Physics Equations Cheatsheet

Y12

Table of contents

1 Mechanics and Materials

Kinematic equations of motion	
Motion	$s = \frac{(u+v)\cdot t}{2}$
	$v = u + a \cdot t$
	$s = u \cdot t + \frac{1}{2} a \cdot t^2$
	$v^2 = u^2 + 2as$
Forces	$\sum F = m \cdot a$
	$g = \frac{F}{m}$
	$W = m \cdot g$
Momentum	$p = m \cdot v$
Moment of force	$= F \cdot x$

Materials	
Density	$\rho = \frac{m}{V}$
Stoke's law	$F = 6\pi \cdot \eta \cdot r \cdot v$
Hooke's law	$\Delta F = k \cdot \Delta x$
Young modulus	stress $\sigma = \frac{F}{A}$
	Strain $\epsilon = \frac{\Delta x}{x}$

Materials	
	$E = \frac{\sigma}{\epsilon}$
Elastic Strain Energy	$\Delta E_d = \frac{1}{2} F \cdot \Delta x$

2 Waves and Electricity

Waves and particle nature of light	
Wave speed	$v = f \cdot \lambda$
Speed of a transverse wave on a string	$v = \sqrt{\frac{T}{\mu}}$
Intensity of radiation	$I = \frac{P}{A}$
Refractive index	$n_1 \cdot sin\theta_1 = n_1 \cdot sin\theta_2$
	$n = \frac{c}{v}$
Critical angle	$sinC = \frac{1}{n}$
Difracction grating	$n \cdot \lambda = d \cdot sin\theta$
De Broglie wavelenght	$\lambda = \frac{h}{p}$
Photon model	$E = h \cdot f$
Einstein's photoelectric equation	$hf = \phi + \frac{1}{2} m \cdot v_{max}^2$

Electricity	
Current	$I = \frac{\Delta Q}{\Delta t}$
Potential difference	$V = \frac{W}{Q}$
Resistance	$R = \frac{V}{I}$
Electrical power, energy and efficiency	$P = V \cdot I$
	$P = I^2 R$
	$P = \frac{V^2}{R}$
	$W = VIt$
Resistivity	$R = \frac{\rho l}{A}$
	$I = nq\nu A$

3 Further Mechanics, Fields and Particles

Further mechanics	
Impulse	$F\Delta t = \Delta p$
Kinetic energy of a non-relativistic particle	$E_k = \frac{p^2}{2m}$
Motion in a circle	$v = \omega r$
	$T = \frac{2*\pi}{\omega}$
	$a = \frac{v^2}{r}$
	$a = r\omega^2$

Electric and magnetic fields	
Electric field	$E = \frac{F}{Q}$
Coulomb's law	$F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2}$
	$E = \frac{Q}{4\pi\epsilon_0 r^2}$
	$E = \frac{V}{d}$
Electric potential	$V = \frac{Q}{4\pi\epsilon_0 r}$
Capacitance	$C = \frac{Q}{V}$
Energy stored in a capacitor	$W = \frac{1}{2}QV$
	$W = \frac{1}{2}CV^2$
	$W = \frac{\frac{1}{2}Q^2}{C}$
Capacitor discharge	$Q = Q_0 e^{\frac{-t}{RC}}$
Resistor-Capacitor discharge	$I = I_0 e^{\frac{-t}{RC}}$
	$V = V_0 e^{\frac{-t}{RC}}$
	$lnQ = lnQ_0 - \frac{-t}{RC}$
	$lnI = lnI_0 - \frac{-t}{RC}$
	$lnV = lnV_0 - \frac{-t}{RC}$
In a magnetic field	$F = BqvSin\theta$
	$F = BIlsin\theta$
Faraday and Lenz's law	$\mathcal{E} = \frac{-d(N\phi)}{dt}$

Nuclear and Particle Physics	
In a magnetic field	$r = \frac{p}{BQ}$
Mass energy	$\Delta E = \Delta m \cdot c^2$

4 Thermodinamycs, Radiation, Oscillations and Cosmology

Thermodinamycs	
Heating	$\Delta E = mc\Delta\theta$
	$\Delta E = L\Delta m$

Thermodinamycs	
Ideal gas equation	$pV = NkT$
Molecular kinetic theory	$\frac{1}{2}m < c^2 >= \frac{3}{2}kT$

Nuclear decay	
Mass-energy	$\Delta E = \Delta m \cdot c^2$
Radioactive decay	$A = \lambda N$
	$\frac{dN}{dt} = -\lambda N$
	$\lambda = \frac{ln2}{t_{\frac{1}{2}}}$
	$N = N_0 e^{-\lambda r}$
	$A = A_0 e^{-\lambda r}$

Oscillations	
Simple harmonic motion	$F = -kx$
	$a = -\omega^2 x$
	$x = A \cdot cos(\omega t)$
	$v = -A\omega \cdot sin(\omega t)$
	$a = -A\omega^2 \cdot cos(\omega t)$
	$T = \frac{1}{f} = \frac{2\pi}{\omega}$
	$\omega = 2\pi f$
Simple harmonic oscillator	$T = 2\pi\sqrt{\frac{m}{k}}$
	$T = 2\pi\sqrt{\frac{l}{g}}$

Astrophysics and cosmology	
Gravitational field strength	$g = \frac{F}{m}$
Gravitational force	$F = \frac{Gm_1m_2}{r^2}$
Gravitational field	$g = \frac{Gm}{r^2}$
Gravitational potential	$V_{grav} = \frac{-Gm}{r}$
Stefan-Boltzmann law	$L = \sigma T^4 A$
Wien's law	$\lambda_{max} T = 2.898 \cdot 10^{-3} m \cdot K$
Intensity of radiation	$I = \frac{L}{4\pi d^2}$
Redshift of electromagnetic radiation	$z = \frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$
Cosmological expansion	$v = H_0 d$

5 Data Sheet

Data sheet	
Acceleration of the free fall	$g = 9.81 \frac{m}{s^2}$
Boltzmann constant	$k = 1.38 \cdot 10^{-23} \frac{J}{K}$
Coulomb's law constant	$k = \frac{1}{4\pi\epsilon_0} = 8.99 \cdot 10^9 \frac{Nm^2}{C^2}$
Electron charge	$e = -1.60 \cdot 10^{-19} C$
Electron mass	$m_e = 9.11 \cdot 10^{-31} kg$
Electronvolt	$1eV = 1.60 \cdot 10^{-19} J$
Gravitational constant	$G = 6.67 \cdot 10^{-11} \frac{Nm^2}{kg^2}$
Gravitational field strength	$g = 9.81 \frac{N}{kg}$
Planck constant	$h = 6.63 \cdot 10^{-34} Js$
Permittivity of free space	$\epsilon_0 = 8.85 \cdot 10^{-12} \frac{F}{m}$
Proton mass	$m_p = 1.67 \cdot 10^{-27} kg$
Speed of light in vacuum	$c = 3.00 \cdot 10^8 \frac{m}{s}$