Quantities

- SCALAR: Measures magnitude only eg. length, speed, mass, etc.
- VECTOR: Measures magnitude and direction eg. displacement, velocity, force, etc.

Graphical Representation of Vectors: line segment and arrow

(length = magnitude) (direction)

[Sketch Picture with initial point, terminal point, and hand-written notation]

Two vectors are equal iff [Sketch picture both w/ & w/o coord. system. Initial/terminal points don't matter. Graph Rep not unique.]

(a). Equal magnitude

(b). Same direction

Mathematical Representation:

2-Dimensional Vector Space V_2	**3-Dimensional** Vector Space V_3	n**-Dimensional** Vector Space V_n
$\mathbf{v} = \vec{v} = \langle a, b \rangle$	$\mathbf{v} = \vec{v} = \langle a, b, c \rangle$	$\mathbf{v} = \vec{v} = \langle a_1, a_2, a_3, \ldots, a_n \rangle$
components of $\mathbf{v}$: a, b		
magnitude:	magnitude:	magnitude:
$\lvert\mathbf{v}\rvert = \sqrt{a^2 + b^2}$	$\lvert\mathbf{v}\rvert = \sqrt{a^2 + b^2 + c^2}$	$\lvert\mathbf{v}\rvert = \sqrt{a_1^2 + a_2^2 + a_3^2 + \ldots + a_n^2}$

POSITION VECTOR: The ***unique*** vector starting at the origin O and ending at the point $P(a,b)$ or $P(a,b,c)$. [Sketch]

Ex: Sketch $\mathbf{v} = \langle 2, -3 \rangle$ starting at **(a).** $P(-1,-2)$ **(b).** Origin

Ex: Find the length of $\vec{w} = \left\langle \frac{2}{3}, \frac{1}{3}, \frac{1}{3} \right\rangle$

Ex. Given $P(2,9)$ and $Q(-1,6)$ **(a).** Sketch $\overrightarrow{PQ}$ **(b).** Find $\overrightarrow{PQ}$ **(c).** Find $\overrightarrow{QP}$

General Formula: For $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$, the vector $\overrightarrow{PQ} = \langle x_2 - x_1, y_2 - y_1, z_2 - z_1 \rangle$

Scalar Multiplication:	$c\mathbf{v} = c\langle a_1, a_2, a_3 \rangle = \langle ca_1, ca_2, ca_3 \rangle$

Ex. Given $\mathbf{v} = \langle 2, 1 \rangle$,

(a). Find and sketch $3\mathbf{v}$

(b). Compare $|\mathbf{v}|$ and $|3\mathbf{v}|$.

[Comments on $|c\mathbf{v}|$ and $c\mathbf{v}$.]

Two vectors $\mathbf{v}$ and $\mathbf{w}$ are parallel iff $\mathbf{w} = c\mathbf{v}$ ie. same or opposite direction