Physics Formula Sheet

Force and Motion

$v_{avg} = \frac{\Delta d}{\Delta t}$	Average velocity $= \frac{\text{displacement}}{\text{change in time}}$
$a = \frac{v_f - v_i}{\Delta t}$	Acceleration $= \frac{\text{final velocity} - \text{initial velocity}}{\text{change in time}}$
$a = \frac{v_f^2 - v_i^2}{2\Delta d}$	Acceleration $= \frac{(\text{final velocity})^2 - (\text{initial velocity})^2}{2\ (\text{displacement})}$
$\Delta d = v_i \Delta t + \frac{1}{2} a \Delta t^2$	Displacement $=$ (initial velocity)(change in time) $+ \frac{1}{2}$ (acceleration)(change in time)^2
$a_c = \frac{v_t^2}{r}$	Centripetal acceleration $= \frac{(\text{tangential velocity})^2}{\text{radius}}$
$F_{net} = m\,a$	Net force $=$ (mass)(acceleration)
$W = F\,d$	Work $=$ (force)(distance)
$\tau = F\,r$	Torque $=$ (force)(lever arm)
$P = \frac{W}{t}$	Power $= \frac{\text{work}}{\text{time}}$
$a^2 + b^2 = c^2$	Pythagorean theorem

Gravitational, Electrical, and Magnetic Forces

$F_g = G\left(\frac{m_1 m_2}{d^2}\right)$	$\begin{pmatrix}\text{Force of gravitational}\\ \text{attraction between}\\ \text{2 objects}\end{pmatrix} = \begin{pmatrix}\text{Universal}\\ \text{gravitational constant}\end{pmatrix}\left(\frac{(\text{mass of 1st object})(\text{mass of 2nd object})}{(\text{distance between center of objects})^2}\right)$
$F_{electric} = k_c\left(\frac{q_1 q_2}{d^2}\right)$	$\begin{pmatrix}\text{Force between}\\ \text{2 charged}\\ \text{particles}\end{pmatrix} = \begin{pmatrix}\text{Coulomb's}\\ \text{constant}\end{pmatrix}\left(\frac{(\text{charge of 1st particle})(\text{charge of 2nd particle})}{(\text{distance between particles})^2}\right)$
$P = VI$	Electrical power $=$ (voltage)(current)
$I = \frac{V}{R}$	Current $= \frac{\text{voltage}}{\text{resistance}}$
$R = R_1 + R_2 + R_3 + \ldots$	Equivalent resistance for resistors in series
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$	Equivalent resistance for resistors in parallel

Energy and Momentum

$KE = \frac{1}{2}mv^2$	Kinetic energy = $\frac{1}{2}$ (mass)(velocity)^2
$PE_g = mgh$	Gravitational potential energy = (mass) $\begin{pmatrix}\text{acceleration due}\\ \text{to gravity}\end{pmatrix}$ (height)
$PE_{elastic} = \frac{1}{2}kx^2$	Elastic potential energy = $\frac{1}{2}\begin{pmatrix}\text{spring}\\ \text{constant}\end{pmatrix}\begin{pmatrix}\text{distance stretched}\\ \text{or compressed}\end{pmatrix}^2$
$E = Pt$	Energy = (power)(time)
$W = \Delta KE$	Work = change in kinetic energy
$ME = KE + PE$	Mechanical energy = kinetic energy + potential energy
$KE_i + PE_i = KE_f + PE_f$	Law of Conservation of Energy
$p = mv$	Momentum = (mass)(velocity)
$J = F\Delta t = m\Delta v$	Impulse = (force)(change in time) = (mass)(change in velocity)
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$	Law of Conservation of Momentum
$Q = mc_p\Delta T$	Heat gained or lost = (mass)(specific heat)(change in temperature)

Waves and Light

$v = f\lambda$	velocity = (frequency)(wavelength)
$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$	$\frac{1}{Focal\ length} = \frac{1}{distance\ to\ image} + \frac{1}{distance\ to\ object}$
$E = mc^2$	Energy = (mass)(speed of light)^2

Constants and Conversions

c = (speed of light) = 3.00 x 10^8 $\frac{m}{s}$

g = (acceleration due to gravity) = 9.8 $\frac{m}{s^2}$

$G = \begin{pmatrix}\text{universal}\\ \text{gravitation}\\ \text{constant}\end{pmatrix}$ = 6.67 x 10^{-11} $\frac{N\ m^2}{kg^2}$

$k_C = \begin{pmatrix}\text{Coulomb's}\\ \text{constant}\end{pmatrix}$ = 8.99 x 10^9 $\frac{N\ m^2}{C^2}$

m_E = (mass of Earth) = 5.97 x 10^{24} kg

r_E = (radius of Earth) = 6.37 x 10^6 m

Newton (N) = $\frac{kg\ m}{s^2}$

Joule (J) = N m

Watt (W) = $\frac{J}{s} = \frac{N\ m}{s}$

Hertz (Hz) = $\frac{cycle}{s}$