Formula List

MECHANICS

Formula	Sample question	Standard solution
$a = \frac{v - u}{t}$ a : constant acceleration v : final velocity u : initial velocity t : time taken	An object has an initial velocity of 10 m s^{-1}. It accelerates constantly for 3 seconds until it reaches a final velocity of 16 m s^{-1}. What is the acceleration of the object?	$a = \frac{v - u}{t}$ $= \frac{16 - 10}{3}$ $= 2$ m s^{-2}
$s = \frac{d}{t}$ s : average speed d : total distance travelled t : time taken	An object travels 12 m in 4 s and then travels 12 m in 2 s. What is the average speed of the object for the total distance travelled?	$s = \frac{d}{t}$ $= \frac{12 + 12}{4 + 2}$ $= 4$ m s^{-1}
$F = ma$ F : resultant force m : mass a : constant acceleration	A 2 kg object experiences a 10 N force from the right and a 6 N force from the left. What will be the acceleration of the object?	$F = 10 - 6 = 4$ N $F = ma$ $4 = (2)(a)$ $a = 2$ m s^{-2}
$W = mg$ W: weight of object m : mass of object g : gravitational field strength	The gravitational field strength on Earth and on the Moon are 10 N/kg and 1.7 N/kg respectively. What is the weight of a 2 kg mass on the Moon?	$W = mg$ $= (2)(1.7)$ $= 3.4$ N
$\rho = \frac{m}{v}$ ρ : density m : mass V : volume	A substance has a mass of 500 kg and occupies 0.5 m^3 of space. What is the density of the substance?	$\rho = \frac{m}{v}$ $= 500 \div 0.5$ $= 1000$ kg m^{-3}
$M = F \times d$ M: moment F : force d : perpendicular distance	What is the maximum and minimum moment which a 10 N force can produce from a 0.5 m spanner?	$M = F \times d$ Maximum $M = (10) \times (0.5)$ $= 5$ N m Minimum M $= (10) \times (0)$ $= 0$ N m
$P = \frac{F}{A}$ P : pressure F : force A : surface area	A cube of side 2 m rests on the floor. Given that the weight of the cube is 80 000 N, calculate the pressure which the cube exerts on the floor.	$P = F \div A$ $= \frac{80\,000}{2 \times 2}$ $= 20\,000$ N m^{-2}

Formula	Sample question	Standard solution
$P = \rho gh$ P : pressure ρ : density g : gravitational field strength h : liquid height	A diver is 50 m below the sea level. What is the water pressure acting on him given that the water density is 1000 kg m^{-3} and the gravitational field strength is 10 N kg^{-1}?	$P = \rho gh$ $= (1000)(10)(50)$ $= 500\,000$ Pa
$P_1V_1 = P_2V_2$ P_1 = pressure at situation 1 V_1 = volume at situation 1 P_2 = pressure at situation 2 V_2 = volume at situation 2	An air bubble 20 m below the water level is 2 cm^3 and it experiences 300 000 N m^{-2} of pressure. What is the volume of the air bubble when it rises to 10 m below the water level and experiences 200 000 N m^{-2} of pressure?	$P_1V_1 = P_2V_2$ $(300\,000)(2) = (200\,000)(V_2)$ $V_2 = 3$ cm^3
$W = F \times d$ W: work done F : force d : distance travelled	A 2 kg mass is lifted vertically upwards for 5 m. Calculate the work done to lift the 2 kg mass given that the gravitational field strength on Earth is 10 N kg^{-1}.	$W = F \times d$ $W = (2 \times 10) \times (5)$ $W = 100$ J
$KE = \frac{1}{2} mv^2$ KE : kinetic energy m : mass v : speed	A 2 kg mass accelerates from 2 m s^{-1} to 3 m s^{-1}. What is the increase in the kinetic energy of the object?	$KE = \frac{1}{2} mv^2$ Increase in KE $= \frac{1}{2}(2)(3)^2 - \frac{1}{2}(2)(2)^2$ Increase in KE = 5 J
$PE = mgh$ PE : potential energy m : mass g : gravitational field strength h : vertical height	A 2 kg mass is lifted vertically upwards for 5 m. Given that the gravitational field strength on Earth is 10 N kg^{-1}, calculate the gain in potential energy by the 2 kg mass.	Gain in PE = mgh $= (2)(10)(5)$ $= 100$ J
$E = Pt$ E : energy P : power t : time taken	A 100 W electric heater is switched on for 5 minutes. What is the minimum amount of electrical energy converted to heat?	$E = Pt$ $= (100)(5 \times 60)$ $= 30\,000$ J

THERMAL PHYSICS

Formula	Sample question	Standard solution
$Q = mc\Delta T$ Q: thermal energy m : mass c : specific heat capacity ΔT : change in temperature	80 000 J of energy is required to increase the temperature of 2 kg of water by 10 °C. What is the specific heat capacity of water?	$Q = mc\Delta T$ $80\,000 = (2)(c)(10)$ $c = 4000$ J kg^{-1} $°C^{-1}$
$C = mc$ C : heat capacity m : mass c : specific heat capacity	80 000 J of energy is required to increase the temperature of 2 kg of water by 10 °C. What is the heat capacity of water?	$Q = mc\Delta T$ $Q = C\Delta T$ $80\,000 = C(10)$ $C = 8000$ J $°C^{-1}$

Formula	Sample question	Standard solution
$Q = ml_f$ Q : thermal energy m : mass l_f : specific latent heat of fusion	600 000 J of energy is required to melt 2 kg of ice at 0 °C to water at 0 °C. What is the specific latent heat of fusion of ice?	$Q = ml_f$ $600\,000 = 2\,l_f$ $l_f = 300\,000$ J/kg
$Q = ml_v$ Q : thermal energy m : mass l_f : specific latent heat of vaporisation	4 000 000 J of energy is required to boil 2 kg of water at 100 °C to steam at 100 °C. What is the specific latent heat of vaporisation of water?	$Q = ml_v$ $4\,000\,000 = 2\,l_f$ $l_f = 2\,000\,000$ J/kg

WAVES

Formula	Sample question	Standard solution
$T = \frac{1}{f}$ T : period f : frequency	The frequency of a wave is 10 Hz. What is the time taken for one complete oscillation?	$T = 1 \div f$ $= 1 \div 10$ $= 0.1$ s
$v = f\lambda$ v : speed of wave f : frequency λ : wavelength	A rope wave completes 2 oscillations in 1 second. Given that the distance between two successive crests is 0.5 m, what is the speed of this wave?	$v = f\lambda$ $= (2)(0.5)$ $= 1$ m s^{-1}
$i = r$ i : angle of incidence r : angle of reflection	A reflected ray is created when a light ray strikes a plane mirror at an angle of incidence of 20°. What is the angle between the angle of incidence and angle of reflection?	$i = 20°$ $r = 20°$ $i + r = 40°$
$n_i \sin i = n_r \sin r$ i : angle of incidence r : angle of refraction n_i : refractive index of the medium which light enters n_r : refractive index of the medium which refraction occurs	A light ray travels across an air-water boundary. Given that the angle of refraction is 18°, calculate the angle of incidence. (Note: refractive index of air and water are 1.0 and 1.3 respectively)	$n_i \sin i = n_r \sin r$ $(1.0)(\sin i) = (1.3)(\sin 18)$ $\sin i = 0.40$ $i = 23.6°$
$n = \frac{c}{v}$ n : refractive index of medium c : speed of light in vacuum, 3×10^8 m s^{-1} v : speed of light in medium	A light ray has a speed of 2.0×10^8 m s^{-1} when travelling through a glass block. What is the refractive index of the glass?	$n = c \div v$ $= (3 \times 10^8) \div (2 \times 10^8)$ $= 1.5$

Formula	Sample question	Standard solution
$\sin c = \frac{1}{n}$ c : critical angle n : refractive index of the medium which refraction occurs	What is the critical angle for a glass which has a refractive index of 1.5?	$\sin c = 1 \div n$ $\sin c = 1 \div 1.5$ $c = 41.8°$
$d = \frac{v \times t}{2}$ d : distance between source and reflecting surface v : speed of wave t : time taken to travel $2d$	A man shouted at a cliff and an echo is heard 3 seconds later. Given that the speed of sound in air is 300 m s^{-1}, calculate the distance between the man and the cliff.	$d = (v \times t) \div 2$ $= (300 \times 3) \div 2$ $= 450$ m

ELECTRICITY AND MAGNETISM

Formula	Sample question	Standard solution
$Q = It$ Q : charge I : current t : time taken	A current of 5 A flows through a resistor for 10 seconds. What is the total amount of charge that has flown through the resistor?	$Q = It$ $= (5)(10)$ $= 50$ C
$V = IR$ V : potential difference I : current R : resistance	A current of 5 A flows through a 2 Ω resistor for 10 seconds. What is the potential difference across the resistor?	$V = IR$ $= (5)(2)$ $= 10$ V
Resistance in series : $R_T = R_1 + R_2 + R_3 + \ldots$ R_T : effective resistance R_1 : resistance of 1st resistor R_2 : resistance of 2nd resistor R_3 : resistance of 3rd resistor	Five 3 Ω resistors are connected in series. What is their effective resistance?	$R_T = R_1 + R_2 + R_3 + \ldots$ $= 3 + 3 + 3 + 3 + 3$ $= 15\ \Omega$
Resistance in parallel : $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$ R_T : effective resistance R_1 : resistance of 1st resistor R_2 : resistance of 2nd resistor R_3 : resistance of 3rd resistor	A 12 Ω resistor, a 6 Ω resistor and a 4 Ω resistor are connected in parallel. What is their effective resistance?	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R_T} = \frac{1}{12} + \frac{1}{6} + \frac{1}{4}$ $= \frac{1}{2}$ $R_T = 2\ \Omega$

Formula	Sample question	Standard solution
$P = VI$ P : power V : potential difference I : current	A 5 A current flows out from a 12 V battery. What is the power given out by the battery?	$P = VI$ $= (12)(5)$ $= 60$ W
$E = VIt$ E : energy V : potential difference I : current t : time taken	A current of 5 A flows out from a 12 V battery. Given that the battery is switched on for 1 minute, how much energy has been converted from chemical energy to electrical energy?	$E = VIt$ $= (12)(5)(60)$ $= 3600$ J
$\frac{V_P}{V_S} = \frac{N_P}{N_S}$ V_P : primary voltage V_S : secondary voltage N_P : number of turns at the primary coil N_S : number of turns at the secondary coil	A transformer has 500 turns at the primary coil and 100 turns at the secondary coil. What is the output voltage when a 250 V supply is connected to the transformer?	$\frac{V_P}{V_S} = \frac{N_P}{N_S}$ $\frac{250}{V_S} = \frac{500}{100}$ $V_S = 50$ V
$V_P I_P = V_S I_S$ V_P : primary voltage V_S : secondary voltage I_P : primary current I_S : secondary current	A 250 V mains is connected to a transformer before supplying power to a laptop labelled as '12.5 V, 2.0 A'. What is the amount of current drawn from the mains?	$V_P I_P = V_S I_S$ $(250)(I_P) = (12.5)(2.0)$ $I_P = 0.1$ A