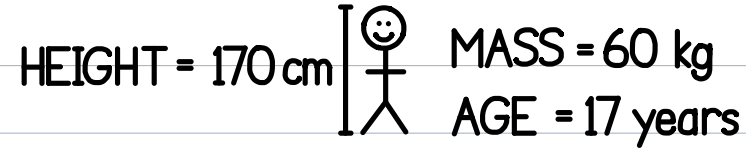
VECTORS

SCALARS AND VECTORS

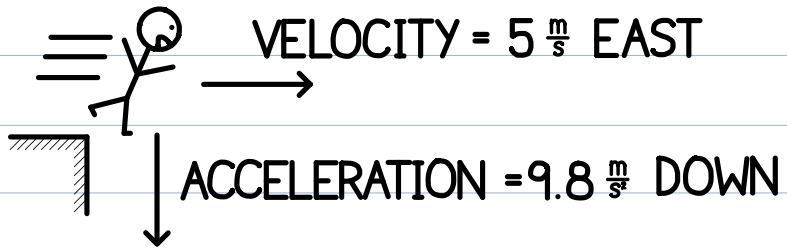
- MEASURABLE QUANTITIES ARE EITHER SCALARS OR VECTORS.
- SCALARS HAVE ONLY MAGNITUDE (SIZE).

EXAMPLE



- VECTORS HAVE BOTH MAGNITUDE AND DIRECTION.

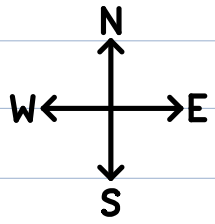
EXAMPLE

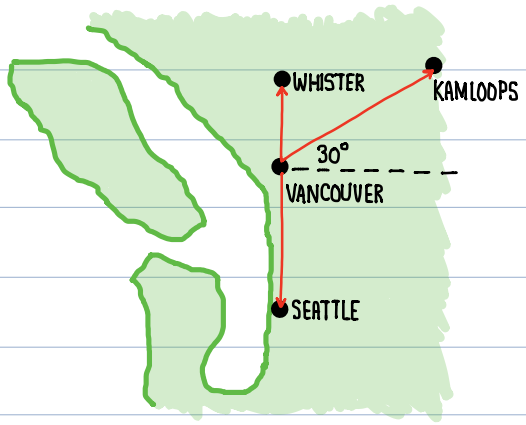


REPRESENTING VECTORS

- A VECTOR CAN BE REPRESENTED BY AN ARROW.
  - THE MAGNITUDE OF THE VECTOR IS REPRESENTED BY THE LENGTH OF THE ARROW.
  - THE DIRECTION OF THE VECTOR IS REPRESENTED BY THE DIRECTION OF THE ARROW.

EXAMPLE





WHISTLER : 120 km NORTH

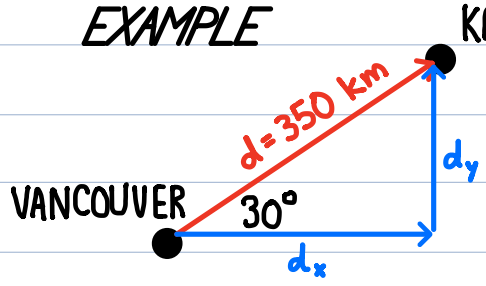
SEATTLE : 200 km SOUTH

KAMLOOPS : 350 km 30° NORTH OF EAST

60° EAST OF NORTH IS ALSO CORRECT BUT THE CONVENTION IS TO USE THE SMALLER ANGLE.

- A VECTOR AT AN ANGLE CAN BE SPLIT IN TO HORIZONTAL AND VERTICAL COMPONENTS.

EXAMPLE



$\cos 30^\circ = \frac{d_x}{d}$

$d_x = d \cos 30^\circ$

$= 350 \cos 30^\circ$

$= 303$ km EAST

$\sin 30^\circ = \frac{d_y}{d}$

$d_y = d \sin 30^\circ$

$= 350 \sin 30^\circ$

$= 175$ km NORTH

KAMLOOPS IS 303 km EAST AND 175 km NORTH OF VANCOUVER.

EXAMPLE

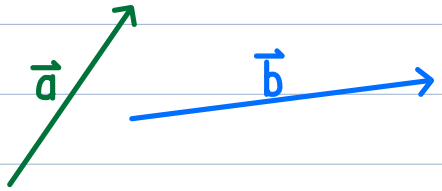
DETERMINE THE HORIZONTAL AND VERTICAL COMPONENTS OF THE FOLLOWING VECTOR:

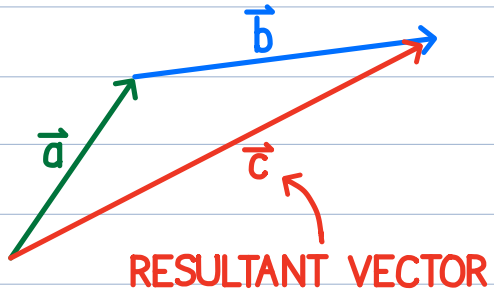
$56\ \frac{m}{s}$ 25° WEST OF SOUTH

VECTOR ADDITION

- VECTORS CAN BE ADDED USING THE HEAD-TO-TAIL METHOD.
  - DRAW THE FIRST VECTOR.
  - DRAW THE SECOND VECTOR WITH ITS TAIL AT THE HEAD OF THE FIRST VECTOR.
  - THE RESULTANT VECTOR IS DRAWN FROM THE TAIL OF THE FIRST VECTOR TO THE HEAD OF THE SECOND VECTOR.

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





EXAMPLE

AARON WALKS 2.5 km EAST THEN 3.0 km 35° NORTH OF EAST. WHAT IS HIS TOTAL DISPLACEMENT?

- VECTORS CAN ALSO BE ADDED USING THE COMPONENT METHOD.
  - SPLIT VECTORS IN TO HORIZONTAL AND VERTICAL COMPONENTS.
  - ADD HORIZONTAL AND VERTICAL COMPONENTS SEPARATELY TO DETERMINE THE COMPONENTS OF THE RESULTANT VECTOR.
  - USE THE PYTHAGOREAN THEOREM AND TANGENT TO DETERMINE THE MAGNITUDE AND DIRECTION OF THE RESULTANT VECTOR.

WHEN ADDING THREE OR MORE VECTORS, THE COMPONENT METHOD IS MORE EFFICIENT.

EXAMPLE

AARON WALKS 2.5 km EAST THEN 3.0 km 35° NORTH OF EAST. WHAT IS HIS TOTAL DISPLACEMENT?

VECTOR SUBTRACTION

- TO SUBTRACT A VECTOR ADD ITS OPPOSITE.

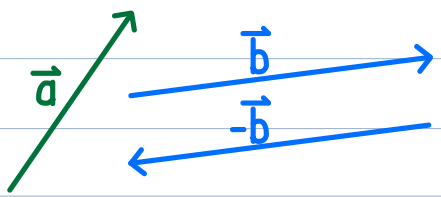
$\vec{a} - \vec{b} = \vec{c}$

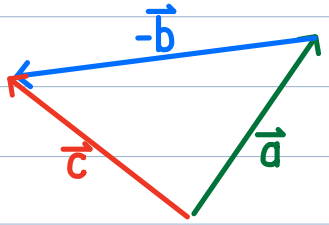
$\vec{a} + (-\vec{b}) = \vec{c}$

MOST OFTEN USED TO DETERMINE THE CHANGE IN A VECTOR QUANTITY:

$\Delta\vec{x} = \vec{x}_f - \vec{x}_i$ (I.E. DISPLACEMENT)

$\Delta\vec{v} = \vec{v}_f - \vec{v}_i$





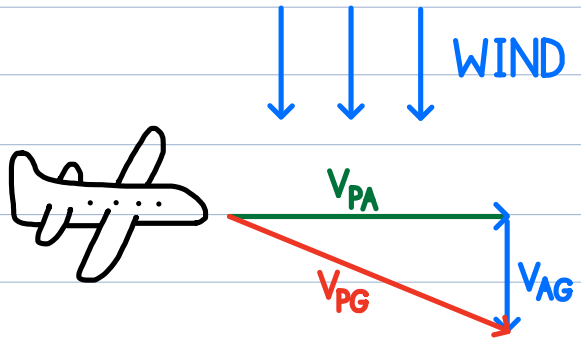
EXAMPLE

A STATIONARY OBSERVER IS MONITORING THE MOVEMENT OF A DOG. INITIALLY, THE DOG IS SEEN 5.0 m EAST OF THE OBSERVER. A FEW SECONDS LATER, THE DOG IS 10.0 m 45° NORTH OF EAST. WHAT IS THE DISPLACEMENT OF THE DOG?

RELATIVE VELOCITY

- THE VELOCITY OF AN OBJECT DEPENDS ON THE FRAME OF REFERENCE OF THE OBSERVER.

PLANES:



V_{PA} : VELOCITY OF PLANE RELATIVE TO AIR

- AIRSPEED OF PLANE
- VELOCITY IN STILL AIR
- DIRECTION THE PLANE IS AIMED

V_{AG} : VELOCITY OF AIR RELATIVE TO GROUND

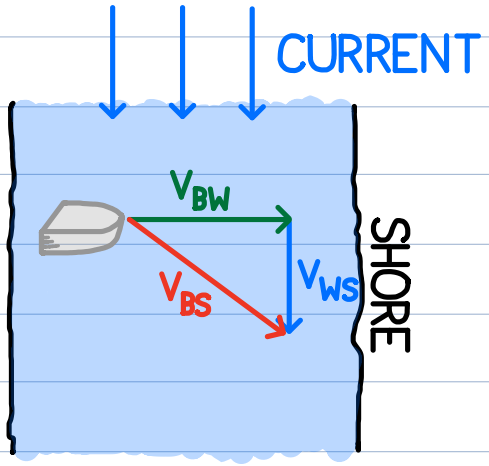
- WIND VELOCITY

V_{PG} : VELOCITY OF PLANE RELATIVE TO GROUND

- GROUND SPEED OF PLANE
- RESULTANT VELOCITY WITH WIND REDIRECTION

BOATS:

$\vec{V}_{PA} + \vec{V}_{AG} = \vec{V}_{PG}$



V_{BW} : VELOCITY OF BOAT RELATIVE TO WATER

- ROWING SPEED
- VELOCITY IN STILL WATER
- DIRECTION THE BOAT IS AIMED

V_{WS} : VELOCITY OF WATER RELATIVE TO SHORE

- CURRENT VELOCITY

V_{BS} : VELOCITY OF BOAT RELATIVE TO SHORE

- RESULTANT VELOCITY WITH CURRENT REDIRECTION

EXAMPLE

A RIVER FLOWS WEST AT A SPEED OF 4.0 $\frac{km}{h}$. WHAT WOULD BE THE VELOCITY OF A BOAT RELATIVE TO THE SHORE IF THE BOAT AIMS...

a) WEST AT 10.0 $\frac{km}{h}$?

b) EAST AT 10.0 $\frac{km}{h}$?

c) SOUTH AT 10.0 $\frac{km}{h}$?