SPH3U: 1.2 Speed and Velocity

1. Recap

distance	position	displacement
d scalar (m)	$\vec{d}$ vector (m)	$\Delta\vec{d}$ vector. (m).

2. Average speed and velocity

Average speed:	total distance divided by total time. $v_{av} = \frac{\Delta d}{\Delta t}$ Units: m/s.

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

$$v_{av} = \frac{\Delta d}{\Delta t} = \frac{43\text{ m}}{28\text{ s}} = 1.5\text{ m/s}.$$

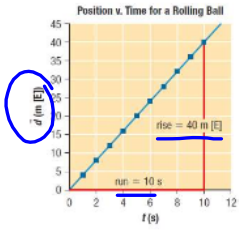
A baseball rolls along a flat parking lot in a straight line at a constant speed of 3.8 m/s. How far will the baseball roll in 15 s?

$v_{av} = 3.8$ m/s. $v_{av} = \frac{\Delta d}{\Delta t} \rightarrow \Delta d = v_{av}\Delta t$

$\Delta d = v_{av}\Delta t = (3.8\text{ m/s})(15\text{ s})$

$= 57\text{ m}.$

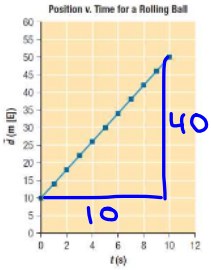
Average velocity: (vector)	total displacement over total time. $\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t}$
position-time graph	a graph with position ($\vec{d}$) on the y-axis and time on the x-axis.
slope	slope of a P-T graph is the average velocity.



$m = \frac{rise}{run}$

$\vec{v}_{av} = \frac{40\text{ m [E]}}{10\text{ s}}$

$= 4\text{ m/s [E]}.$



$\vec{v}_{av} = 4\text{ m/s [E]}.$

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

$\vec{\Delta d} = 82\text{ m [N]}. \quad \Delta t = 15\text{ s}.$

$\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t} = \frac{82\text{ m [N]}}{15\text{ s}} = 5.5\text{ m/s [N]}.$

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

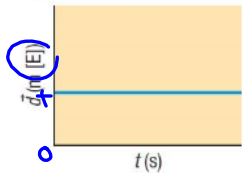
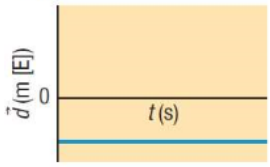
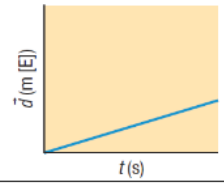
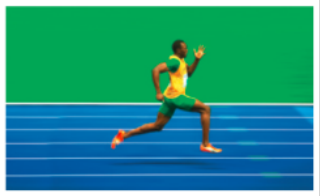
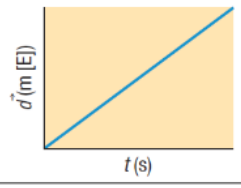
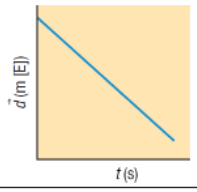
$\vec{v}_{av} = 22.3\ \frac{km}{h} \times \frac{1000\text{ m}}{1\text{ km}} \times \frac{1\text{ h}}{60\text{ min}} \times \frac{1\text{ min}}{60\text{ s}} = 22.3 \times \frac{1000}{3600} = 6.194\text{ m/s}.$

$\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t} \rightarrow \Delta t = \frac{\vec{\Delta d}}{v_{av}} = \frac{241\text{ m [W]}}{6.194\text{ m/s [W]}} = 38.9\text{ s}$

3. Motion with uniform and non-uniform velocity

Uniform velocity:	constant velocity in a straight line.
Non-uniform velocity:	velocity that changes or does not travel in a straight line.
accelerated motion	another name for non-uniform velocity.

Example	Uniform?	Why?
A car travels down a straight highway at a steady 100 km/h.	✓	- straight line - constant velocity.
A passenger on an amusement park ride travels in a circle at a constant speed of 1.2 m/s.	✗	- not a straight line.
A parachutist jumps out of an aircraft.	✗	- accelerating towards Earth.

Position-Time Graph	Type of Motion	Example
Graph A 	-at rest. - $\vec{v}=0$, $\vec{a}=0$. - East of reference.	
Graph B 	-at rest. -West of reference.	
Graph C 	-constant velocity. -uniform motion. -moving East.	
Graph D 	-constant velocity - moving East - faster	
Graph E 	-constant velocity. -moving West.	

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