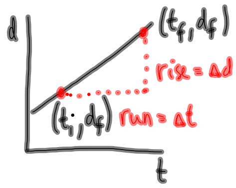
Velocity from Position-Time Graphs

If velocity is constant, you find the slope between ANY two points

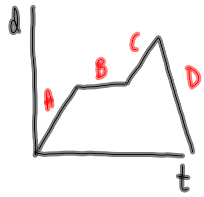


Slope = velocity

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

Slope = $\frac{\Delta d}{\Delta t}$ (just like $\frac{\Delta y}{\Delta x}$)

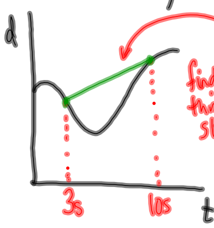
If you have constant velocity in different sections of the graph,



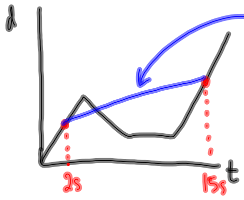
then you just find the slope in each section

(just like you did in investigation 2)

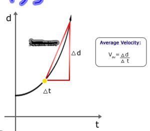
If the velocity is not constant, then you can find the average velocity from the slope of the line joining two points



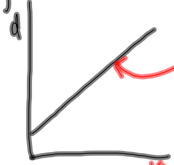
find this slope to find the average velocity between 3s and 10s.



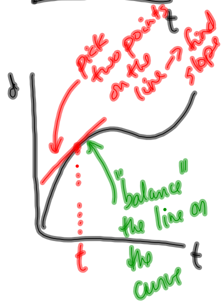
The slope of this line would be the average velocity between 2s and 15s.



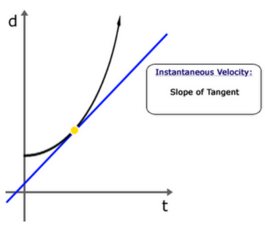
If you need to find the instantaneous velocity:

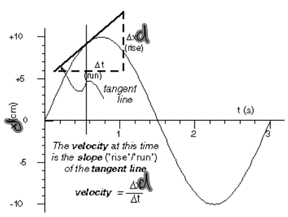


the instantaneous velocity here is always the same (ie. constant velocity)



Here the instantaneous velocity is changing since the d-t graph is curved. You just draw a tangent (eyeball it) and find the slope.





Another Car Problem

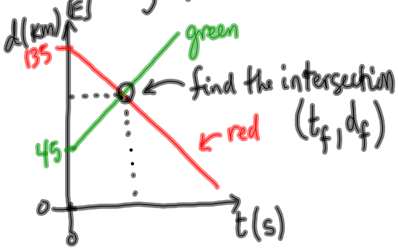
Red car: 18m/s [W] starting at 135km [E] of origin

Green car: 21m/s [E] starting at 45km [E] of origin

[E] → +

[W] → −

Sketch the d-t graph:



Write the equations:

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

So $\Delta d = v \Delta t$

$d_f - d_i = v(t_f - \cancel{t_i})$ 0

$d_f - d_i = v t_f$

$d_f = v t_f + d_i$ ← look familiar?

$(y = mx + b)$ ← it is just $y = mx + b$

Red car: $y = -(18\text{m/s})x + 135\text{km}$

Green car: $y = (21\text{m/s})x + 45\text{km}$

where x is the final time, y is the final position

Look! Watch the units.... You need to change to m!

Solve the system of equations:

$-(18\text{m/s})x + 135000\text{m} = (21\text{m/s})x + 45000\text{m}$

$+(18\text{m/s})x \quad -45000\text{m} \quad +(18\text{m/s})x \quad -45000\text{m}$

$90000\text{m} = (39\text{m/s})x$

$x = \frac{90000\text{m}}{39\text{m/s}}$

$x = 2308\text{s}$ (or $2.3 \times 10^3\text{s}$)

use unrounded answer to sub into green or red eq.

green: $y = (21\text{m/s})x + 45000\text{m}$

$y = (21\text{m/s})(2308\text{s}) + 45000\text{m}$

$y = 93461$ (9.3×10^4 m or 93 km)

final answer: It takes 2.3×10^3s for the cars to meet at 93km [E] of the origin.