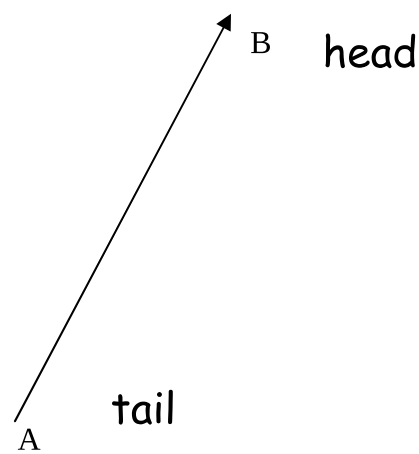
Vectors

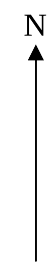
Vectors vs scalars

An airplane is travelling 500km/h … which way?

vectors	scalars
velocity	time
weight	age
force	temperature
	volume

Vectors





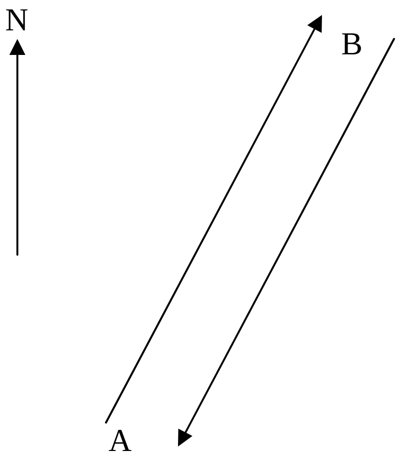
$\overrightarrow{AB}$ is a vector that runs from A to B.
The size of $\overrightarrow{AB}$ is denoted by $|\overrightarrow{AB}|$

1cm = 100km/h

If $\overrightarrow{AB}$ represents an airplane traveling 500km/h in a north easterly direction then $|\overrightarrow{AB}|$ = 5cm = 500km/h.

The direction of the arrow represents the direction of the airplane, the length is its speed.

Suppose we have



$|\overrightarrow{AB}| = |\overrightarrow{BA}| = 500$km/h

but $\overrightarrow{AB} \neq \overrightarrow{BA}$ because they are in opposite directions. (parallel)

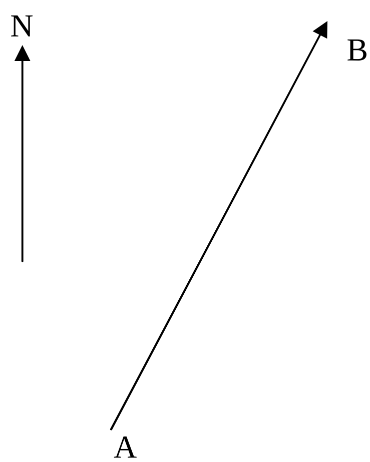
$\overrightarrow{AB}$ and $\overrightarrow{BA}$ are <u>opposite vectors</u>

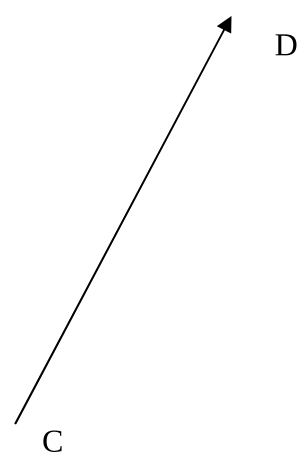
$\therefore \overrightarrow{AB} = -\overrightarrow{BA}$

1cm = 100km/h

Vectors are denoted by their endpoint as in $\overrightarrow{AB}$ or they can take on a name such as $\vec{v}$.

If we have





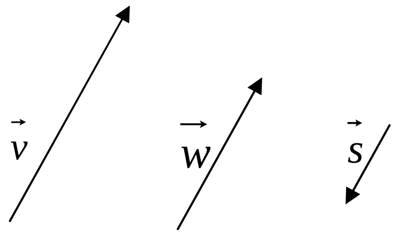
1cm = 100km/h

If $|\overrightarrow{AB}| = |\overrightarrow{CD}|$ (magnitudes) and $\overrightarrow{AB} // \overrightarrow{CD}$ (parallel) and the direction from A to B is the same as from C to D

then $\overrightarrow{AB} = \overrightarrow{CD}$

If two planes are heading East at 400km/h, one from Calgary and one from Toronto, they have the same vectors.

On the other hand, if two vectors are parallel but not necessarily with the same magnitude or same direction, they are <u>collinear.</u>



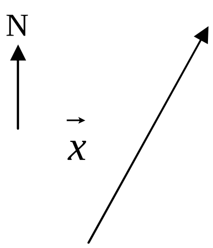
$\vec{w} = k\vec{v}$ where $0 < k < 1$

$\vec{s} = k\vec{v}$ where $-1 < k < 0$

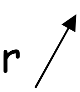
<u>Unit Vector</u>

If we multiply the vector $\vec{x}$ by $\frac{1}{|\vec{x}|}$, then we have $\frac{1}{|\vec{x}|}\vec{x}$, called the <u>unit vector</u>. It has the same direction as $\vec{x}$ but a magnitude of 1.

Example: Given



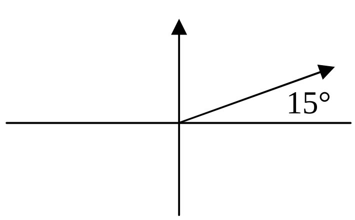
$|\vec{x}| = 3$

Then $\frac{1}{3}\vec{x}$ is the unit vector 

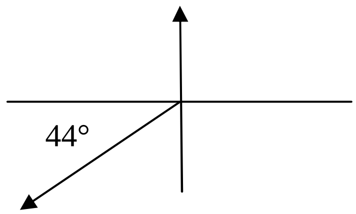
$$|\frac{1}{3}\vec{x}| = \frac{1}{3}|\vec{x}| = \frac{1}{3}(3) = 1$$

The unit vector of $\vec{x}$ is written $\hat{x}$

NESW – direction and Bearings

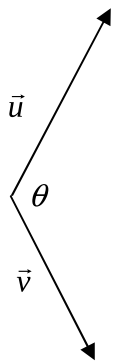


E15°N
N75°E
Bearing: 75°



W44°S
S46°W
Bearing: 226°

<u>Angle Between Two Vectors</u>



Tail to tail: $0 \le \theta \le 180°$

<u>Geometric Vectors</u>: vectors without reference to coordinate axis.

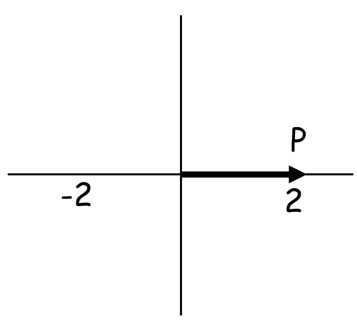
10km/h[E23°S]

<u>Algebraic Vectors</u>: vectors with reference to coordinate axis.

Consider $A \longrightarrow B$ $\quad\overrightarrow{AB}$ where $|\overrightarrow{AB}| = 2$

Suppose the point A is the origin.

Component form



Then we have $\overrightarrow{AB} = \overrightarrow{OP} = (2,0)$

If we have $\overrightarrow{AB}$ then $\overrightarrow{AB}$ can be moved until the point A is on the origin and the point B will be at the point P(a,b).

So $\overrightarrow{AB} = \overrightarrow{OP} = (a,b)$ ~ a vector from (0,0) to (a,b)