

Definitions/Laws/Principles

A LEVEL PHYSICS

1. **Radian:** The angle subtended at the centre of a circle by an arc of length equal to the radius of the circle.
2. **Angular displacement:** Ratio of the length of arc, subtended at the circumference of the circle, and the radius of the circle.
3. **Angular speed:** Angle subtended at the centre of the circle by an object moving at the circumference of the circle in unit time
4. **Centripetal Force:** It is the resultant force acting on an object moving in a circular path at constant speed; always towards the centre of the circle and perpendicular to the velocity of the object.
5. **Gravitational field:** A region of space in which a mass experiences a force.
6. **Gravitational field strength:** The gravitational force exerted per unit mass on a small test mass placed at that point
7. **Line of force of a gravitational field:** Represents the direction of the force exerted on a small test mass in a gravitational field.
8. **Geostationary orbits:** An orbit in which a geostationary satellite always stays above the same point on the surface of a planet.
9. **Potential energy:** ability to do work as a result of the position/shape, etc. of an object.
10. **Gravitational potential energy:** Gravitational potential energy at a point is defined as the work done in bringing a test mass from infinity to the point.
11. **Gravitational potential:** work done in bringing a unit test mass from infinity to the point.
12. **Kepler's 3rd law:** The square of the period of the orbit is proportional to the cube of the radius of the orbit.
13. **Escape speed:** The minimum initial speed a mass must have so that it escapes the gravitational field of a planet/star/, etc. to infinity.
14. **Displacement (in SHM):** Shortest distance of the object from equilibrium position.
15. **Amplitude (in SHM):** Maximum displacement of the object from the equilibrium position.
16. **Frequency (in SHM):** Number of oscillations completed per unit time.
17. **Period (in SHM):** Time to complete one oscillation.

18. **Angular frequency:** The relation to the period by $2\pi/T$ and the frequency by $2\pi f$.
19. **Simple harmonic motion:** $a = -\omega^2 x$, the magnitude of the acceleration is directly proportional to the displacement from equilibrium position, and always directed towards the equilibrium position.
20. **Free oscillations:** Oscillations without any external forces.
21. **Forced Oscillations:** When a body's oscillations are being influenced by an external periodic force.
22. **Damping:** The process whereby energy is taken from the oscillating system. / The damping is a resistance offered to the oscillation.
23. **Light damping:** Amplitude decreases gradually. It takes many oscillations for the motion to stop.
24. **Heavy damping:** Amplitude decreases rapidly. The motion stops after a few oscillations.
25. **Critical damping:** The minimum amount of damping required to return an oscillator to its equilibrium position in the shortest time without oscillating.
26. **Natural frequency:** If a system undergoes free oscillations, the frequency at which it will oscillate is called its natural frequency
27. **Driving frequency:** If the oscillations are forced, the system then oscillates at the frequency of the periodic force. This is called the driving frequency.
28. **Resonance:** When driving frequency is equal to natural frequency, the amplitude becomes maximum; this is called resonance.
29. **Mole:** amount of substance containing same number of particles as in 0.012 kg of carbon-12.
30. **Relative atomic mass:** Ratio of mass of an atom to one twelfth of the mass of an atom of carbon-12. Numerically equal to mass of one mole of atoms in grams.
31. **Relative molecular mass:** Ratio of mass of a molecule to one twelfth of the mass of an atom of carbon-12. Numerically equal to mass of one mole of molecules in grams.
32. **Avogadro's number:** The number of atoms in 12g of carbon-12 (6.02×10^{23}).
33. **Ideal gas:** An ideal gas is a gas which obeys the ideal gas equation, $Pv = NRT$, at all pressures, volumes and temperatures.
34. **Boltzmann constant:** molar gas constant divided by the Avogadro constant.

35. **Brownian motion:** Brownian motion refers to the random movement displayed by small particles that are suspended in fluids.
36. **assumptions about kinetic theory of ideal gases:**
- All molecules behave as identical, hard, perfectly elastic spheres.
 - The volume of the molecules is negligible compared to the volume of the containing vessel.
 - There are no forces of attraction or repulsion between molecules
 - There are many molecules all moving randomly.
37. **root-mean-square velocity (r.m.s speed):** the measure of the speed of particles in a gas, defined as the square root of the average velocity-squared of the molecules of a gas.
38. **Thermal equilibrium:** When two bodies are in thermal equilibrium their temperatures are equal and there is no net heat transfer between the two bodies.
39. **thermometric property:** A thermometric property is any physical property of a substance that changes measurably with temperature.
40. **Zeroth Law of thermodynamics:** If body A is in thermal equilibrium with body C and body B is in thermal equilibrium with body C then body A and B are also in thermal equilibrium with each other.
41. **Fixed points:** A fixed point is any temperature where all thermometers give the same reading even when they are using different thermometric properties.
42. **Ice point:** The temperature where pure ice and pure water are in thermal equilibrium at standard atmospheric pressure.
43. **Steam point:** The temperature at which pure water and vapor are in thermal equilibrium at standard atmospheric pressure.
44. **Absolute zero:** The temperature at which it is suggested that no more energy can be removed from a gas and it is at its lowest temperature.
45. **Triple point of water:** The temperature and pressure at which ice, water, and steam are in thermal equilibrium and all three can coexist.
46. **Kelvin:** One Kelvin(1K) is $1/273.16$ of the triple point of water on the thermodynamic scale.
47. **Specific heat capacity:** The numerical value of specific heat capacity of a substance is equal to the amount of heat energy needed to raise the temperature of a unit mass by 1K.

- 48. **Latent heat of fusion:** The energy required to melt a solid without a change in temperature is called latent heat of fusion.
- 49. **Specific latent heat of fusion:** The numerical value of specific latent heat of fusion is equal to the quantity of heat energy needed to melt a solid of unit mass, without a change in temperature.
- 50. **Latent heat of vaporization:** The energy required to vaporize a liquid without a change in temperature is called latent heat of vaporization.
- 51. **Specific latent heat of vaporization:** The numerical value of specific latent heat of vaporization is equal to the quantity of heat energy needed to boil a liquid of unit mass, without a change in temperature.
- 52. **Internal energy:** can be expressed as the sum of a random distribution of kinetic and potential energies associated with the molecules of the system.
- 53. **First law of thermodynamics:** The increase in internal energy of a system is equal to the sum of heat added to the system and the work done on the system.
- 54. **Coulomb's law:** Any two point charges exert an electrical force on each other that is proportional to the product of their charges and inversely proportional to the square of the distance between them.
- 55. **Electric field:** Electric field is a region of space where a charge experiences an electric force.
- 56. **Line of force of electric field:** They represent the direction of the electric force that will be exerted on a positive test charge in an electric field.
- 57. **Electric field strength:** The force exerted on a unit positive test charge at that point.
- 58. **Electric potential:** The electric potential at a point is equal to the work done in bringing unit positive charge from infinity to that point
- 59. **Electric potential energy:** Electric potential energy of a test charge q at a point in the electric field is defined as the work done to bring the test charge from infinity to that point.
- 60. **Field of force:** A region of space in which a particle experiences a force.
- 61. **Capacitance:** The capacitance of a capacitor is the charge stored on one plate per unit of potential difference between the plates.
- 62. **Farad:** The Farad (1F) is the capacitance of a capacitor which stores one coulomb of charge when the potential across the capacitor is one volt.

63. **Magnetic field:** A region of space where a magnetic north pole, experiences a force.
64. **Magnetic flux density:** the force experienced per unit length by a long straight conductor carrying unit current and placed at right angles to the field at that point.
65. **Magnetic flux:** The magnetic flux Φ through area A is defined as: $\Phi = BA$ where B is the component of the magnetic flux density perpendicular to the area.
66. **Magnetic flux linkage:** For a coil with N turns, the magnetic flux linkage is defined as the product of the magnetic flux and the number of turns.
67. **One Weber:** The weber is defined as the magnetic flux through a surface if a magnetic field of flux density 1 T exists perpendicularly to an area of 1 m².
68. **Tesla:** 1 Tesla is defined as the magnetic flux density of a uniform magnetic field when a wire of length 1m , carrying a current of 1A, placed perpendicular to the field, experiences a force of 1N in a direction at right angles to both the field and the current.
69. **Faraday's law:** The magnitude of the induced emf is proportional to the rate of change of magnetic flux linkage.
70. **Lenz's law:** Any induced current or induced emf will be established in a direction so as to produce effects which oppose the change that is producing it.
71. **Specific charge:** Specific charge of any charged particle is defined as the charge to mass ratio of that particle.
72. **R.m.s current or voltage:** The rms value of the alternating current or voltage is that the value of the direct current or voltage that would produce heat at the same rate in a resistor.
73. **Peak current or voltage:** The maximum value attained by an alternating current or voltage during one cycle is called its Peak value.
74. **Rectification:** Rectification is the process in which an alternating current is forced to only flow in one direction.
75. **Smoothing:** When a circuit is used to remove ripple from the output of a rectifier.
76. **Photon:** A photon is a discrete “packet” or a “quantum” of electromagnetic radiation.

- 77. **Photoelectric effect:** The photoelectric effect is the phenomena in which electrons are emitted from the surface of a metal upon the absorption of electromagnetic radiation.
- 78. **Threshold frequency:** Threshold frequency is the minimum frequency of an incident radiation required to just remove an electron from the surface of a metal.
- 79. **Work function energy:** The work function of a material is defined as the minimum amount of the work necessary to remove a free electron from the surface of the material.
- 80. **De Broglie wavelength:** The wavelength associated with a moving particle. It is equal to the ratio of Planck's constant and momentum of the particle.
- 81. **Valance band:** The valence band is the outermost range of electron energies of an atom of a solid that is bound to an atom.
- 82. **Conduction band:** A range of electron energies in a solid where electrons in are free to move throughout the material.
- 83. **Forbidden band (band gap):** Band gap is the energy difference between top of valence band and bottom of conduction band. It is also a range of energy in a solid where no electron states exist.
- 84. **Mass defect:** The mass defect of a nucleus is defined as the difference between the total mass of the separated nucleons and the combined mass of the nucleus.
- 85. **Mass excess:** the difference between the mass of a nuclide (in u) and its mass number.
- 86. **Binding energy:** The energy required to break a nucleus into its constituent protons and neutrons to infinity.
- 87. **Nuclear fission:** Nuclear fission is the disintegration of a heavy nucleus into two lighter nuclei of approximately equal masses.
- 88. **Nuclear fusion:** Nuclear fusion is the combining of the two light nuclei to produce a heavier nucleus.
- 89. **Spontaneous radioactive decay:** nuclear decay is spontaneous because: the decay of a particular nucleus is not affected by the presence of other nuclei. And the decay of nuclei cannot be affected by chemical reactions or external factors such as temperature and pressure.

90. **Random radioactive decay:** nuclear decay is random because: it is impossible to predict when a particular nucleus in a sample is going to decay. And each nucleus in a sample has the same probability of decaying per unit time.
91. **Half-life:** Half-life is defined as the time taken for half the original number of radioactive nuclei to decay.
92. **Decay constant:** The decay constant λ of a nucleus is defined as its probability of decay per unit time.
93. **Activity:** The activity of a radioactive substance is defined as the average number of atoms disintegrating per unit time.
94. **Amplitude modulation:** the amplitude of the carrier waves varies in synchrony with the displacement of the information signal.
95. **Frequency modulation:** The frequency of the carrier wave varies in synchrony with the displacement of the information signal.
96. **Information signal:** It refers to any time varying voltage, current or electromagnetic wave that carries information.
97. **Carrier wave:** A waveform that is modulated by either AM or FM before being transmitted
98. **Analogue signal:** A signal that is continuously variable, having a continuum of possible values
99. **Digital signal:** A signal that consists of a series of 1s and 0s
100. **Bandwidth:** The bandwidth of a signal is the range of frequencies being transmitted.
101. **Noise:** when unwanted power on signal, that is random, is added to the signal.
102. **Crosslinking:** any phenomenon by which a signal transmitted on one circuit or channel of a transmission system creates an undesired effect in another circuit or channel.
103. **Signal attenuation:** The reduction in power and signal strength during transmission of a signal.
104. **Repeaters:** An electronic device that receives a signal and retransmits it after amplifying it.
105. **Regeneration:** signal regeneration is signal processing that restores a signal, recovering its original characteristics.
106. **Sampling rate:** How many samples per second the value of an analogue signal is taken.

- 107. Ultrasound:** Any sound with a frequency above 20,000 Hz (or 20 kHz); above the highest audible frequency is defined to be ultrasound.
- 108. Specific acoustic impedance:** product of medium density and the speed of sound in the medium.
- 109. Piezo electric transducer:** A material that produces an e.m.f. when it is stressed, causing its shape to change. Also, when a voltage is applied across it in one direction, it changes its dimensions slightly.
- 110. Intensity reflection coefficient:** The intensity reflection coefficient a is defined as the ratio of the intensity of the reflected wave relative to the incident wave.
- 111. X-rays:** X rays are relatively high-frequency EM radiation. They are produced by transitions between inner-shell electron levels, which produce x rays characteristic of the atomic element, or by accelerating electrons.
- 112. Intensity of x-rays:** Intensity is the power / rate of energy transfer per unit cross-sectional area.
- 113. Hardness of x-rays:** The measure of the penetrating strength of a beam.
- 114. Sharpness of x-rays:** How well defined the edges of structures are.
- 115. Contrast of x-rays:** The difference in degree of blackening between structures.
- 116. Main properties of ideal op-amp**
- Infinite input impedance: The infinite input resistance of an ideal op-amp means that no current is drawn from the supply, there are no 'lost volts' and the input voltage to the op-amp is as large as possible.
 - Infinite open-loop gain (A_0): This means that when an op-amp is used on its own, with no feedback loop, then a small input signal will be amplified to an 'infinite' output signal.
 - Zero output resistance: This means that there will be no 'lost volts' when current is supplied by the op-amp.
 - Infinite bandwidth: The bandwidth of an op-amp is the range of frequencies that are amplified by the same amount. An ideal op-amp will amplify signals of all frequencies.
 - Infinite slew rate: An ideal op-amp should change the output instantaneously as the input is changed. The slew rate of the op-amp is the factor that affects this time delay. An infinite slew rate means there is no time delay.

- 117. Negative feedback:** The process of taking a fraction, of the output and adding it to the inverting input of an op-amp.
- 118. Open loop gain:** Open-loop gain is the gain of the op-amp without positive or negative feedback.
- 119. Gain:** The ratio of the voltage output and the voltage input
- 120. Virtual earth:** virtual earth means that the voltage at that particular node is almost equal to ground voltage (0V).