Physics Cheat Sheet

1 Units

SI: m, kg, s
area: m^2, volume: m^3
velocity: m/s, acceleration: m/s^2

Common Conversions

1. $3600\ s = 1\ hour$
2. $5280\ ft = 1\ mile$
3. $1.094\ yards = 1\ meter$
4. $1.609\ km = 1\ mile$
5. $2.54\ cm = 1in$
6. $1\ m/s = 2.237\ mi/hr$
7. $745.7\ Watts = 1\ hp\ (HorsePower)$
8. $1\ mL = 1\ cm^3$

Common Physical Constants

1. $c = 2.998 \times 10^8\ m/s$ (Speed of Light)
2. $g = 9.81\ m/s^2 = 32.2\ ft/s^2$
3. $g_{moon} = 1.62\ m/s^2 \approx \frac{1}{6} g_{earth}$
4. $G = 6.674 \times 10^{-11} Nm^2/kg^2$
5. $R_e = 6380\ km$ (Earth Radius)
6. $R_{earth-moon} = 60R_e$ (Earth-Moon Distance)
7. $R_{earth-sun} = 150\ million\ km$ (Earth-Sun)
8. $\rho_{air} = 1.2041 kg/m^3 = 0.0012041\ g/cm^3$
9. $\rho_{water} = 1\ g/cm^3$

2 Density

$\rho = \frac{m}{V}$
Objects less Dense than Water will rise in Water.
Objects less Dense than Air will rise in Air.

3 Motion: 1D

Speed must be positive, velocity can be positive or negative
$v_{av} = \frac{\Delta x}{\Delta t}$, v = slope of x vs. t curve
$a_{av} = \frac{\Delta v}{\Delta t}$, a= slope of v vs. t curve

Constant Acceleration Processes
$a = constant$
$v = v_0 + at$
$x = x_0 + v_0 t + \frac{1}{2} a t^2$
$v^2 = v_0^2 + 2a\Delta x$ (Handy Eq.)

Motion with Gravity: $a = -g$

4 Motion: 2D

Constant Acceleration Processes

$a_x = 0$	$a_y = -g$
$v_x = v_{x0}$	$v_y = v_{y0} - gt$
$x = x_0 + v_{x0} t$	$y = y_0 + v_{y0} t - \frac{1}{2} g t^2$

Handy Eq.

$v_x^2 = v_{x0}^2$	$v_y^2 = v_{y0}^2 - 2g\Delta y$
$v^2 = v_0^2 - 2g\Delta y$	

Vector Velocity

$v_x = v_0 cos(\theta)$	$v_y = v_0 sin(\theta)$

5 More Motion Formulas

$R_0 = \frac{v_0^2}{g} sin(2\theta)$ [Note: $sin(2\theta) = 2sin(\theta)cos(\theta)$]
$y_{max} = \frac{v_0^2}{2g} sin^2(\theta)$
$T_{flight} = \frac{2v_0}{g} sin(\theta)$

$y(x) = tan(\theta_0)x\left(1 - \frac{x}{R_0}\right)$
$R = \frac{R_0}{2}\left[1 \pm \sqrt{1 - \frac{h}{y_{max}}}\right]$
$\theta_{max\ range} = \frac{\pi}{4} + \frac{gh}{2v_0^2}$

6 Newton's Laws of Motion

1. $v = constant$ if $F_{net} = 0$
2. $F_{net} = ma$
3. Action = Reaction, $F_{12} = -F_{21}$
4. $F = -G\frac{m_1 m_2}{R^2}$

7 Forces

$F_{grav} = -G\frac{Mm}{R^2}$. Near Earth $F_{grav} = mg$.
$F_{fric} = \mu N$
$F_{spring} = -kx$
$F_{buoy} = \rho V g$
$F_{drag} = \frac{1}{2} C_D \rho A v^2$

$v_T = \sqrt{\frac{2mg}{C_D \rho A}}$
$v_T(\frac{mi}{hr}) = 0.45566\frac{\sqrt{m\ (ingrams)}}{D(in\ mm)}$ (spherical objects)

8 Energy

units: Joules $(N \cdot m)$
Energy is neither created nor destroyed

$$\underbrace{\frac{1}{2}mv^2}_{KE} + \underbrace{mgh}_{PE} = \underbrace{\frac{1}{2}mv_0^2}_{KE_0} + \underbrace{mgh_0}_{PE_0}$$

Types of Energy

1. Mechanical Energy
2. Thermal Energy
3. Electrical Energy
4. Magnetic Energy
5. Light Energy (Electromagnetic)
6. Sound Energy (Acoustic)
7. Chemical Energy
8. Nuclear Energy

Power
units: Watts (J/s)
Power = Rate of Energy Flow
$P_{av} = \frac{\Delta E}{\Delta t}$

9 Circular Motion

Centripetal means towards the center of the circle
$a_{centrip} = \frac{v^2}{r}$, $F_{centrip} = \frac{mv^2}{r}$
$T = 2\pi r/v$ (T is period of motion)