Unit 2: Kinematics

2.1 Introduction and Vectors

Kinematics: the study of motion.

Scalars: quantities that are specified by a value (magnitude) only and no direction.

ex. time, mass, volume, age, pressure, ~~height~~ ... speed

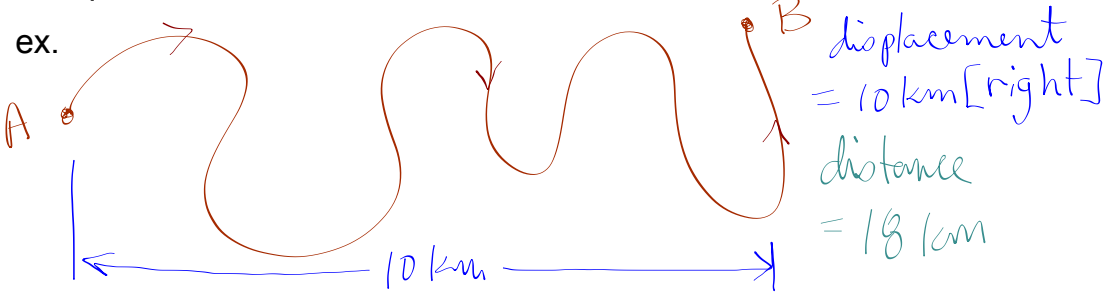
Vectors: are quantities that are specified by both magnitude and direction.

ex. velocity → 120 km/h [N]
displacement → 127 m [N 15° E]

Distance: is a measure of the total travel of the object regardless of direction.

Displacement: is the NET travel of an object as measured from start to finish **AND** requires a direction.

ex.



Velocity: is speed with direction ... it is a vector quantity while speed is scalar.

Position: is a displacement from a given origin. It is a vector quantity. Think of the cartesian coordinate system.

As a convention, we make [North] and [East] positive, and [South] and [West] negative. In space, we call [up] and [right] positive and the opposites negative. However, any direction can be established as positive as long as it is stated somewhere and adhered to for all measurements.

Time Interval: $\Delta t = t_f - t_i$ *or* *final time - initial time*

in math we see $\Delta x = x_2 - x_1$ *same idea*

Δ is greek for d = difference

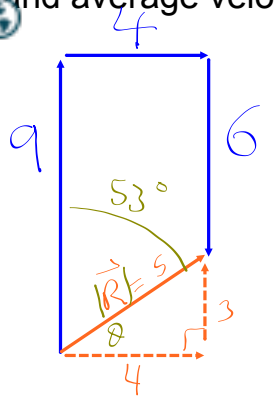
Displacement: $\Delta\vec{d} = \vec{d}_f - \vec{d}_i$ or *final position - initial position*

indicates a vector quantity

Average Speed: $v = d/\Delta t$ or *total distance / total time*

Average Velocity: $\vec{v} = \Delta\vec{d}/\Delta t$ or *change in displacement / change in time*

ex. Gru is looking for supervilain Vector. He drives North 9 km then turns East for 4 km then heads south for 6 km where he traps him in a dead end. The chase lasts 12 minutes. Determine the distance, displacement, average speed and average velocity of Gru during the chase.



$d = 9 + 4 + 6$

$d = 19\,km$

$v_{avg} = \frac{d}{\Delta t}$

$= \frac{19\,km}{12\,min} \cdot \frac{60\,min}{1\,hr}$

$v_{avg.} = 95\,km/hr$

$(\tan\theta = \frac{3}{4})\ \tan^{-1}$

$\theta = 37°$

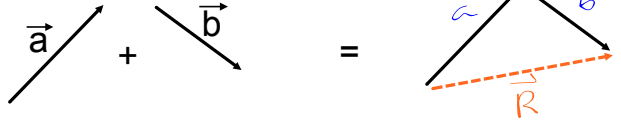
$\vec{d} = 5\,km\,[N\,53°\,E]$

$\vec{v} = \frac{\vec{d}}{\Delta t} = \frac{5\,km\,[N\,53°\,E]}{12\,min} \cdot \frac{60\,min}{hr}$

$\vec{V} = 25\,km/hr\,[N\,53°\,E]$

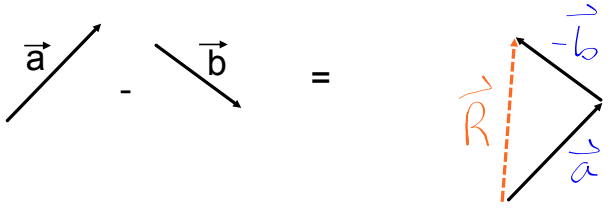
Vector Properties: When adding vectors, place them tip to tail to find the resultant vector

ex.



A vector can become negative by reversing its direction.

So to subtract vector $\vec{b}$ from vector $\vec{a}$, we could add $\vec{a} + (-\vec{b})$ $= \vec{a} - \vec{b}$



practice: Scalar and Vector worksheet

https://www.physicsclassroom.com/Physics-Interactives/Vectors-and-Projectiles/Vector-A