SPH3U
UNIVERSITY PHYSICS

KINEMATICS

- Speed & Velocity
  (P.14-18)

Speed & Velocity

Many people use the terms speed and velocity interchangeably in every day language. However, they have very different meanings in physics. ***Speed*** *is defined as the distance travelled per unit time.* ***Velocity*** *is defined as the displacement (change in position) of an object per unit time.*

SPEED (v)

- distance travelled per unit time
- scalar quantity ☞ *since distance is a scalar quantity*

VELOCITY ($\vec{v}$)

- displacement of an object per unit time
- vector quantity ☞ *since displacement is a vector quantity*

Speed & Velocity

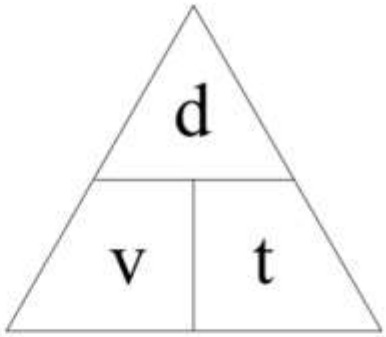
However, objects seldom move at one speed or velocity. They speed up, slow down, and change directions. Thus, average speed and average velocity are more useful quantities for describing the motion of objects that change speed or velocity.

Average Speed

*The **average speed**, or v_{avg}, of a moving object is the total distance travelled divided by the total elapsed time. You are probably already familiar with the term kilometres per hour (km/h). However, the SI unit for speed is metres per second (m/s).*

AVERAGE SPEED (v_{avg})

$$v_{avg} = \frac{\Delta d_T}{\Delta t_T}$$



where v_{avg} is the average speed (m/s)
Δd_T is the total distance (m)
Δt_T is the total time (s)

Average Speed

PRACTICE

1. A dog runs in a straight line for a distance of 43 m in 28 s. What is the dog's average speed?

$v_{avg} = 1.5$ m/s

Average Speed

PRACTICE

2. A baseball rolls along a flat parking lot in a straight line at a constant speed of 3.8 m/s. How far will the baseball roll in 15 s?

d = 57 m

Average Velocity

*The **average velocity**, or $\vec{v}_{avg}$, of an object is its total displacement, or change in position, divided by the total time taken for the motion.*

AVERAGE VELOCITY ($\vec{v}_{avg}$)

$$\vec{v}_{avg} = \frac{\Delta\vec{d}_T}{\Delta t_T}$$

where $\vec{v}_{avg}$ is the average velocity (m/s)
$\Delta\vec{d}_T$ is the total displacement (m)
Δt_T is the total time (s)

NOTE!

Another very common unit for speed or velocity is km/h.

Average Velocity

PRACTICE

3. On a windy day, a balloon's position changes as it is blown 82 m[N] away from a child in 15 s. What is the average velocity of the balloon?

v_{avg} = 5.5 m/s[N]

Average Velocity

PRACTICE

4. A subway train travels at an average velocity of 22.3 km/h[W]. How long will it take for the train to undergo a displacement of 241 m[W]?

t = 38.9 s