

# Grade 11 Technical Science



Term 1:  
Mechanics



# Introduction to mechanics

## 1.1 Sign conventions

A scalar is a physical quantity with only magnitude. A scalar value is written as a magnitude and a unit.

A vector is a physical quantity with magnitude and direction. A vector value is written as a magnitude with a unit and a direction.

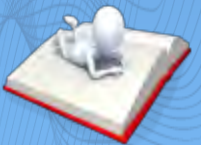
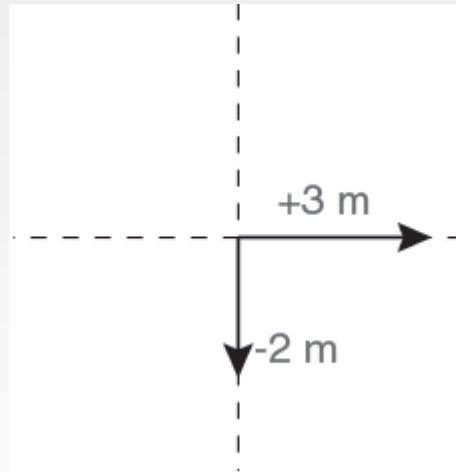
Definition



# Introduction to mechanics

## 1.1.1 Cartesian coordinate system

### Example



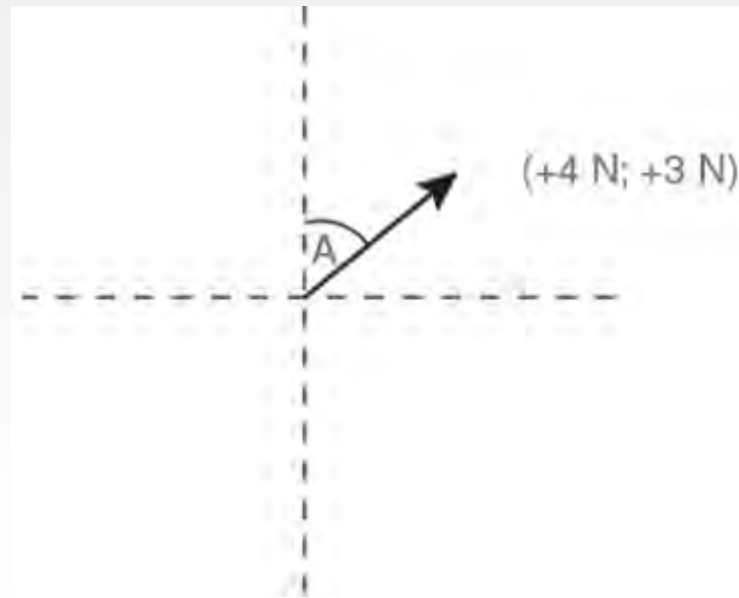
## Example

The magnitude of force vector A is

$$A = \sqrt{4^2 + 3^2}$$
$$= 5 \text{ N}$$

The direction of force vector A is:

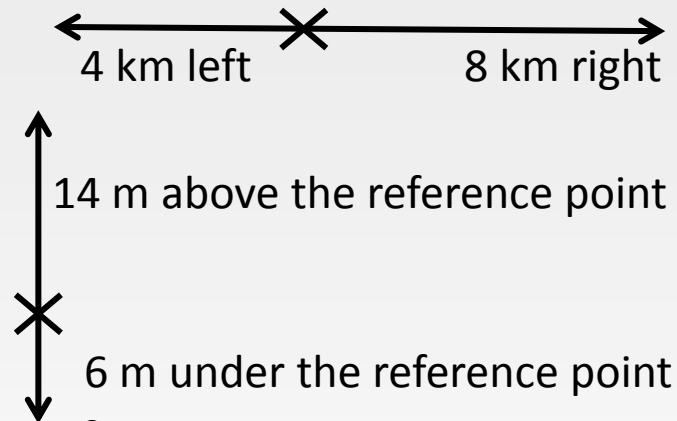
$$\tan\theta = \frac{3}{4}$$
$$\theta = \tan^{-1} \left( \frac{3}{4} \right)$$
$$= 36,87^\circ$$



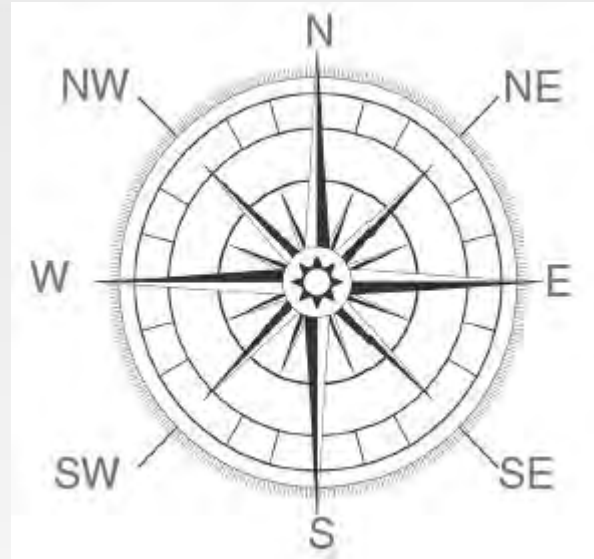
## Example

There must be a point or system of axes used as a reference.

- A fixed point can be used to describe horizontal movement from left to right or from west to east.
- A fixed point can be used as a reference point from which to describe vertical movement: upwards or downwards from a point.
- A fixed point can be used as a reference point for a compass bearing.

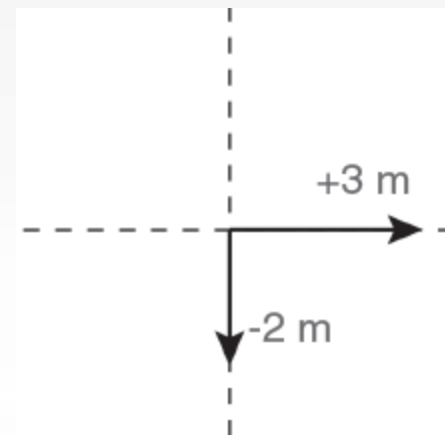


## 1.1.2 Compass directions



### Example

Two displacements of 3 m east and 2 m south respectively



## 1.1.3 Bearings

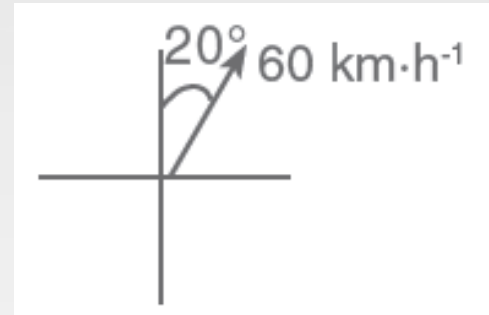


### Examples

A car that moves at  $60 \text{ km}\cdot\text{h}^{-1}$  maintains a velocity of  $60 \text{ km}\cdot\text{h}^{-1}$ ,  $140^\circ$ .



A car maintains a velocity of  $60 \text{ km}\cdot\text{h}^{-1}$ ,  $20^\circ$ .



## 1.1.4 Applications of direction

### Examples

- Displacement:  
35 m east; 300 km  $260^\circ$ ; 56 m
- Velocity:  
 $35 \text{ m}\cdot\text{s}^{-1}$  west;  $30 \text{ km}\cdot\text{h}^{-1}$   $135^\circ$ ;  $56 \text{ m}\cdot\text{s}^{-1}$





# Introduction to mechanics

- Acceleration:  
 $5 \text{ m}\cdot\text{s}^{-2}$  north;  $30 \text{ m}\cdot\text{s}^{-2}$   $95^\circ$ ;  $56 \text{ m}\cdot\text{s}^{-2}$
- Force:  
35 N east; 300 N  $260^\circ$ ; 56 N; 140 N above the horizontal level
- Gravitational, electrical and magnetic fields:  
Gravitational fields are always attractive and directed towards the centre of the object; electric fields are always directed from the positive to the negative, and magnetic fields are always directed from north to south.

