

List of Definitions

Physics Form 4

Disclaimer: The terms marked with an asterisk (*) are provided definitions which are obtained from external sources (i.e. not textbook).

➤ Chapter 1: Measurement

Basic terms		
1	Physics	The study of matter and energy as well as phenomena happening around us.
2	Base quantity	A physical quantity which cannot be derived from another physical quantity.
3	Derived quantity	A physical quantity that is related to base quantities through a formula.
4	Scalar quantity	Physical quantity that has magnitude only.
5	Vector quantity	Physical quantity that has both magnitude and direction.

➤ Chapter 2: Force and Motion I

Basic terms		
1	Linear motion	Motion in a straight line.
2	Distance	Length of route covered by an object.
3	Displacement	Shortest distance between the initial position and the final position in a specific direction.
4	Speed	Rate of change of distance travelled.
5	Velocity	Rate of change of displacement.
6	Acceleration	Rate of change of velocity.
7	Free fall	The state of an object whereby the motion of the object is affected only by gravitational force.
8	Gravitational acceleration	The acceleration of a free-falling object caused by gravitational force.
9	Inertia	The tendency of an object to remain at rest or, if moving, to continue its motion in a straight line at uniform velocity.
10	Momentum	Product of mass and velocity.
11	Explosion	A situation where an object at rest breaks up into two or more parts.
12	Force	An influence that can change the motion of an object / Product of mass and acceleration.
13	Impulse	Change of momentum
14	Impulsive force	The rate of change momentum in a collision
15	Gravitational field strength	The force acting per unit mass caused by gravitational pull.
16	Weight*	Force acting on an object due to gravity.

Principles		
1	Newton's First Law of Motion	(Inertia) An object will remain at rest or move at uniform velocity unless acted upon by an external force.
2	Newton's Second Law of Motion	(Force) The rate of change of momentum is directly proportional to the force and acts in the direction of the applied force.
3	Newton's Third Law of Motion	(Action-reaction pair) For every action, there is a reaction of equal magnitude, but in the opposite direction.
4	Principle of Conservation of Momentum	Total momentum of a system is conserved if there is no external force acting on the system.

➤ **Chapter 3: Gravitation**

Basic terms		
1	Centripetal force	A force that acts on a body in a direction towards the centre of the circle.
2	Geostationary/geosynchronous satellite	A satellite in geosynchronous orbit, with an orbital period the same as the Earth's rotation period.
3	Radius of orbit (of a planet)	The average value of the distance between a planet (moving body) and the Sun (focus).
4	Escape velocity	The minimum velocity needed by an object on the surface of a planet to overcome the gravitational force and escape to outer space.

Principles		
1	Newton's Universal Law of Gravitation	The gravitational force between two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between centres of the two bodies.
2	Kepler's First Law (Law of Orbits)	All planets move in elliptical orbits with the Sun at one focus.
3	Kepler's Second Law (Law of Areas)	A line that connects a planet to the Sun sweeps out equal areas in equal intervals of time.
4	Kepler's Third Law (Law of Periods)	The square of the orbital period of any planet is directly proportional to the radius of the orbit.

➤ Chapter 4: Heat

Basic terms		
1	Thermal equilibrium	Both objects in thermal contact are in thermal equilibrium when the net heat transfer between them is zero.
2	Heat capacity	The quantity of heat needed to raise the temperature of the object by 1°C.
3	Specific heat capacity	The quantity of heat needed to raise the temperature of 1 kg mass of a substance by 1°C.
4	Latent heat	Heat that is absorbed during melting and boiling without change in temperature.
5	Specific latent heat	Quantity of heat that is absorbed or released during a change of phase of 1 kg of a substance without any change in its temperature.
	(a) Specific latent heat of fusion, l_f	The quantity of heat that is absorbed during melting or the quantity of heat released during freezing of 1 kg of the substance without any change in temperature.
	(b) Specific latent heat of vaporization, l_v	The quantity of heat that is absorbed during boiling or the quantity of heat released during condensation of 1 kg of the substance without any change in temperature.

Principles		
1	Boyle's Law	Pressure is inversely proportional to volume for a fixed mass of gas at constant temperature.
2	Charles' Law	Volume is directly proportional to absolute temperature for a fixed mass of gas at constant pressure.
3	Gay-Lussac's Law (Pressure Law)	Pressure is directly proportional to absolute temperature of a fixed mass of gas at constant volume.
4	Avogadro's law*	At a constant temperature and pressure, the volume occupied by an ideal gas is directly proportional to the number of molecules of the gas present in the container.

➤ Chapter 5: Waves

Basic terms		
1	Progressive wave	A wave where the profile of the wave propagates with time.

2	Stationary wave	A wave where the profile of the wave does not propagate with time.
3	Mechanical wave	Wave that requires a medium to transfer energy from one point to another.
4	Electromagnetic wave	Wave that does not require a medium to transfer energy.
5	Transverse wave	Particles of the medium vibrate in the direction perpendicular to the direction of propagation of the wave.
6	Longitudinal wave	Particles of the medium vibrate in the direction parallel to the direction of propagation of the wave.
7	Compressions	Compressed regions in a wave profile.
8	Rarefactions	Stretched regions in a wave profile.
9	Amplitude	Maximum displacement of a particle from its equilibrium position.
10	Period	The time taken by a particle to make one complete oscillation or by a source to produce one complete cycle of wave.
11	Frequency	Number of complete oscillations made by a particle or number of cycles of wave produced by a source in one second.
12	Wavelength	Distance between two consecutive points in phase.
13	Wave speed	Distance travelled per second by a wave profile.
14	Equilibrium position	The original position of the particle before a system oscillates.
15	Displacement	Distance of a particle from the equilibrium position.
16	Periodic force	A force which acts at specific time intervals and not continuously.
17	Damping	<p>The reduction in amplitude in an oscillating system due to loss of energy.</p> <p>External damping - Oscillating system loses energy to overcome friction or air resistance.</p> <p>Internal damping - Oscillating system loses energy because of the stretching and compression of the vibrating particles in the system</p>
18	Forced oscillation	Periodic external force is applied on an oscillating system to replace energy lost due to damping.
19	Resonance	The phenomenon whereby a periodic force is applied to an oscillating system at its natural frequency.
20	Wavefront	The line that joins the points in phase in a wave.
21	Coherent sources	Two sources of waves coherent when the frequency of both waves is the same and the phase difference is constant.

22	Continuous (electromagnetic) spectrum	No specific boundary separates two adjacent types of waves.
23	Monochromatic light*	Light with a single constant frequency.
24	Natural frequency*	The frequency of a system that oscillates freely without external force.
25	(a) Constructive interference	Two crests or two troughs are in superposition that produces maximum combined displacement.
	(b) Destructive interference	A crest and a trough are in superposition to produce zero combined displacement.
26	Electromagnetic waves	A spectrum of waves that are made up of an electric field and a magnetic field that oscillates perpendicularly to one another.

Principles		
1	Refraction of waves	The change in direction of propagation of waves caused by the change in velocity of waves when the waves propagate from one medium to another.
2	Diffraction of waves	The spreading of waves when the waves propagate through a slit or side of a barrier.
3	Principle of superposition	When two waves overlap, the resultant displacement is the sum of the individual displacements of the two waves.
4	Interference of waves	The superposition of two or more waves from a coherent source of waves.

➤ **Chapter 6: Light and Optics**

Basic terms		
1	Refractive index	The ratio of speed of light in vacuum to the speed of light in medium.
2	Critical angle	The angle of incidence in the medium of high optical density when the angle of refraction in the medium of lower optical density is 90° .
3	Mirage*	A phenomenon in which light rays bend via refraction to produce a displaced image of distant objects or the sky.
4	Lens	A piece of transparent material which has two surfaces with at least one surface curved.
Optical terms for lens		
1	Optical centre, O	Point at the centre of the lens.
2	Principal axis	Straight line through the optical centre of a lens and centre of curvature of both surfaces of the lens.
3	Axis of lens	Straight line through the optical centre and perpendicular to the principal axis.

4	Object distance, u	Distance between object and optical centre of a lens.
5	Image distance, v	Distance between image and optical centre of a lens.
6	Focal length, f	Distance between focal point and optical centre of a lens.
7	Linear magnification, m	The ratio of image height to object height.
8	Power of lens / Optical power*	The reciprocal of focal length. / The degree to which a lens, mirror or other optical system converges or diverges light.

Optical terms for spherical mirrors		
1	Principal axis	Straight line passing through the centre of curvature and pole of the spherical mirror.
2	Centre of curvature, C	Centre of sphere which produces a concave or convex mirror.
3	Radius of curvature of mirror, r	Distance between the pole of spherical mirror and the centre of curvature.
4	Object distance, u	Distance between object and optical centre of a mirror.
5	Image distance, v	Distance between image and optical centre of a mirror.
6	Focal length, f	Distance between focal point and optical centre of a mirror.

Physics Form 5

➤ Chapter 1: Force and Motion II

Basic terms		
1	Resultant force	The single force that represents the vector sum of two or more forces acting on an object.
2	Free body diagram (of an object)	A diagram that shows all the forces acting (on that object) only.
3	Resolution of forces	The process of resolving a force into two components.
4	Forces in equilibrium	The state in which the forces acting on an object produce a zero resultant force.
5	Elasticity	The property of material that enables an object to return to its original shape and size after force applied on it is removed.
6	Spring constant/Force constant, k	The ratio of the force applied to the extension or compression of a spring.
7	Elastic limit	The maximum stress that can be developed within a material without causing permanent deformation.
8	Friction, R	The force resisting the relative motion of solid surfaces, fluid layers and material elements sliding against each other.

Basic terms		
1	Hooke's law	The extension of a spring is directly proportional to the force applied on the spring provided the elastic limit of the spring is not exceeded.

➤ Chapter 2: Force and Motion I

Basic terms		
1	Density, ρ	Mass per unit volume.
2	Liquid pressure*	The pressure caused by the weight of the liquid.
3	Atmospheric pressure, P_{atm}	The pressure due to the weight of the layer of air acting on the surface of the earth.
4	Buoyant force, F_B	The force acting upwards on an object immersed in a fluid when there is pressure difference between the lower surface and upper surface of the object.
5	Streamline*	A line along which the flow of a moving fluid is least turbulent.
6	Angle of attack*	The angle between a reference line on a body and the vector representing the relative motion between the body and the fluid through which it is moving.

Basic terms		
1	Pascal's principle	The pressure applied on an enclosed fluid is transmitted uniformly in all direction in the fluid.
2	Archimedes' principle	An object which is partially or fully immersed in a fluid will experience a buoyant force equal to the weight of fluid displaced.
3	Bernoulli's principle	When the velocity of a fluid increases, the pressure in the fluid decreases and vice versa.

➤ Chapter 3: Electricity

Basic terms		
1	Electric field	The region around a charged particle where any electric charge in the region will experience an electric force.
2	Electric field strength, E	The electric force acting on a unit positive charge placed at the point.
3	Electric current, I	The rate of flow of charge in a conductor
4	Potential difference/voltage, V	The work done in moving one coulomb of charge from one point to another
5	Ohmic conductor	A conductor which obeys Ohm's Law.
6	Resistivity (of a conductor), ρ	A measure of a conductor's ability to oppose the flow of electric current.

7	Non-conductor	A material that does not conduct electricity / good insulator.
8	Semiconductor	A material that conducts electricity better than an insulator but not as good as a conductor.
9	Conductor	A material that conducts electricity.
10	Superconductor	A material that conducts electricity without any resistance.
11	Critical temperature, T_c	The temperature when the resistivity of a superconductor becomes zero.
12	Electromotive force (e.m.f), \mathcal{E}	The energy transferred by an electrical source move one coulomb of charge in a complete circuit.
13	Voltage drop*	The decrease in electrical potential along the path of a current flowing in an electrical circuit.
14	Internal resistance, r	The resistance caused by electrolyte in the dry cell.
15	Electrical power, P^*	The rate at which electrical energy is transferred by an electric circuit.
16	Resistance, R^*	A measure of the opposition to current flow in an electric circuit / The ratio between potential difference and electric current.
17	6V, 12W	12 J of energy is produced in 1 second when being operated at 6 V.

Basic terms		
1	Ohm's law*	The current through a conductor between two points is directly proportional to the voltage across the two points.

➤ **Chapter 4: Electromagnetism**

Basic terms		
1	Catapult field	A resultant magnetic field produced by the interaction between the magnetic field from a current-carrying conductor and the magnetic field from a permanent field.
2	Direct current*	Unidirectional flow of electric charge.
3	Electromagnetic induction	The production of an induced e.m.f. in a conductor where there is relative motion between the conductor and a magnetic field or when the conductor is in a changing magnetic field.
4	Induced current*	The current generated in a wire due to a changing magnetic field.
5	Magnetic flux (through a surface)	Magnetic field lines that pass through a surface. / The surface integral of the normal component of the magnetic field over that surface

6	Ideal transformer	A transformer that does not experience any loss of energy, that is the efficiency is 100%.
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Basic terms		
1	Faraday's law	The magnitude of induced e.m.f. is directly proportional to the rate of cutting of magnetic flux.
2	Lenz's law	The induced current always flows in a direction that opposes the change of magnetic flux that causes it.

➤ Chapter 5: Electronics

Basic terms		
1	Thermionic emission	The emission of free electrons from a heated metal surface.
2	Cathode rays	Beams of electrons moving at high speed in a vacuum.
3	Semiconductor diode	An electronic component which allows electric current to flow in one direction only.
4	Rectification	The process of converting an alternating current into a direct current.
5	(a) Full-wave rectification	A process where both halves of every cycle of alternating current is made to flow in the same direction.
	(b) Half-wave rectification	A process where one half of every cycle of alternating current is made to flow in the same direction.
6	Transistor*	A semiconductor device used to amplify or switch electrical signals and power.
7	Doping	A process of adding a small amount of impurities into the semiconductor to increase the electrical conductivity.

➤ Chapter 6: Nuclear Physics

Basic terms		
1	Radioactive decay/Radioactivity	A process in which a unstable nucleus becomes more stable by emitting radioactive radiation.
2	Alpha particle (α)	A helium nucleus which consists of two protons and two neutrons.
3	Beta particle (β)	A fast-moving electron.
4	Gamma decay	High-frequency electromagnetic wave.
5	Half-life, $T_{1/2}$	The time taken for a sample of radioactive nuclei to decay to half of its initial number.
6	Isotope*	Atom of the same element that have the same number of protons but different number of neutrons.

7	Nuclide	A class of atoms characterized by their number of protons, number of neutrons and their nuclear energy state.
8	Radioisotope	Isotope with unstable nuclei that can emit radioactive radiation.
9	Nuclear energy	Atomic energy, released during nuclear reactions such as radioactive decay, nuclear fission and nuclear fusion.
10	Nuclear fission	A nuclear reaction when a heavy nucleus splits into two or more lighter nuclei while releasing a large amount of energy.
11	Nuclear fusion	A nuclear reaction in which small and light nuclei fuse to form a heavier.
12	Mass defect, m	Loss of mass due to radioactive decay.
13	Chain reaction*	A process in which neutrons released in fission produce an additional fission in at least one further nucleus.
14	Nucleon number*	The total number of protons and neutrons in an atom.

➤ **Chapter 7: Quantum Physics**

Basic terms		
1	Black body	An idealised body that is able to absorb all electromagnetic radiation that falls on it.
2	Thermal radiation	Electromagnetic radiation that includes visible light and radiation that cannot be seen by the human eye such as infrared radiation.
3	Quantum of energy	Discrete energy packet.
4	Photoelectric effect*	Emission of electrons when electromagnetic radiation (such as light) hits a material.
5	Threshold frequency, f_0	The minimum frequency (for a light photon) required to produce photoelectric effect on a metal.
6	Work function	The minimum energy required from a photoelectron to be emitted from a metal surface.
7	Radiation*	The emission or transmission of energy in the form of waves or particles through space or through a material medium.
8	Photon*	Light energy exists in the form of an energy packet.

Principles		
1	Einstein's Photoelectric Theory	If a photon's frequency is sufficient to knock off an electron, the collision will produce the photoelectric effect.
2	de Broglie's hypothesis of matter waves	All particles can exhibit wave properties.

