

Introduction to Vectors

All quantities can be divided into two categories – scalars and vectors.

A scalar quantity is a quantity that is described by its magnitude.

Example:
 time 4 s
 speed 15 m/s
 mass 22 kg
 } two parts: measurement + unit

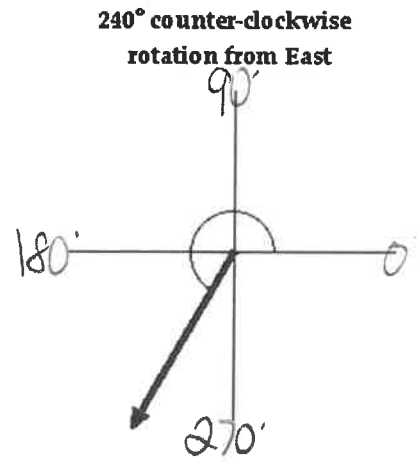
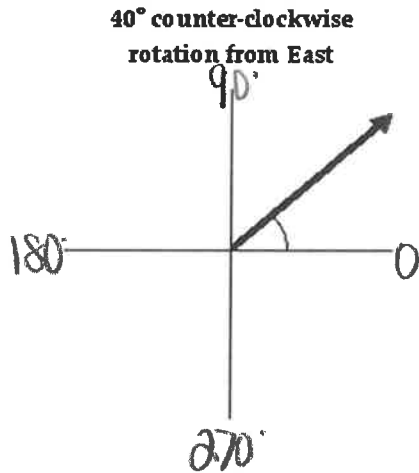
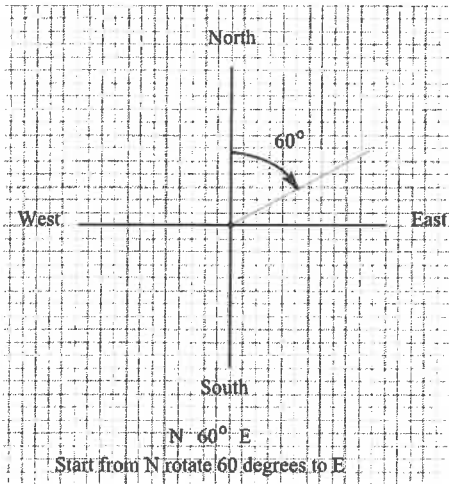
A vector quantity is one described by both magnitude and direction.

Example:
 velocity 7.2 m/s [NE]
 force 190 N [up]
 } three parts: measurement, unit + direction

The direction of a vector is always expressed in square brackets using either:

1. Compass Directions -
 One of the four basic directions or relative to a north or south position so that the angle is less than 90.

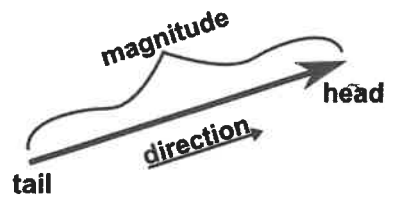
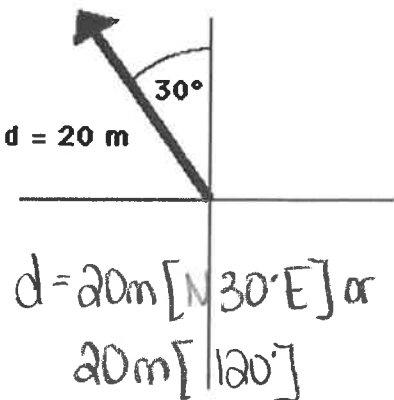
2. RCS Directions -
 Angle is measured counterclockwise from due east (x-axis)



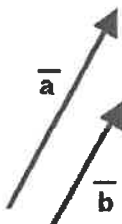
Representing Vectors

Use a Scale and arrow indicates the direction

SCALE: 1 cm = 4 m



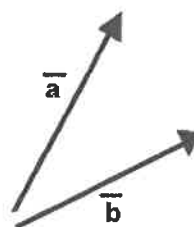
Example #1



Vector a and Vector b have same direction but different magnitude.

$$\vec{a} \neq \vec{b}$$

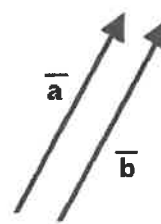
Example #2



Vector a and Vector b have same magnitude but different direction.

$$\vec{a} \neq \vec{b}$$

Example #3



Vector a and Vector b have same direction and same magnitude.

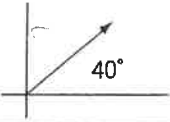
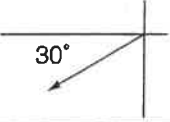
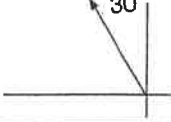
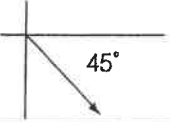
$$\vec{a} = \vec{b}$$

Goal • Practise calculating both compass directions and RCS directions.

What to Do

Answer each question in the space provided. You will need a ruler and a protractor.

1. Use the diagrams in the table below to calculate both compass directions and RCS directions.

Diagram				
Compass direction	[N 50° E]	[S 60° W]	[N 30° W]	[S 45° E]
RCS direction	[40°]	[210°]	[120°]	[315°]

2. (a) Convert the following RCS directions to the equivalent compass direction.

RCS direction	40° RCS	90° RCS	120° RCS	250° RCS	310° RCS
Compass direction	[N 50° E]	[N]	[N 30° W]	[S 20° W]	[S 40° E]

- (b) Convert the following compass directions to the equivalent RCS direction.

Compass direction	S40°E	N20°W	W	N45°E	S20°W
RCS direction	[310°]	[110°]	[180°]	[45°]	[250°]

Adding Vectors

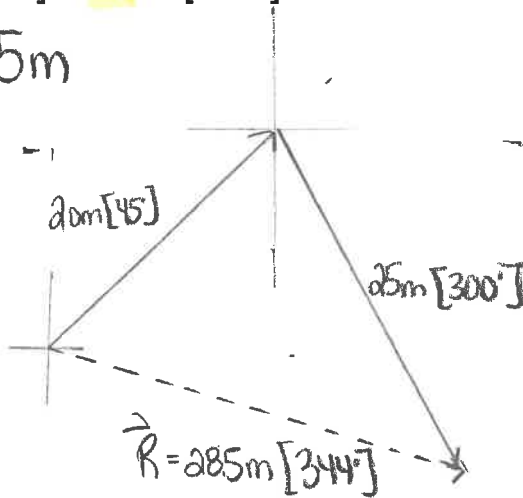
Vectors can be added together to determine the resultant (\vec{R}). Many methods exist:

1. Graphically: Head-to-Tail Method

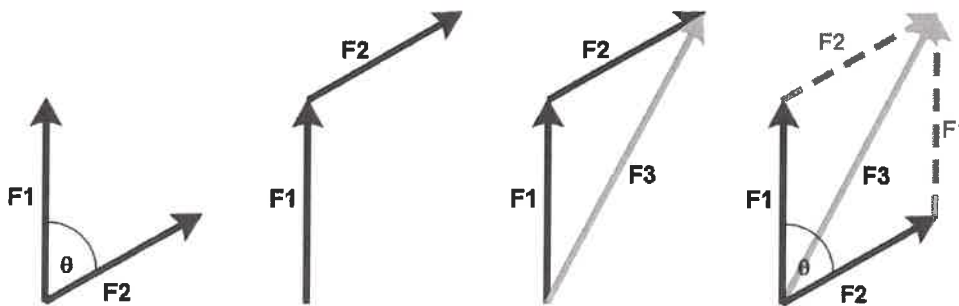
- used for adding two or more vectors, regardless of direction
- draw a vector to scale
- where the head of the first vector ends, the tail of the second vector begins
- repeat for all vectors
- draw a line from the tail of the first vector to the head of the last vector (from start to finish – this line is the resultant)
- measure length and direction of the resultant
- convert to real units using the given scale

Example: 20.0 m 25.0 m
 20 m $[45^\circ]$ + 25 m $[300^\circ]$ = ?

Scale: $1\text{ cm} = 5\text{ m}$



- Note: The order in which vectors are added does NOT matter. The magnitude and the direction of the resultant is not changed.



$$F_1 + F_2 = F_3 \text{ or } F_2 + F_1 = F_3$$

2. Algebraically

- used to find sum of collinear vectors (vectors on the same line)
- treat vectors as though quantities on a number line

$$\begin{array}{c} 5 \\ \longrightarrow \end{array} + \begin{array}{c} 5 \\ \longrightarrow \end{array} = \begin{array}{c} 10 \\ \longrightarrow \end{array}$$

$$\begin{array}{c} 5 \\ \longrightarrow \end{array} + \begin{array}{c} -5 \\ \longleftarrow \end{array} = 0$$

$$\begin{array}{c} 5 \\ \longrightarrow \end{array} + \begin{array}{c} 10 \\ \longrightarrow \end{array} = \begin{array}{c} 15 \\ \longrightarrow \end{array}$$

$$\begin{array}{c} 5 \\ \longrightarrow \end{array} + \begin{array}{c} -10 \\ \longleftarrow \end{array} = \begin{array}{c} -5 \\ \longleftarrow \end{array}$$

$$\begin{array}{c} 5 \\ \longrightarrow \end{array} + \begin{array}{c} -15 \\ \longleftarrow \end{array} = \begin{array}{c} -10 \\ \longleftarrow \end{array}$$

$$\begin{array}{c} 10 \\ \uparrow \end{array} + \begin{array}{c} -5 \\ \downarrow \end{array} = \begin{array}{c} 5 \\ \uparrow \end{array}$$

Example: 25.0 N 20.0 N
 $25\text{ N [E]} + 20\text{ N [W]} = ?$

$$\begin{array}{c} 25\text{ N} \\ \longrightarrow \end{array} + \begin{array}{c} -20\text{ N} \\ \longleftarrow \end{array} = \begin{array}{c} 5\text{ N} \\ \longrightarrow \end{array}$$

Assign #34 from Finding
Directions
plus # 1-6 on W/S
that follows