Physics

Formula Sheet

You may keep this Formula Sheet.

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VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

VICTORIA State Government

Motion and related energy transformations

velocity; acceleration	$v = \frac{\Delta s}{\Delta t}; \quad a = \frac{\Delta v}{\Delta t}$
equations for constant acceleration	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $s = vt - \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $s = \frac{1}{2}(u + v)t$
Newton's second law	$\Sigma F = ma$
uniform circular motion	$F_{\text{net}} = \frac{mv^2}{r} \qquad v = \frac{2\pi r}{T}$
Hooke's law	$F = -kx$
elastic potential energy	$E_{\text{s}} = \frac{1}{2}kx^2$
gravitational potential energy	$E_{\text{g}} = mg\Delta h$
kinetic energy	$E_{\text{k}} = \frac{1}{2}mv^2$
Newton's law of universal gravitation	$F_{\text{g}} = G\frac{m_1 m_2}{r^2}$
gravitational field	$g = G\frac{M}{r^2}$
impulse	$F\Delta t = m\Delta v$
momentum	$p = mv$

Einstein's special theory of relativity

Lorentz factor	$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$
time dilation	$t = \gamma t_0$
length contraction	$L = \frac{L_0}{\gamma}$
relativistic rest energy	$E_0 = mc^2$
relativistic total energy	$E_{\text{total}} = E_{\text{k}} + E_0 = \gamma mc^2$
relativistic kinetic energy	$E_{\text{k}} = (\gamma - 1)mc^2$

Fields and application of field concepts

uniform electric field between charged plates	$E = \frac{V}{d}$
energy transformations of charges in an electric field	$\frac{1}{2}mv^2 = qV$
field of a point charge	$E = k\frac{Q}{r^2}$
electric force on a charged particle	$F = qE$
Coulomb's law	$F = k\frac{q_1 q_2}{r^2}$
magnetic force on a moving charge	$F = qvB$
magnetic force on a current-carrying conductor	$F = nIlB$
radius of a charged particle in a uniform magnetic field	$r = \frac{mv}{qB}$

Generation and transmission of electricity

current; power	$I = \frac{V}{R}; \quad P = VI$
resistors in series	$R_T = R_1 + R_2 + \ldots$
resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
ideal transformer action	$\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$
AC voltage and current	$V_{RMS} = \frac{1}{\sqrt{2}}V_{peak} \qquad I_{RMS} = \frac{1}{\sqrt{2}}I_{peak}$
electromagnetic induction	$\varepsilon = -N\frac{\Delta\Phi_B}{\Delta t} \qquad \Phi_B = B_\perp A$
transmission losses	$V_{drop} = I_{line}R_{line} \qquad P_{loss} = I^2_{line}R_{line}$

Waves

wave equation	$v = f\lambda$
constructive interference	path difference $= n\lambda$
destructive interference	path difference $= \left(n + \frac{1}{2}\right)\lambda$
interference pattern spacing	$\Delta x = \frac{\lambda L}{d}$ when $L >> d$

The nature of light and matter

photoelectric effect	$E_{\text{k max}} = hf - \phi$
photon energy	$E = hf = \dfrac{hc}{\lambda}$
photon momentum	$p = \dfrac{h}{\lambda}$
de Broglie wavelength	$\lambda = \dfrac{h}{p}$

Data

acceleration due to gravity at Earth's surface	$g = 9.81 \text{ m s}^{-2}$
mass of the electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$
magnitude of the charge of the electron	$q_e = 1.60 \times 10^{-19} \text{ C}$
Planck's constant	$h = 6.63 \times 10^{-34} \text{ J s}$ $h = 4.14 \times 10^{-15} \text{ eV s}$
speed of light in a vacuum	$c = 3.00 \times 10^{8} \text{ m s}^{-1}$
universal gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
mass of Earth	$M_E = 5.97 \times 10^{24} \text{ kg}$
radius of Earth	$R_E = 6.37 \times 10^{6} \text{ m}$
Coulomb constant	$k = 8.99 \times 10^{9} \text{ N m}^2 \text{ C}^{-2}$

Metric (SI) multipliers

p = pico = 10^{-12}	n = nano = 10^{-9}	μ = micro = 10^{-6}	m = milli = 10^{-3}
k = kilo = 10^{3}	M = mega = 10^{6}	G = giga = 10^{9}	T = tera = 10^{12}

Unit conversions

1 tonne (t) = 10^3 kg
1 kilowatt hour (kW h) = 3.6×10^6 J

Nomenclature

force due to gravity	F_g
terminology for force	$F_{\text{on A by B}}$
normal force	F_N

End of Formula Sheet