DEFINITION, TERMS & LAWS PHYSICS F4F5

FORM 4

Chap	Terms/Laws	Definition/Statement
1.1	Physical quantity	A quantity that can be measured
	Base quantity	A physical quantity that cannot be derived from another physical quantity
	Derived quantity	A quantity which can be obtained by combination of base quantities by mean of multiplication, division or both
	Scalar quantity	Physical quantities that have magnitude only
	Vector quantity	Physical quantities that have both magnitude and direction
2.1	Linear motion	Motion in a straight line
	Speed, v	Rate of change of distance
	Velocity, v	Rate of change of displacement
	Acceleration, a	Rate of change of velocity
2.3	Free fall motion	A situation where an object falls down due to gravitational force only
2.4	Inertia	Tendency of an object to remain at rest or to continue its uniform motion in a straight line at uniform velocity
	Newton's first law of motion	An object will remain at rest or move at uniform velocity unless acted upon by an external foce
2.5	Momentum, p	A product of mass multiplies by velocity
2.6	Force, F	The action of pushing or pulling to change the size and direction of motion of an object
	Newton's second law of motion	Rate of change of momentum is directly proportional to the force and acts in the direction of the applied force
2.7	Impulse, J	Change of momentum
	Impulsive Force, F	Rate of change of momentum in a collison or impact in a short period of time
	Newton's third law of motion	For every action there is a reaction of equal magnitude but in the opposite direction
2.8	Weight, W	A gravitational force acting on an object
3.1	Newton's universal law of gravitation	The gravitational foce between two bodies is directly proportional to the product of the masses of both bodies and inversely proportional to the square of the distance between the centres of the two bodies
	Centripetal force	A force acts on the body in a direction towards the centre of the circle
3.2	Kepler's first law	All planets move in elliptical orbits with the Sun at one focus (Law of Orbits)
	Kepler's second law	A line that connects a planet to the Sun sweeps out the equal areas in equal times (Law of Areas)
	Kepler's third law	The square of the orbital period of any planet is directly proportional to the cube of the radius of its orbit (Law of Periods)
	Orbital radius	Average value of the distance between the planet and the Sun
3.3	Escape velocity, v	Minimum velocity needed by an object on the surface of the Earth to overcome the gravitational force and escape to outer space
4.1	Temperature, T	Measure of the degree of hotness of an object
	Heat, Q	The amount of thermal energy that can be transferred from one object to another
	Thermal equilibrium	A condition where net heat transfer between two objects becomes zero
4.2	Heat capacity, C	Quantity of heat needed to raise temperature of the object by 1°C

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	Specific heat capacity, c	Quantity of heat needed to raise the temperature of 1kg mass of the substance by 1°C
4.3	Latent heat	Heat that is absorbed during melting and boiling without change in temperature
	Specific latent heat, l	The quantity of heat that is absorbed or released during a change of phase of 1kg of the substance without any change in its temperature
	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 1kg of the substance without any change in temperature (solid-liquid | liquid-solid)
	Specific latent heat of vaporisation, l_v	The quantity of heat that is absorbed during boiling or the quantity of heat released during condensation of 1kg of the substance without any change in temperature (liquid-gas | gas-liquid)
4.4	Boyle's law	Pressure is inversely proportional to volume for a fixed mass of gas at constant temperature
	Charles' law	Volume is directly proportional to absolute temperature for a fixed mass of gas at constant pressure
	Gay-Lussac's law	Pressure is directly proportional to absolute temperature of a fixed mass of gas at constant volume
5.1	Oscillation, vibration	Repetitive motions about an equilibrium position in a closed path
	Amplitude, A	Maximum displacement from its equilibrium position
	Transverse wave	A wave which the vibration of particles in the medium is perpendicular to the direction of propagation of the wave
	Longitudinal wave	A wave which the vibration of particles in the medium is parallel to the direction of the wave
	Period, T	The time taken by a particle to make one complete oscillation or by a source to produce one complete cycle of wave
	Frequency, f	Number of complete oscillations made by a particle or number of cycles of wave produced by a source in one second
	Wavelength, λ	Distance between two consecutive points in phase
	Wave speed, v	Distance travelled per second by a wave profile
5.2	External damping	Oscillating system loses energy to overcome friction or air resistance
	Internal damping	Oscillating system loses energy because of the stretching and compression of the vibrating particles in the system
	Damping	Reduction in amplitude in an oscillating system due to loss of energy
	Resonance	When a periodic force is applied to an oscillating system at its natural frequency
5.3	Wavefront	Lines joining all the points of the same phase
5.4	Refraction of waves	The change in direction of propagation of waves caused by the change in the velocity of waves when the waves propagate from one medium to another
5.5	Diffraction of waves	The spreading of waves when the waves pass through a gap or round a barrier
5.6	Interference of waves	The superposition of two or more waves from a coherent source of waves
	Constructive Interference	Occurs when two crests or troughs are in superposition to produce maximum amplitude
	Destructive Interference	Occurs when a crest and a trough are in superposition to produce zero combined amplitude

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5.7	Electromagnetic spectrum	Seven types of electromagnetic waves that forms a continuos spectrum
	Electromagnetic wave	Produced when electric and magnetic field vibrate at right angle to each other
6.1	Refraction of light	A phenomenon when light changes direction when it travels from one medium to another medium of different densities
	Refractive index, n	The ratio od speed of light in vacuum to the speed of light in medium
	Snell's Law	When light travels from one mediu to another medium, the incident ray, the refracted ray and the normal meet at one point and are in the same plane
6.2	Total internal reflection	When light travels from a medium with high optical density to a medium of low optical density
	Critical angle, c	Incident anglewhen refracted angle equal to 90°
	Formation of rainbow	Caused by refraction, dispersion and total internal reflection when light passes through water droplets in air
6.3	Optical centre, O	Points at the centre of the lens
	Principle axis	Straight line through the optical centre of a lens and the centre of curvature of both surfaces of the lens
	Axis of lens	Straight line through the optical centre and perpendicular to the principal axis
	Focal point, F	Point located at the principle axis of a lens
	Object ditance, u	Distance between object and optical centre of a lens
	Image distance, v	Distance between image and optical centre of a lens
	Focal length, f	Distance between focal point, F and optical centre, O of a lens
	Linear magnification, m	Ratio of image height to object height = ratio of image distance to object distance
6.6	Principal axis	Straight line passing through the centre of curvature, C and pole of the spherical mirror, P
	Centre or curvature, C	Centre of sphere which produces a concave or convex mirror
	Radius of curvature of mirror, r	Distance between the pole of spherical mirror,P and the centre of curvature, C
	Focal point, F	A point on the principal axis of the spherical mirror
	Object distance, u	Distance between object and the pole of spherical mirror, P
	Image distance, v	Distance between image and the pole of spherical mirror, P
	Focal length, f	Distance between focal point, F and the pole of spherical mirror, P

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FORM 5

Chap	Terms/Laws	Definiton/Statement
1.1	Resultant force	The single force the represents the vector sum of two or more forces acting on an object
1.2	Resolution of forces	Process of resolving a force into two components
1.3	Equilibrium of forces	Forces acting on an object produce a zero resulting force
1.4	Elasticity	The property of material that enables an object to return to its original shape and size after the force applied on it is removed
	Hooke's law	Extension of a spring is directly proportional to the force applied on the spring provided the elastic limit of the spring is not exceeded
2.1	Pressure	Force per unit area
2.2	Atmospheric pressure	Pressure due to the weight of the layer of air acting on the surface of the earth
2.3	Gas pressure	The force per unit area exerted by the gas molecules as they collide with the wall of the container
2.4	Pascal's Principle	Pressure applied on an enclosed fluid is transmitted uniformly in all direction in the fluid
	Hydraulic system	A system that uses a liquid to transmit pressure
2.5	Buoyang force	Force acting upwards on an object immersed in a liquid when there is pressure difference between the lower surface and upper surface of the object
	Archimedes' principle	An object which partially or fully immersed in afluid will experience a buoyang force equal to the weight of fluid displace
2.6	Bernoulli's principle	When the velocity of a fluid increases, the pressure in the fluid decreases and vice versa
3.1	Electric field	Region around a charged particle where any electric charge in the region will experience an electric force
	Electric field strength, E	Electric force acting on aunit positive charge placed at a point
	Current, I	Rate of flow of charge, Q in a conductor
	Potential difference, V	The work done, W in moving one coulomb of charge, Q from one point to another
3.2	Ohm's law	The electric current, I flowing through a conductor is directly proprortional to the potential difference across it if the temperature and other physical conditions are constant
	Ohmic conductors	Conductors that obey Ohm's law
	Resistance, R	Ratio of the potential difference across the conductor to the electric current flowing through it
	Resistivity of a conductor, p	A measure of a conductor's ability to oppose the flow of electric current
	Superconductors	Materials that conduct electricity without any resistance
	Critical temperature, T	The temperature when the resistivity of a superconductor becomes zero
3.3	Electromotive force	The energy transferred or work done by an electrical source to move one coulomb of charge in a complete circuit
	Internal resistance, r	The resistance caused by electrolyte in the dry cell
3.4	Electrical energy	The ability of the electric current to do work
	Electric power	The rate of electrical energy dissipated or transferred

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4.1	Catapult field	Resultant magnetic field produced by the interaction between the magnetic field from a current-carrying conductor and the magnetic field from a permanent magnet
	Magnetic field	A region in the surrounding of a magnet which a magnetic material experiences a detectable force
4.2	Electromagnetic induction	Production of an induced e.m.f. in a conductor when there is relative motion between the conductor and a magnetic field or when the conductor is in a changing magnetic field
	Induced current	The current produced when there is the change in magnetic flux
	Lenz's law	The induced current always flow in a direction that opposes the change of magnetic flux that causes it
	Faraday's law	The magnitude of indeuced e.m.f. is directly proportional to the rate of cutting of magnetic flux
4.3	Transformer	An electrical device which increases or decreases an alternating voltage based on the principle of electromagnetic induction
	Step-up transformer	Trasformer that is used to increase the voltage
	Step-down transformer	Transformer that is used to decrease the voltage
	Ideal transformer	Transformer that does not experience any loss of energy, that is the efficiency, n is 100%
5.1	Thermionic emission	The emission of free electrons from a heated metal surface
	Cathode rays	Beams of electrons moving at high speed ina vacuum
5.2	Semiconductor diode	Electric component which allows electric current to flow in one direction only
	Rectification	The process of converting an alternating current into a direct current
	Full-wave rectification	Process where both halves of every cycle of an alternating current is made to flow in the same direction
5.3	Transistor	An electronic component that has three terminals, namely emitter, E, base, B and collector, C
6.1	Radioactive decay	Process in which an unstable nucleus becomes more stable by emitting radioactive readiation
	Alpha particle, α	Helium nucleus which consist of two protons and two neutrons
	Beta particle, β	A fast-moving electron (negative)
	Gamma rays, γ	High-frequency electromagnetic wave (neutral)
	Half-life	The time taken for a sample of radioactive nuclei to decay to half of its initial number
6.2	Nuclear energy	Atomic energy, released during nuclear reactions such as radioactive decay, nuclear fission and nuclear fusion
	Nuclear fission	Nuclear reaction when a heavy nucleus splits into two or more lighter nuclei while releasing a large amount of energy
	Nuclear fusion	Nuclear reaction in which small and light nuclei fuse to form a heaview nucleus while releasing a large amount of energy. This nuclear reaction happens under extremely high temperature and pressure
	Chain reaction	A self-sustaining reaction in which the products of a reaction can initiate another similar reaction
7.1	Black body	An idealised body that is able to absorb all electromagnetic radiation that falls on it
	Thermal radiation	Electromagnetic radiation that includes visible light and radiation that cannot be seen by the human eye such as infrared radiation
	Quantum of energy	Discrete energy packet and not a continuous energy

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7.2	Photoelectric effect	When a metal surface is illuminated by a beam of light at a certain frequency, electrons can be emitted from the metal
7.3	Work function	The minimum energy required for a photoelectron to be emitted from a metal surface
	Treshold frequency	The minimum frequency for a light photon to produce photoelectric effect

FORM 4 FORMULAE

Chap	Terms/Laws	Formula
2.1	Speed, v	$v = \frac{d}{t}$
	Velocity, v	$v = \frac{s}{t}$
	Acceleration, a	$a = \frac{v-u}{t}$
	Linear motion without displacement	$v = u + at$
	Linear motion without acceleration	$s = \frac{1}{2}(u+v)t$
	Linear motion without final velocity	$s = ut + \frac{1}{2}at^2$
	Linear motion without time	$v^2 = u^2 + 2as$
2.3	Free fall motion without displacement	$v = u + gt$
	Free fall motion without acceleration	$s = ut + \frac{1}{2}gt^2$
	Free fall motion without time	$v^2 = u^2 + 2gs$
2.5	Momentum	$p = mv$
	Principle of Conservation of Momentum	$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
	Explosion	$m_1v_1 = -m_2v_2$
2.6	Force	$F = ma$

Chap	Terms/Laws	Formula
3.1	Newton's Universal Law of Gravitation	$F = \frac{Gm_1m_2}{r^2}$
	Gravitational acceleration	$g = \frac{GM}{(R+h)^2}$
	Gravitational acceleration on the surface of Earth	$g = \frac{GM}{R^2}$
	Centripetal force	$F = \frac{mv^2}{r}$
	Centripetal acceleration	$a = \frac{v^2}{r}$
3.2	Kepler's III Law	$T^2 = \left(\frac{4\pi^2}{GM}\right)r^3$
	Solving problem of Kepler's Law III	$\frac{{T_1}^2}{{T_2}^2} = \frac{{r_1}^3}{{r_2}^3}$
3.3	Linear speed of satellite	$v = \sqrt{\frac{GM}{r}}$
	Linear speed of satellite on the surface of Earth	$v = \sqrt{\frac{GM}{R+H}}$
	Escape velocity	$v = \sqrt{\frac{2GM}{r}}$
4.1	Temperature	$\theta = \frac{L_\theta}{L_{100}} \times 100°C$
4.2	Heat capacity	$C = \frac{Q}{\Delta\theta}$
	Specific heat capacity	$c = \frac{Q}{m\Delta\theta}$
		$c = \frac{Pt}{m(\theta_2 - \theta_1)}$

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	Newton's II Law of Motion	$F = \frac{mv - mu}{t}$
2.7	Impulse	$J = Ft$
	Impulsive force	$F = \frac{mv - mu}{t}$
2.8	Weight	$W = mg$
4.4	Boyle's Law	$P_1V_1 = P_2V_2$
	Charles Law	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
	Gay-Lussac LAw	$\frac{P_1}{T_1} = \frac{P_2}{T_2}$
5.1	Wave frequency	$f = \frac{1}{T}$
	Wave speed	$v = f\lambda$
5.3	Solving the problem of wave refraction	$\frac{v_1}{\lambda_1} = \frac{v_2}{\lambda_2}$
5.6	Wavelength	$\lambda = \frac{ax}{D}$

4.3	Specific latent heat	$l = \frac{Q}{m}$
	Specific latent heat	$l = \frac{Pt}{(m_1 - m_2)}$
	Specific latent heat	$Pt = ml$
	Heat quantity	$mc\Delta\theta + ml$
6.1	Refractive index	$n = \frac{\sin i}{\sin r}$
	Refractive index in transparent	$n = \frac{H}{h}$
	Snell's Law	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
6.2	Critical angle	$\sin c = \frac{1}{n}$
6.3	Linear magnification	$m = \frac{h_i}{h_o}$
		$m = \frac{v}{u}$
6.4	Thin lens formula	$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

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FORMULA FORM 5

Chap	Term/Law	Formula
1.2	Horizontal component	$F_x = F\ kos\ \theta$
	Vertical component	$F_y = F\ sin\ \theta$
1.3	Sine rule	$\frac{X}{\sin x} = \frac{Y}{\sin y}$
1.4	Hooke's Law	$F = kx$
	Elastic potential energy	$E_p = \frac{1}{2}Fx$
	Elastic potential energy with a constant	$E_p = \frac{1}{2}kx^2$
	Density	$\rho = \frac{m}{V}$
2.1	Pressure	$P = \frac{F}{A}$
	Liquid pressure	$P = h\rho g$
2.2	Atmospheric pressure	$P = h\rho g$
2.3	Gas pressure	$P = h\rho g$
2.4	Pascal principle	$\frac{F_2}{A_2} = \frac{F_1}{A_1}$
2.5	Buoyant force	$F_B = \rho V g$
3.1	Electric field strength	$E = \frac{F}{q}$
	Electric field strength of two parallel charged paltes	$E = \frac{V}{d}$
	Electric current	$I = \frac{Q}{t}$
	Potetial difference	$V = \frac{W}{Q}$
		$V = \frac{E}{Q}$

Chap	Term/Law	Formula
3.2	Ohm Law	$V = IR$
	Effective resistance of parallel circuit	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \ldots$
	Resistivity of conductor	$\rho = \frac{RA}{l}$
3.3	Electromotive force	$\varepsilon = \frac{E}{Q}$
		$\varepsilon = V + Ir$
3.4	Electrical energy	$E = VIt$
	Electrical power	$P = \frac{E}{t}$
	Electrical power	$P = VI$
4.3	Simple Transformer	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$
	Efficiency of a transformer	$\eta = \frac{V_S I_S}{V_P I_P} \times 100\%$
5.1	Electric potential energy	$E = eV$
	Principle of conservation of energy	$eV = \frac{1}{2}mv^2$
5.3	Amplifier	$\beta = \frac{I_C}{I_B}$
	Output voltage	$V_{out} = \frac{R_2}{R_1 + R_2}V_{in}$
6.1	Alpha decay	${}^4_2He$
	Beta decay	${}^0_{-1}e$
	Number of radioactive nuclei that has not decayed	$N = \left(\frac{1}{2}\right)^n N_0$
6.2	Total energy released	$E = mc^2$

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7.1	Photon energy	$E = hf$
	Photon energy	$E = \frac{hc}{\lambda}$
	Wavelength	$\lambda = \frac{h}{mv}$
	Photon power	$P = nhf = \frac{nhc}{\lambda}$

7.2	Gradient of graph	$m = \frac{hc}{e}$
7.3	Einstein's photoelectric equation	$\frac{1}{2}mv^2 = hf - W$
		$\frac{1}{2}mv^2 = h(f - f_0)$
	Work function	$W = hf_0$

CONSTANT VALUE IN PHYSICS

Term	Value
Timeinterval between 2 consecutive dots, t	0.02 s
Gravitational acceleration, g	9.81 ms^{-2} / 9.81 N kg^{-1}
Gravitational constant, G	6.67×10^{-11} N m^2 kg^{-2}
Mass of Earth, M	5.97×10^{24} kg
Radius of Earth, R	6.37×10^{6} m
Specific heat capacity of water, c	4200 J kg^{-1} °C^{-1}

Term	Value
Speed of light in vacuum, c	3.0×10^{8} m s^{-1}
Atmospheric pressure, P_{atm}	76 cm Hg
Carge of an electron, e	1.6×10^{-19} C
Mass of electron, m	9.11×10^{-31} kg
1 unit jisim atom (u.j.a), m	1.66×10^{-27} kg
Planck's constant, h	6.63×10^{-34} J s