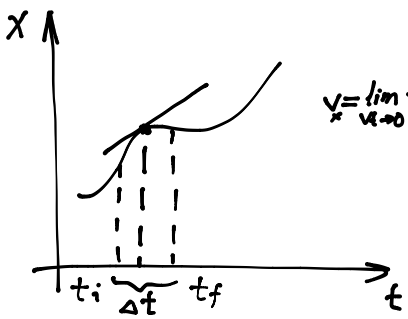
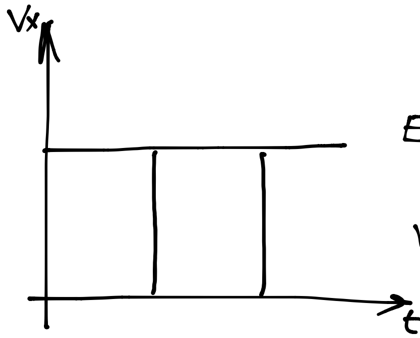
Jan 16th, 2013



$v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$



Example: velocity is constant

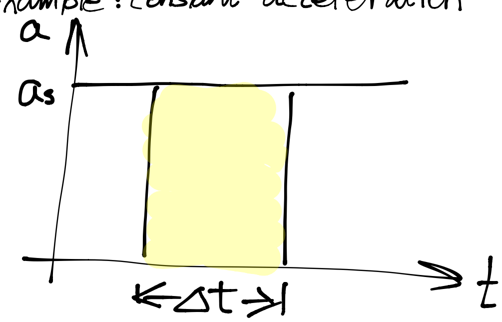
$V_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{\Delta X}{\Delta t}$

$\Rightarrow \Delta x = \underbrace{V_x \Delta t}_{\text{area under the line}}$

$$\Delta x = \lim_{\Delta t_i \to 0} (V_x)_i (\Delta t_i)$$

$$= \int_{t_i}^{t_f} V_x \, dt = \text{area under } V_x\text{-versus-}t \text{ curve}.$$

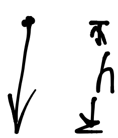
Example: constant acceleration



A tennis ball falling from the ceiling of Mp 102.

MODEL: Use the particle model. Assume that air resistance is negligible.

VISUALISE: $t_0, V_0 = 0$ m/s, y_0



$t_1, V_1 = ?$ $y_1 = 0$ m

SOLVE: For constant acceleration a_s, $\Delta s = V_{si}\Delta t + \frac{1}{2} a_s (\Delta t)^2$

$$\Delta y = V_0 \Delta t + \frac{1}{2} a_y (\Delta t)^2$$

$$y_1 - y_0 = V_0 (t_1 - t_0) + \frac{1}{2}(-g)(t_1 - t_0)^2$$

g = acceleration due to gravity.

$$y_1 - y_0 = (0\,m/s)(t_1 - t_0) - \frac{1}{2} g (t_1 - 0\,s)^2$$

$$0\,m - y_0 = -\frac{1}{2} g t_1^2$$

$$\sqrt{\frac{2y_0}{g}} = t_1$$

For MP102, $g = 9.8\,m/s^2$ and $y_0 = 3.6$m

$$t_1 = \sqrt{\frac{2(3.6\,m)}{9.8\,m/s^2}} = 0.9\,s$$

ASSESS : Compare with actual measurement .