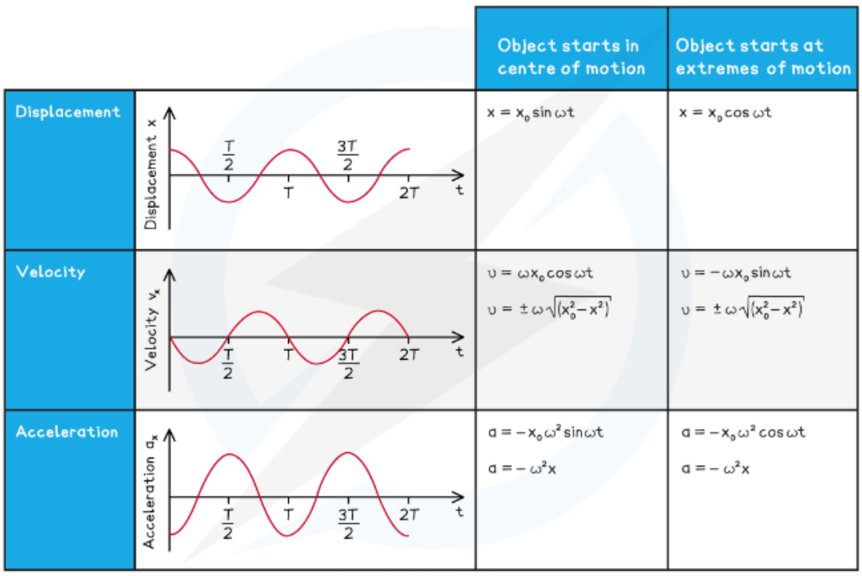
- **Frequency (length of pendulum)** → $f = \sqrt{(g / \ell)} \times (1 / 2\pi)$ (to derive)
- **Instantaneous displacement (x is zero at t = 0)** ↓
  - $x = x_0 \sin(\omega t)$



- **Instantaneous velocity (x is zero at t = 0)** → $v = v_0 \cos(\omega t)$
- **Instantaneous acceleration (x is zero at t = 0)** → $a = -a_0 \sin(\omega t)$ (to derive)
- **Instantaneous displacement (x is max at t = 0)** ↓
  - $x = x_0 \cos(\omega t)$



- **Instantaneous velocity (x is max at t = 0)** → $v = -v_0 \sin(\omega t)$ (to derive)
- **Instantaneous acceleration (x is max at t = 0)** ↓
  - $a = -a_0 \cos(\omega t)$ (to derive)



- **Instantaneous velocity (other equation)** → $v = \omega \sqrt{(x_0^2 - x^2)}$
- **Maximum velocity** → $v_0 = \omega x$
- **Instantaneous kinetic energy** → $E_K = (1 / 2) \times [m \omega^2 (x_0^2 - x^2)]$
- **Maximum kinetic energy** → $E_K = (1 / 2) \times (m \omega^2 x_0^2)$
- **Instantaneous potential energy** → $E_P = (1 / 2) \times (m \omega^2 x^2)$
- **Maximum potential energy** → $E_P = (1 / 2) \times (m \omega^2 x_0^2)$
- **Total energy of an oscillating system** → $E_{Total} = (1 / 2) \times (m \omega^2 x_0^2)$
- **Displacement at the instant $E_K = E_P$** → $x = x_0 / \sqrt{2}$ (to derive)

Definitions

- **Electric Field** → A region of space around a (source) charge, in which a another (test) charge experiences a force
- **Electric Field Strength** → The electrostatic force exerted per unit positive test charge in an electric field
- **Uniform electric field** → A field of force throughout which the electric field strength and direction remains constant
- **Point charge** → For a point outside a spherical conductor, the charge of the sphere may be considered to be a point charge at its centre
- **Coulomb's Law of Electrostatic Force** → The electrostatic force between two point charges is directly proportional to the product of the charges and inversely proportional to the square of distance between their centres
- **Electric Potential** → Amount of work done, to bring a unit positive test charge from infinity, to a point inside the electric field
- **Potential difference (uniform electric field)** → Work done per unit charge in an electric field

Formulas

Upload Tag

- **Electric field strength (basic)** → E = F / q
- **Coulomb's law of electrostatic force** → E = (Q_1 x Q_2) / (4πε_0 x r^2)
- **Electric field strength (point charge)** → E = Q / (4πε_0 x r^2)
- **Uniform electric field strength (uniform)** → ΔV / Δd
- **Non-uniform electric Field Strength** → - (ΔV / Δd)
- **Resultant electric field strength b/w two like charges** → $E_{Resultant}$ = (+ E_1) + (- E_2)
- **Resultant electric field strength b/w two unlike charges** → $E_{Resultant}$ = (+ E_1) + (+ E_2)
- **Electric potential** → Q / (4πε_0 x r)
- **Resultant electric potential b/w two point charges** → $V_{Resultant}$ = (V_1) + (V_2)
- **Electric potential (E / r graph)** → Area under graph
- **Electric field strength (V / r graph)** → negative of potential gradient
- **Electric potential energy (basic)** → W = q x V
- **Electric potential energy (point charge)** → E_P = (Q x q) / (4πε_0 x r)
- **Electric potential energy (+q accelerates)** → Electrical potential energy (E_P = q x V) is lost to kinetic energy (E_K= (1 / 2) x m x v^2)
- **Potential difference (uniform electric field)** → V = W / q
- **Acceleration of +q in a uniform electric field** → a = (E x q) / m (to derive)
- **Mass to Charge ratio** → (m / q) = (E / a) = ΔV / (a x Δd) (to derive)
- **Initial vertical velocity u_y of +q** → u_y = 0

- **Vertical acceleration a_y of +q** → $a_y = v_y^2 / (2 \times S_y)$ (to derive)
- **Vertical displacement S_y of +q** → $S_y = (1/2) \times a \times t^2$ (to derive)
- **Initial horizontal velocity u_x of +q** → u_x (constant) = $u \cos \theta$
- **Horizontal acceleration a_x of +q** → $a_x = 0$
- **Horizontal displacement S_x of +q** → $u \cos \theta \times t$ (to derive)

Capacitance

- **Definitions**
  - **Capacitance (parallel plate capacitor)** → Ratio of charge stored on one of the plates to the potential difference between the two plates of a parallel plate capacitor
  - **Capacitance (isolated charged sphere)** → Ratio of charge stored to the potential at the surface of the spherical conductor
- **Formulas**
  - **Capacitance (parallel plate capacitor)** → $C = Q / V$
  - **Capacitance (isolated charged sphere)** → $C = r / k$ where $k = 1 / 4\pi\varepsilon_0$
  - **Time constant** → $\tau = RC$
  - **Discharging capacitors - exponential decrease** → $X = X_0 e^{-1/RC \times t}$
  - **Energy stored (area under graph)** → $W = (Q \times V) / 2$
  - **Energy stored (charge is constant)** → $W = Q^2 / 2C$
  - **Energy stored (voltage is constant)** → $W = CV^2 / 2$
  - **Combined capacitance (capacitors connected in series)** → $(1 / C_{Total}) = (1 / C_1) + (1 / C_2) + (1 / C_3)$
  - **Combined capacitance (capacitors connected in parallel)** → $C_{Total} = C_1 + C_2 + C_3$

Definitions

- **Magnetic fields** → A field of force produced by a current carrying conductor, by moving charges or by permanent magnets
- **Magnetic flux** → The product of the number of turns of coil, magnetic flux density and the cross-sectional area of coil perpendicular to the direction of the magnetic flux density (Φ = NBA)
- **Magnetic flux density** → Force acting per unit current per unit length on a wire placed at right angles to the magnetic field [B = F/(I x L)]
- **Tesla** → Unit of magnetic flux density whose field lines perpendicular to a straight wire carrying a current of one ampere exerts a force of one newton per unit length [T = N / (A x m)]
- **Faraday's law** → Induced e.m.f is proportional to rate of change of magnetic flux linkage
- **Lenz's law** → Direction of an induced current in a conductor is such that it opposes the change in magnetic flux that caused it

Formulas

Upload Tag

- **Magnetic flux** → Φ = NBA cos θ (θ = angle b/w magnetic field lines & normal to cross-sectional area of coil)
- **Force exerted by magnetic field** → F = BIL sin θ / cos θ (sin θ - angle b/w magnetic field lines & length of wire; cos θ - angle b/w magnetic field lines & normal to length of wire)
- **Magnetic flux density - current carrying conductor** → B = (μ_0 x I) / (2π x r)
- **Magnetic flux density - solenoid** → B = ((μ_0 x I x N) / L
- **Magnetic flux density - flat coil** → B = ((μ_0 x I x N) / (2 x r)
- **Force exerted by two current carrying conductors** → F = ((μ_0 x I_1 x I_2 x L) / (2π x r)
- **Force on a moving charged particle** → F = qvB sin θ (to derive)
- **Horizontal distance moved by charged particle** → Sx = u x t (to derive)
- **Time taken to move one circular path by charged particle** → (2π x r) / u sin θ (to derive)
- **Radius of circular path by charged particle** → r = mv / qB (to derive)
- **Time spent by charged particle in a B field is independent of its velocity** → (2π x m) / qB (to derive)
- **Momentum of charged particle** → P = qBr (to derive)
- **Velocity selector** → v = E / B
- **Hall voltage** → (I x B) / (n x t x q) (to derive)
- **Induced e.m.f (Faraday's law)** → e.m.f = - (ΔΦ / Δt)

Definitions

- **Direct current** → Current that flows in one direction only
- **Alternating current** → Current whose polarity reverses after fixed intervals of time
- **Rectification** → Process by which an alternating current (AC) is converted to direct current (DC)
- **Half wave rectification** → Process by which half the wave of an alternating current (AC) is converted to direct current (DC)
- **Full wave rectification** → Process by which the whole wave of an alternating current (AC) is converted to direct current (DC)
- **Smoothing** → Output voltage / current does not fall to zero
- **Ripple voltage** → Fluctuating output voltage superimposed on the direct current output of an alternating current source, after rectification
- **Root mean square of alternating current (DC)** → Value of direct current that produces the same mean power / heating in a resistor as alternating current
- **Root mean square of alternating current (heating effect)** → Value of direct current that dissipates heat energy across a resistor at the same rate as alternating current
- **Root mean square of alternating voltage (steady voltage)** → Value of steady / constant voltage that produces the same mean power / heating in a resistor as alternating voltage
- **Root mean square of alternating voltage (mathematical)** → If the alternating voltage was squared, then averaged out, the r.m.s would be the square root of this average value

Formulas

Upload Tag

- **Instantaneous magnetic flux linkage** → $\Phi = \Phi_0 \cos(\omega t)$
- **Instantaneous e.m.f induced** → $\varepsilon = \varepsilon_0 \sin(\omega t)$
- **Torque on a coil manually rotated in a magnetic field** → $T = BIL \sin\theta \times d$
- **Instantaneous current** → $I = I_0 \sin(\omega t)$
- **Average power output** → $P_{avg} = P_0 / 2$
- **Root mean square of alternating current** → $< I > = I_0 / \sqrt{2}$ (to derive)
- **Root mean square of alternating voltage** → $< V > = V_0 / \sqrt{2}$ (to derive)

Definitions

- **Mass defect** → Difference in mass between the nucleus of an atom and the sum of the masses of its individual protons and neutrons (P.S: Include neutron(s) released with nucleus)
- **Binding energy** → Energy required to infinitely split the protons and neutrons of a nucleus
- **Radioactivity** → Phenomenon where unstable atomic nucleus randomly and spontaneously decays and emits α or β particles, and γ radiation
- **Spontaneous** → Decay of a nucleus is not influenced by external factors such as temperature, pressure, chemical reactions or presence of other nuclei
- **Random** → Not possible to predict which particular nucleus will decay in the next second
- **Activity** → Rate at which a nucleus decays
- **Decay constant** → The probability that an individual nucleus will decay per unit of time
- **half-life** → Time taken for the number of undecayed nuclei or activity to fall to half of it initial value
- **unified atomic mass** → $1/12^{th}$ of the mass of an atom of carbon-12
- **Nuclear fission** → A process in which the nucleus of an atom splits into two or more smaller nuclei of approximately equal mass, releasing a large amount of energy
- **Nuclear fusion** → Process in which two light nuclei combine to form a heavier nucleus, releasing a large amount of energy in the process

Formulas

Upload Tag

- **Einstein's mass-energy equation** → $E = m \times c^2$
- **J to cV** → 1 J = 1 cV
- **J to eV** → $1\ eV = 1.6 \times 10^{-19}\ J$
- **J to MeV** → $1\ eV = 1.6 \times 10^{-13}\ J$
- **Binding energy** → $B.E = \Delta m \times c^2$
- **Alpha decay equation** ↓
  - $^{A}_{Z}X \longrightarrow ^{A-4}_{Z-2}Y + ^{4}_{2}\alpha$
- **Beta (-) decay equation** ↓
  - $^{A}_{Z}X \longrightarrow ^{A}_{Z+1}Y + ^{0}_{-1}\beta$
- **Beta (+) decay equation** ↓
  - $^{A}_{Z}X \longrightarrow ^{A}_{Z-1}Y + ^{0}_{+1}\beta$
- **Activity** → $A = -\lambda N$ ($= \Delta N / \Delta t$)
- **Radioactive decay** → $X = X_0\, e^{-\lambda t}$
- **Fraction of undecayed nuclei** → $(N / N_0) = e^{-\lambda t}$
- **Decay constant** → $\lambda = 0.693 / t_{1/2}$

Definitions

- **Photons** → Discrete packets or quantums of energy of electromagnetic radiation
- **Photoelectric effect** → Phenomenon where electrons are emitted from the surface of a metal when it is exposed to EMR / photons whose exceeds threshold frequency
- **Intensity** → Power intercepted per unit cross-sectional area
- **Threshold frequency** → Minimum frequency of incident EMR / photons required to eject electrons from a metal surface
- **Work function energy** → Minimum energy of incident EMR / photons required to eject electrons from a metal surface
- **Cut-off wavelength** → Maximum wavelength of incident EMR / photons that would result in emission of electrons from a metal surface; wavelengths greater than cut-off wavelength would not result in emission of electrons
- **Work function energy on a surface** → Energy of incident EMR / Photons equal to work function energy result in emission of electrons with zero kinetic energy from a metal surface
- **De broglie wavelength** → Wavelength associated with fast moving particles
- **Excitation of e-** → Transitioning of an electron from a lower to a higher energy level within an atom
- **De-excitation of e-** → Transitioning of an electron from a higher to a lower energy level within an atom

- **Absorption line spectrum** → A series of dark lines on a background of all colours corresponding discrete wavelengths of radiations or photons absorbed when electrons of gaseous atoms cooled at low pressure transition from lower to higher energy levels; photons absorbed have energies equal to difference in energy levels between which electrons transition
- **Emission line spectrum** → A series of coloured lines on a black background corresponding discrete wavelengths of radiations or photons emitted when electrons of gaseous atoms heated at low pressure transition from higher to lower energy levels; photons emitted have energies equal to difference in energy levels between which electrons transition

Formulas

PDF Upload Tag

- **Energy (one photon)** → $E = hf_0$ or $E = (hc) / \lambda_0$
- **Total energy of photons** → $E_T = n \times hf_0$ ('n' is number of photons incident)
- **Intensity** → I = P / A ('P' is power)
- **Einstein's photoelectric equation** → $E_K = hf - \Phi$
- **Momentum of a photon** → $P = h / \lambda$
- **Momentum of an e- accelerated through a potential difference** → $P = \sqrt{(2mqV)}$ (to derive)
- **Einstein's theory of relativity** → E = P x c ('P' is momentum)

Definitions

- **Specific acoustic impedance** → The product of the speed of the ultrasound in the medium and the density of the medium
- **Intensity reflection coefficient** → The ratio of the intensity of the reflected wave relative to the incident wave
- **Attenuation of ultrasound / x-ray** → The reduction of energy, and thus intensity of ultrasound / x-ray, due to the absorption of ultrasound / x-ray as it travels, over a distance, through a medium
- **80 KeV x-ray** → X-rays produced when high speed electrons of kinetic energy 80 KeV, accelerated through a potential difference 80 KV, hit target anode
- **Hardness of x-ray beam** → Penetrating power of x-ray beam; harder x-rays have greater penetrating power
- **Sharpness of x-ray image** → Associated with how well defined the boundaries of an x-ray image are
- **Contrast of x-ray image** → Difference in degree of blackening between different regions of an x-ray image
- **Tomography** → Medical imaging technique that produces a detailed three-dimensional cross-sectional images of slices of a body part or structure
- **PET scanning** → A type of nuclear procedure that images body tissues and organs by measuring metabolic activity of their cells
- **Tracer** → A radioactive substance, injected into the body in small amounts, absorbed my body tissues allowing for study of their structure and function
- **Annihilation** → When a particle collides with its equivalent antiparticle, the two are destroyed and their masses converted to pure energy in the form of photons

Formulas

Upload Tag

- **Specific acoustic impedance** → $Z = \rho \times c$ ('c' is speed of ultrasound in medium)
- **Intensity reflection coefficient** → $\alpha = I_R / I_0$ or $\alpha = (Z_1 - Z_2)^2 / (Z_1 + Z_2)^2$
- **Attenuation of ultrasound (one medium)** → $I_R = I_0e^{-\mu x}$ ('I_R' is intensity of ultrasound reflected)
- **Attenuation of x-ray** → $I_T = I_0e^{-\mu x}$ ('I_T' is intensity of x-ray transmitted)
- **Attenuation of ultrasound (two media)** → $I_R = I_0 (e^{-\mu 1\ x1} \times e^{-\mu 2\ x2})$
- **Attenuation of x-ray (two media)** → $I_T = I_0 (e^{-\mu 1\ x1} \times e^{-\mu 2\ x2})$
- **Kinetic energy of one x-ray photon at cut-off wavelength** → $E_K = qV = hc / \lambda_0$
- **Total energy released in one annihilation event** → $E_T = 2 \times \Delta mc^2$ (two γ-ray photons released)
- **Wavelength of each γ-ray photon released** → $\lambda = hc / \Delta mc^2$ ('Δmc^2' = energy for one γ-ray photon released = $E_T / 2$)

Definitions

- **Luminosity** → Total power output of radiation emitted by a star
- **Radiant flux intensity** → The radiant power transmitted normally through a surface per unit of area, of radiation measured on Earth
- **Standard candle** → An astronomical object which has a known luminosity due to a characteristic quality possessed by that class of object
- **Wien's displacement law** → The black body radiation curve for different temperatures peaks at a wavelength which is inversely proportional to the temperature
- **Stefan-Boltzmann Law** → The total energy emitted by a black body per unit area per second is proportional to the fourth power of the absolute temperature of the body
- **Doppler effect** → The apparent change in wavelength or frequency of the radiation from a source due to its relative motion away from or toward the observer
- **Redshift** → The fractional increase in wavelength (or decrease in frequency) due to the source and observer receding from each other
- **Blueshift** → The fractional decrease in wavelength (or increase in frequency) due to the source and observer moving towards each other
- **Hubble's Law** → The recession speed of galaxies moving away from Earth is proportional to their distance from the Earth

Formulas

Upload Tag

- **Radiant flux intensity** → $F = L / (4\pi d^2)$ ('d' is distance between star and Earth)
- **Wien's displacement law (relationship)** → $\lambda_{max} \propto 1 / T$
- **Wien's displacement law (equation)** → $\lambda_{max1}T_1 = \lambda_{max2}T_2$ (to derive)
- **Stefan-Boltzmann Law** → $L = 4\pi r^2 \sigma T^4$
- **Redshift** ↓
  - $(\Delta\lambda / \lambda) = (\Delta f / f) = (v / c)$
  - Where:
    - $\Delta\lambda$ = shift in wavelength (m)
    - λ = wavelength emitted from the source (m)
    - Δf = shift in frequency (Hz)
    - f = frequency emitted from the source (Hz)
    - v = speed of recession (ms^{-1})
    - c = speed of light in a vacuum (ms^{-1})
- **Hubble's Law** → $v = H_0 d$ (where 'd' is distance between galaxy and Earth)
- **Age of universe** → $T_0 = 1 / H_0$