# Formula Cheat Sheet

## Velocity

Rate at which a particle moves with per unit per second

### One dimension

Formula: $V = V_o + at$

Usage: Find the velocity of a particle in one dimensional space

Example: A ball is thrown from the top of a six story building, find the velocity of the particle when it hits the ground after 10 seconds. Assume no air resistance and no terminal velocity.

- $a = 9.8m/s$
- $t = 10s$
- $v_o = 0$

$\therefore v = 0 + 9.8(10) = 98m/s^2$

## Free Fall Acceleration

Formula: $y = y_o + v_o t + \frac{1}{2}at^2$

Usage:

Example: A ball is thrown from the top of a building 90 meters above the ground as a *projectile*. It takes 10 seconds for the ball to hit the ground. What was the initial velocity of the ball?

- $a = -g = -9.81m/s$
- $t = 10s$
- y = 90 m

$0 = 90 + (10)V_o - 490.5$

$0 = -400.5 + 10V_o$

$400.5 = 10V_o$

$V_o = 40.05$

**Apply velocity formula:** $V = 40.05 - 9.81(10)$

$V = -58.05m/s$

This is *downward speed*

## Vectors

### Addition and Subtraction

It is commutative and associative.

$\vec{S} = \vec{A} + \vec{B} = \vec{B} + \vec{A}$

$(\vec{A} + \vec{B}) + \vec{C} = \vec{A} + (\vec{B} + \vec{C})$

Example:

$\vec{A} =< 1, 2, 3 >$

$\vec{B} =< 4, 5, 6 >$

$\vec{C} = \vec{A} + \vec{B} =< (1 + 4), (2 + 5), (3 + 6) >$

$\vec{C} =< 5, 7, 9 >$

### Multiplication

### Dot/Scalar Product

$\vec{A} \bullet \vec{B} = \cos\phi$

Result is a scalar and is commutative.

Example:

$\vec{A} =< 1, 2, 3 >$

$\vec{B} =< 4, 5, 6 >$

$\phi = 45$

$|\vec{A}| = \sqrt{13}$

$|\vec{B}| = \sqrt{77}$

$\vec{A} \bullet \vec{B} = \sqrt{13} * \sqrt{77} * \cos(45)$

### Cross/Vector Product

$\vec{A} =< 1, 2, 3 >$

$\vec{B} =< 4, 5, 6 >$

$\vec{A} \times \vec{B}$

Produces an orthogonal (perpendicular) vector to both $\vec{A}$ and $\vec{B}$

**Misc**

$a_{\mathrm{x}} = a\cos\theta$

$a_{\mathrm{y}} = a\sin\theta$

$|a| = \sqrt{a((\cos\theta)^2 + (\sin\theta)^2)}$

$arctan(\frac{a_{\mathrm{x}}}{a_{\mathrm{y}}}) = \theta$

$\cos\phi = \frac{\vec{A}\bullet\vec{B}}{|\vec{A}|*|\vec{B}|}$

Magnitude of $\vec{A} \times \vec{B} = |\vec{A}| * |\vec{B}| * \sin\phi$