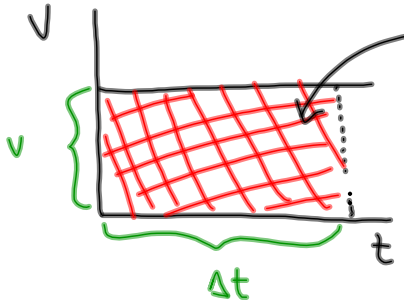
Acceleration & Displacement

If an object has constant velocity, then we can easily find its displacement using $v = \frac{\Delta d}{\Delta t} \Rightarrow \Delta d = v\Delta t$

What if the object has acceleration and the velocity is not constant? How can we find the displacement?

Consider an object with constant velocity:



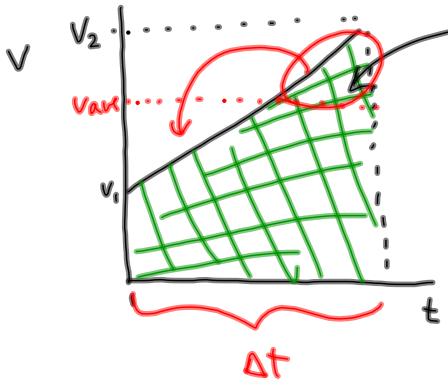
Area of rectangle = l x w

Area = $v\Delta t$

but $\Delta d = v\Delta t$

So $\text{Area}_{(v\text{-}t\ \text{graph})} = \Delta d$

Consider an object with constant acceleration:



area of trapezoid = $\frac{1}{2}(h_1 + h_2)\,b$

$\text{area} = \frac{1}{2}(v_1 + v_2)\,\Delta t$

Since area = displacement,

$\Delta d = \frac{1}{2}(v_1 + v_2)\,\Delta t$

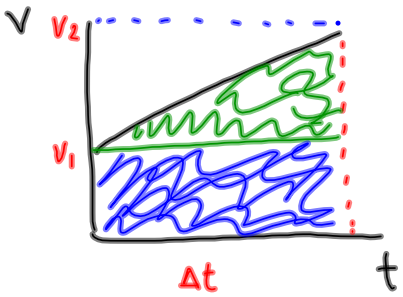
$\Delta d = \frac{(v_1 + v_2)}{2}\,\Delta t$

$\Delta d = v_{ave}\,\Delta t$

$\left(v_{ave} = \frac{\Delta d}{\Delta t}\right)$ really comes from this.

YOU CAN ONLY DO THIS IF there is constant acc.

$v_{ave} = \left(\frac{v_1 + v_2}{2}\right)$



area = ▭ + △

$$\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$$

$$\Delta d = v_2 \Delta t - \frac{1}{2} a (\Delta t)^2$$

$$v_2^2 = v_1^2 + 2a\Delta d$$

May be useful.