Recall: $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$ where $\Delta\vec{v} = \vec{v}_f - \vec{v}_i$

Example 2

+ dir

A skateboarder rolls down a hill with an average acceleration of +0.40m/s² (a). He is on the hill for 4.8s (Δt) and was going +10.1m/s (v_f) at the bottom of the hill. What was his velocity (v_i) at the start?

$\vec{a} = +0.40 m/s^2$

$\Delta t = 4.8 s$

$\vec{v}_f = +10.1 m/s$

$\vec{v}_i = ??$

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

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

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

$-\vec{v}_f \quad -\vec{v}_f$

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

$-\vec{a}\Delta t + \vec{v}_f = \vec{v}_i$

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

Δv

$\vec{v}_i = +10.1 m/s - (+0.40 \frac{m}{s^2})(4.8 s)$

$\vec{v}_i = +10.1 m/s - 1.92 m/s$

Δv

$\frac{m}{s^2} \cdot s = \frac{m}{s}$

$\vec{v}_i = +8.18 m/s$

$\vec{v}_i = 8.2 m/s$ [downhill]

Example 3

A ball is dropped and falls until it reaches a velocity of 29.8m/s [down]. How long was it falling?

$v_i = 0$

implies $\vec{a} = 9.81 m/s^2$ [down] (near Earth's surface)

v_f Δt

down = +

$\vec{v}_i = 0 m/s$

$\vec{v}_f = +29.8 m/s$

$\vec{a} = +9.81 m/s^2$

$\Delta t = ?$

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

$$\vec{a}\Delta t = \Delta \vec{v}$$

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

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

$$\Delta t = \frac{+29.8 m/s - 0}{+9.81 m/s^2}$$

$$\Delta t = \frac{+29.8 m/s}{+9.81 m/s}$$

$$\Delta t \doteq 3.037716616\ldots s$$

$$\boxed{\Delta t = 3.04 s}$$

Watch out for units

$\frac{km}{h} \rightarrow \frac{m}{s}$