Introduction To Vectors

Term	Definition	Notation	Examples
Magnitude			
Direction			
Scalar			
Vector			
Unit Vector			
Equal Vectors *(Equivalent)*			
Opposite Vectors			
Parallel Vectors			
Coincident Vectors			

Classifying Vectors
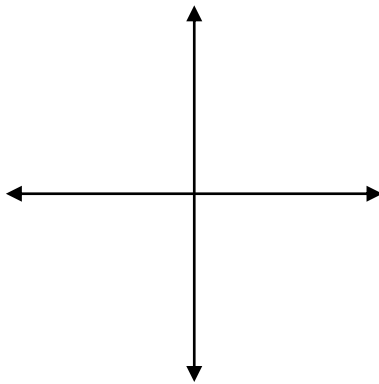
For the following diagram, state:

a) Two vectors that are equal. $\overrightarrow{AB}$ _____

b) Two vectors that are opposite. $\overrightarrow{GH}$ _____

c) Two vectors that are coincident. $\overrightarrow{AK}$ _____

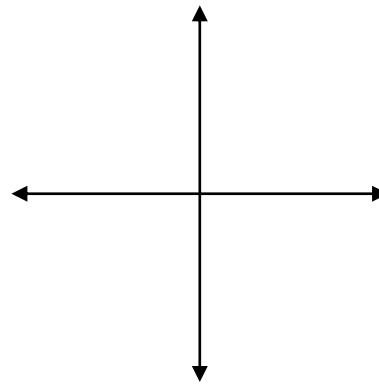d) Two vectors that parallel, but have different magnitudes. $\overrightarrow{AH}$ _____
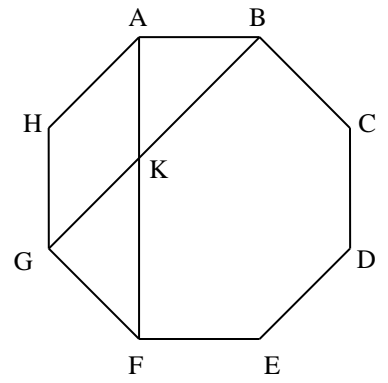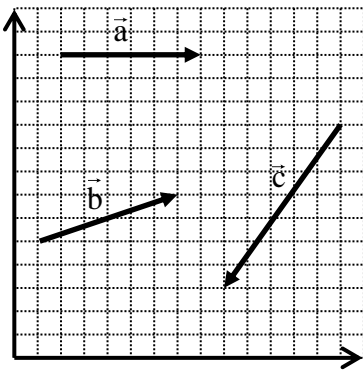

Drawing Vectors

$\vec{a} = 10$ cm [N25ºE]

$\vec{b} = 25$ cm [S60ºW]

Calculating Vectors

Calculate the magnitude and direction of the following vectors:

Vector Addition & Subtraction

Vector Addition

- To add vectors, line them up from _____ to _____.

- The sum of the vectors is drawn from _____ to _____.

- The sum of the vectors is also called the _____.
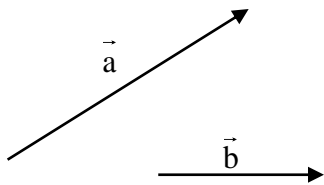
State the resultant vector for each of the following:

a) $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CD}$

b) $\overrightarrow{AL} + \overrightarrow{PZ} + \overrightarrow{QA} + \overrightarrow{ZQ}$

Determine $\vec{a} + \vec{b}$ if $|\vec{a}| = 5.2$ cm, $|\vec{b}| = 7.2$ cm, and the angle between the two vectors is $40.00°$.

METHOD 1: Drawing

METHOD 2: Cosine Law

METHOD 3: SohCahToa (Components)

Vector Subtraction

- To subtract vectors, add the _____ of the vector being subtracted.

State the resultant vector for each of the following:

a) $\overrightarrow{AB} - \overrightarrow{CB} - \overrightarrow{DC}$ b) $\overrightarrow{PZ} - \overrightarrow{LA} - \overrightarrow{AQ} - \overrightarrow{QZ}$

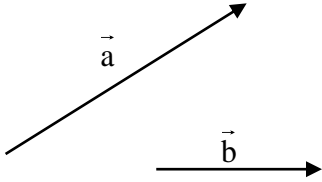Determine $\vec{a} - \vec{b}$ if $|\vec{a}| = 5.2$ cm, $|\vec{b}| = 7.2$ cm, and the angle between the two vectors is 40.00°.

Zero Vector

- A vector with a magnitude of _____ and no _____.

i.e. $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC}$

Vector Operations

Properties of Vectors Activity

Property #1	**Property #2**	**Property #3**
$\vec{a} + \vec{0} = \vec{a}$	$\vec{a} - \vec{a} = \vec{0}$	$\vec{a} + \vec{b} = \vec{b} + \vec{a}$
True / False	True / False	True / False

Property #4	**Property #5**	**Property #6**
$\vec{a} - \vec{b} = -\vec{b} + \vec{a}$	$\vec{a} - \vec{b} = \vec{b} - \vec{a}$	$(\vec{a} + \vec{b}) + \vec{c} = \vec{a} + (\vec{b} + \vec{c})$
True / False	True / False	True / False

Property #7	**Property #8**	**Property #9**
$(\vec{a} - \vec{b}) + \vec{c} = \vec{a} - (\vec{b} + \vec{c})$	$\vec{a} + \vec{a} = 2\vec{a}$	$\vec{a} + \vec{b} + \vec{a} + \vec{b} + \vec{a} = 3\vec{a} + 2\vec{b}$
True / False	True / False	True / False

Property #10	**Property #11**	**Property #12**
$3(2\vec{a}) = 2(3\vec{a})$	$2(\vec{a} + \vec{b}) = 2\vec{a} + 2\vec{b}$	$2(\vec{a} - \vec{b}) = 2\vec{a} - 2\vec{b}$
True / False	True / False	True / False

Vector Operations

Simplify each of the following:

a) $3(5\vec{a} + \vec{b}) - (2\vec{b} - 4\vec{a})$

b) $6(3\vec{a} - 2\vec{b} + 5\vec{c}) + \dfrac{1}{2}(4\vec{a} + 4\vec{b}) - 10(3\vec{c} - \vec{b} + 2\vec{a})$

If $\vec{a} = 2\vec{x} + 3\vec{y} - 4\vec{z}$ and $\vec{b} = \vec{x} + 5\vec{z}$, express $10\vec{b} - 2\vec{a}$ in terms of $\vec{x}$, $\vec{y}$ and $\vec{z}$.

Determine the value of $|2\vec{a} + 30\vec{b}|$ if $|\vec{a}| = 10$ cm, $\vec{b}$ is a unit vector, and the angle between the two vectors is 70°.

Applications of Vectors – Velocity

- Velocity measures the rate of change in the position of an object, including direction.

- Velocity is a vector because it has both _____ and _____.

- Air speed (water speed) is the speed of a plane (boat) relative to a person on board.

- Ground speed is the speed of a plane (boat) relative to a person on the ground and includes the effect of wind (current).

Connie the canoeist wants to cross a river that is 250 m wide. The current flows at 5 km/h parallel to the bank and Connie can paddle at 13 km/h in still water. If she directs her boat towards a dock directly across the river:

a) What is her actual velocity as she crosses the river?

b) How far downstream will Connie end up?

c) How long does it takes her to cross the river?

A plane is steering at N30°W at an air speed (speed in still air) of 550 km/h. If the wind is from S50°W at 80 km/h, find the ground speed and the course of the plane.

How far will the plane have travelled in 2 hours?

Applications of Vectors – Force

- Force is something that either _____ or _____ an object.

- Force is measured using the unit _____.

- A mass of 1kg exerts a force of _____.

Determine the downward force exerted by a 10 kg box of textbooks.

Components of Force

A force applied to an object can broken down into two components:

_____ – _____

_____ – _____

Marsha pushes shopping cart up a 15° incline using a force of 60 N. Calculate the horizontal and vertical forces being exerted on the cart.

- When an object is _____, an opposite _____ force is used to counteract the applied forces.

Determine the tension in a cable that is supporting a suspended 0.75 kg pendant light fixture.

A piece of mobile art is suspended from the ceiling using two cables that make angles of 65° and 70° with the ceiling. If the mobile exerts a downward force of 48N, what is the tension in each cable?