L02 - Uniform Motion in 1-Dimension

Agenda:

- Formative Quiz
- Simple Questions
- Graphs - Velocity is the Rate of Change of Position
- Multi-Step Questions
- Diagramming Algebraic Questions

Simple Questions

Displacement ($\vec{\Delta d}$): Change of Position ($\vec{\Delta d} = \vec{d}_f - \vec{d}_i$)

Time Interval (Δt): Change in Time ($\Delta t = t_f - t_i$)

1) $\vec{v} = \frac{\vec{\Delta d}}{\Delta t}$ ⇦ $\vec{\Delta d} = \vec{d}_f - \vec{d}_i$

2) $\vec{\Delta v} = \frac{\vec{d}_f - \vec{d}_i}{\Delta t}$ ⇦ $\Delta t = t_f - t_i$

3) $\vec{v} = \frac{\vec{d}_f - \vec{d}_i}{t_f - t_i}$

A person starts 5.00 m to the left of a stop sign and ends up 20.0 m to the right of it in 5.00 s. What is the velocity of this person?

$\vec{d}_i = 5m[L]$ or $-5m[R]$

$\vec{d}_f = 20m[R]$

$t = 5s$

$\vec{v} = ?$

① $\vec{\Delta d} = \vec{d}_f - \vec{d}_i$

$= 20m[R] - (-5m[R])$

$= 25m[R]$

② $\vec{v} = \frac{\vec{\Delta d}}{\Delta t} = \frac{25m[R]}{5s}$

$\vec{v} = 5m/s[R]$

Alternate

$\vec{v} = \frac{\vec{d}_f - \vec{d}_i}{\Delta t}$

$\vec{v} = \frac{20m[R] - (-5m[R])}{5s}$

$\vec{v} = \frac{25m[R]}{5s} = 5m/s[R]$

Simple Questions

Displacement ($\vec{\Delta d}$): Change of Position ($\vec{\Delta d} = \vec{d}_f - \vec{d}_i$)

Time Interval (Δt): Change in Time ($\Delta t = t_f - t_i$)

1 $\vec{v} = \frac{\vec{\Delta d}}{\Delta t}$ $\Leftarrow$ $\vec{\Delta d} = \vec{d}_f - \vec{d}_i$

2 $\vec{\Delta v} = \frac{\vec{d}_f - \vec{d}_i}{\Delta t}$ $\Leftarrow$ $\Delta t = t_f - t_i$

3 $\vec{v} = \frac{\vec{d}_f - \vec{d}_i}{t_f - t_i}$

The earth moves at an average speed of 107 000 km/h. What distance, in metres, does the earth travel in a 24 hour period?

Option #1

$v = 107{,}000$ km/h

$t = 24$ h

$d =$

$v = \frac{d}{t}$ $\quad 107{,}000 = \frac{d}{24}$

$d = 2{,}568{,}000$ km

$d = 2.568 \times 10^9$ m

Answer in $a.bc \times 10^d$ m

2 5 6 8 9

Option #2

$\frac{107{,}000 \text{ km}}{\text{h}} \times \frac{1 \text{ h}}{3600 \text{ s}} \times \frac{1000 \text{ m}}{1 \text{ km}}$

$v = 29{,}722.\overline{2}$ m/s

$t = 24$ h $= 86{,}400$ s

$v = \frac{d}{t}$ $\quad 29{,}722.\overline{2} = \frac{d}{86{,}400}$

$d = 2.568 \times 10^9$ m

$\div 3.6$

$100 \frac{\text{km}}{\text{h}} = 27.\overline{7}$ m/s

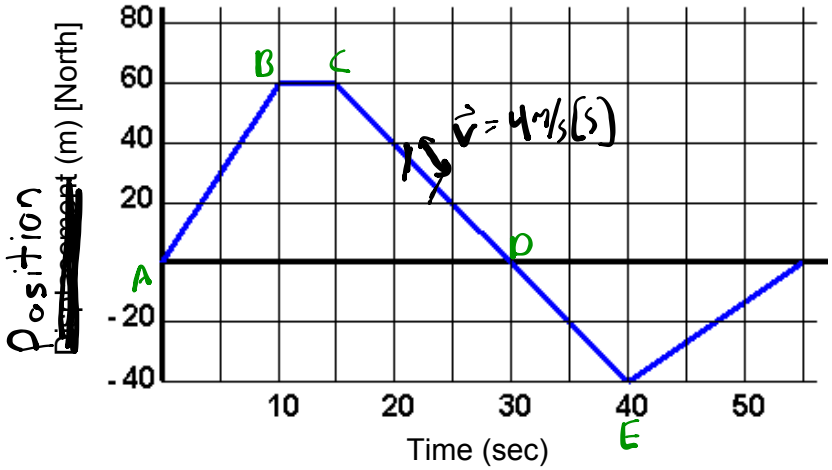
Graphs - Velocity is the Rate of Change of Position

https://phet.colorado.edu/en/simulation/legacy/moving-man

$$Slope = \frac{Rise}{Run}$$

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$$

$$\vec{v} = \frac{\vec{d_f} - \vec{d_i}}{t_f - t_i}$$



A→B

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{60 m [N]}{10 s} = 6 m/s [N]$ or Slope: $\frac{rise}{run} = \frac{60}{10} = 6 m/s [N]$

C→D

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{60 m [S]}{15 s} = 4 m/s [S]$

D→E

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{40 m [S]}{10 s} = 4 m/s [S]$

Multi-Step Questions

Displacement ($\vec{\Delta d}$): Change of Position ($\vec{\Delta d} = \vec{d}_f - \vec{d}_i$)

Time Interval (Δt): Change in Time ($\Delta t = t_f - t_i$)

1. $\vec{v} = \frac{\vec{\Delta d}}{\Delta t}$ ⇦ $\vec{\Delta d} = \vec{d}_f - \vec{d}_i$

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3. $\vec{v} = \frac{\vec{d}_f - \vec{d}_i}{t_f - t_i}$

Mr. Bayer and Mr. Kocher on racing bikes start from the electronic sign in front of the high school and are racing to Bloke's Bakery. The loser has to buy doughnuts. Mr. Bayer travels 5.0 m/s [East] and Mr. Kocher travels 4.5 m/s [East]. How much farther from the sign is Mr. Bayer than Mr. Kocher after 5.0 s?

Bayer

$\vec{v} = 5 m/s [E]$

$t = 5 s$

$\vec{\Delta d} = ?$

$\vec{v} = \frac{\vec{\Delta d}}{\Delta t}$

$5 m/s [E] = \frac{\vec{\Delta d}}{5 s}$

$\vec{\Delta d} = 25 m [E]$

Kocher

$\vec{v} = 4.5 m/s [E]$

$t = 5 s$

$\vec{\Delta d} = ?$

$\vec{v} = \frac{\vec{\Delta d}}{\Delta t}$

$4.5 m/s [E] = \frac{\vec{\Delta d}}{5 s}$

$\vec{\Delta d} = 22.5 m [E]$

⇨ (A) 2.5 m
(B) 22.5 m
(C) 25.0 m
(D) 47.5 m

Multi-Step Questions

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A man has a 120 mile trip to make, of which the first half is over congested highways, while the second half is over a good freeway. If he averages 40 mi / h over the first 60 miles, of what average speed must he drive the remaining 60 miles to average 60 mi / h for the entire trip.

Not 80 mi/h

Total Trip	First half	Second half
$d = 120$ mi $v = 60$ mi/h $t = ?$ $v = \frac{d}{t}$ $60 = \frac{120}{t}$ $\times t \quad \times t$ $60t = 120$ $\div 60 \quad \div 60$ $t = 2$ hours	$d = 60$mi $v = 40$ mi/h $t = ?$ $v = \frac{d}{t}$ $40 = \frac{60}{t}$ $\times t \quad \times t$ $40t = 60$ $\div 40 \quad \div 40$ $t = 1.5$ hours	$t = ?$ 0.5 hrs $d = 60$mi $v = ?$ $v = \frac{d}{t} = \frac{60}{0.5}$ $v = 120$ mi/h

Diagramming Algebraic Questions

Displacement ($\vec{\Delta d}$): Change of Position ($\vec{\Delta d} = \vec{d}_f - \vec{d}_i$)

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(2) $\vec{\Delta v} = \frac{\vec{d}_f - \vec{d}_i}{\Delta t}$ ⇦ $\Delta t = t_f - t_i$

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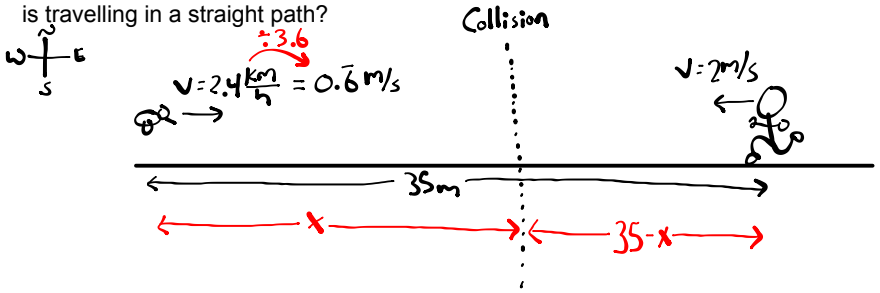
$2.4\ \frac{km}{h} \times \frac{1h}{3600s} \times \frac{1000m}{1km}$

A mosquito flies toward you with a velocity of 2.4 km/h [E]. If a distance of 35.0 m separates you and the mosquito initially, at what point (distance and time) will the mosquito hit your sunglasses if you are travelling toward the mosquito with a speed of 2.0 m/s and the mosquito is travelling in a straight path? 3



Mosquito

$v = 0.6\bar{6}$ m/s
$d = x$
$t = ?$

$v = \frac{d}{t}$
$\times t \quad \times t$
$vt = d$
$\div v \quad \div v$
$t = \frac{d}{v}$

$t = \frac{x}{0.6\bar{6}}$

Person

$v = 2$ m/s
$d = 35 - x$
$t = ?$

$v = \frac{d}{t}$
$t = \frac{d}{v}$

$t = \frac{35-x}{2}$

$t_1 = t_2$

$\frac{x}{0.6\bar{6}} = \frac{(35-x)}{2}$

$2x = 0.6\bar{6}(35-x)$

$2x = 23.\bar{3} - 0.6\bar{6}x$
$+0.6\bar{6}x \qquad +0.6\bar{6}x$

$2.6\bar{6}x = 23.\bar{3}$
$\div 2.6\bar{6} \quad \div 2.6\bar{6}$

$x = 8.75$ m

Mosquito goes 8.75m
Person goes 26.25m

$t = \frac{x}{0.6\bar{6}} = \frac{8.75}{0.6\bar{6}} = 13.125$ s