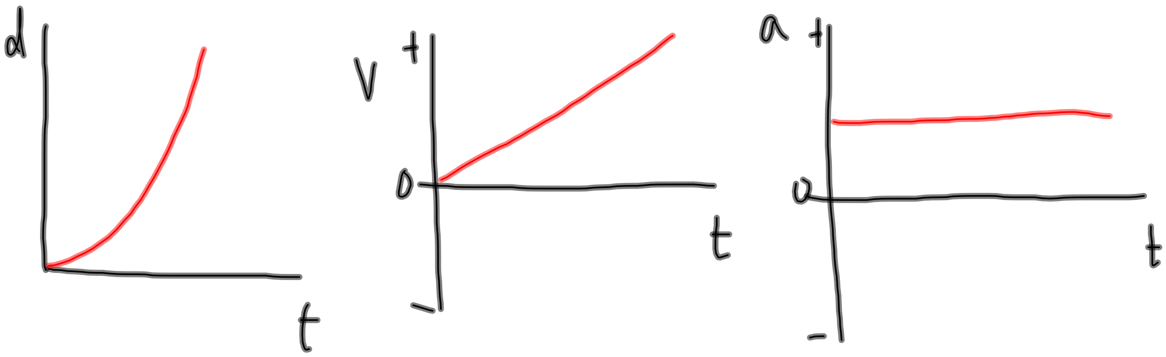
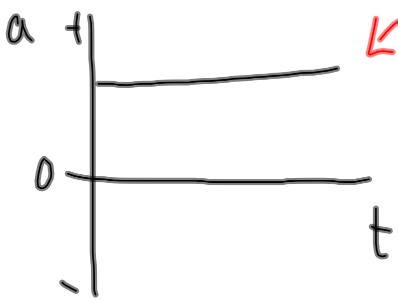
Acceleration

Sketch d-t / v-t / a-t graphs for:

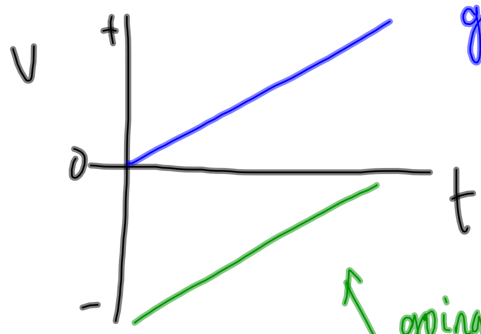
going away and speeding up steadily



What ways can you get positive acceleration?



+ acc ⇒ + slope on velocity · time graph

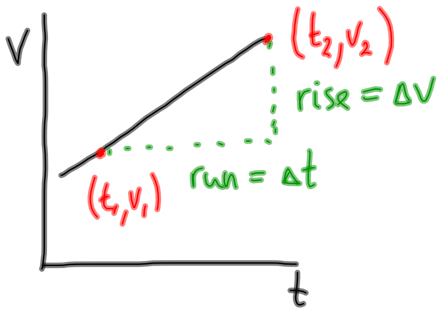


going away / steadily speeding up

↑ going towards / steadily slowing down


Logger Pro - L02IN4A2*
File Edit Experiment Data Analyze Insert Options Page Help
Page 1
Collect
Velocity (m/s)
Linear Fit for: Latest | Velocity
Correlation: 0.9997
RMSE: 0.001013 m/s
m (Slope): 0.09643 m/s/s
Slope = 0.09643 m/s/s
slope = acceleration
(Δt:1.38 Δv:0.000)
Time (s)
Acceleration (m/s^2)
Statistics for: Latest | Acceleration
max: 0.1090 at 0.6000
mean: 0.09566
samples: 28
mean acceleration = 0.09566 m/s²
(Δt:1.38 Δy:0.013)
Time (s)

Consider an object that has constant acceleration:



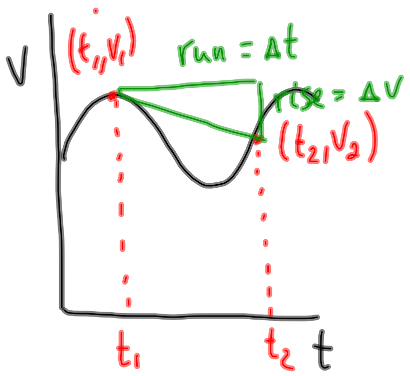
$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$\text{slope} = \frac{\Delta v}{\Delta t}$$

From previous demo, we know that slope = acceleration.

$$\therefore \quad a = \frac{\Delta v}{\Delta t}$$

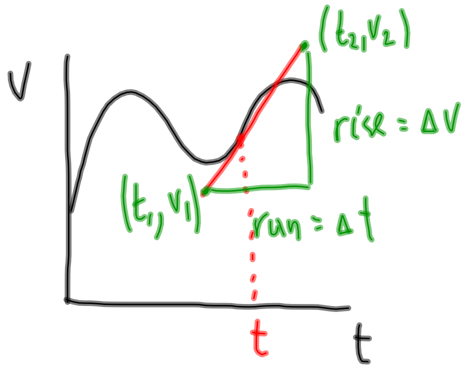
Consider when the acceleration is not constant:



$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$a_{ave} = \frac{\Delta v}{\Delta t}$$

Average acceleration is the slope of the line between t_1 and t_2.



$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$a_{inst} = \frac{\Delta v}{\Delta t}$$

The instantaneous acceleration is the slope of the tangent at time t.

The acceleration equation:

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

Acceleration is a vector quantity. There will be acceleration if an object's speed and/or direction changes.

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

Where $\vec{a}$ is the acceleration (m/s/s or m/s^2)

$$\frac{m}{s} \div s = \frac{m}{s} \cdot \frac{1}{s} = \frac{m}{s^2}$$

$\Delta \vec{v}$ is the change in velocity (m/s)

note: $\Delta \vec{v} = \vec{v}_2 - \vec{v}_1$

Δt is the time interval (s)

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$\vec{a} = 5.2 m/s^2$ [downhill]

$\Delta t = 8.5 s$

$\vec{V}_2 = ?$

$\vec{V}_1 = 0$ (implied)

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

$$\vec{a} = \frac{\vec{V}_2 - \vec{V}_1}{\Delta t}$$

$$\vec{a}\Delta t = \vec{V}_2 - \vec{V}_1$$

$$\vec{V}_2 = \vec{V}_1 + \vec{a}\Delta t$$

$$\vec{V}_2 = 0 m/s + (5.2 m/s^2 \text{ [downhill]})(8.5 s)$$

$$\vec{V}_2 \doteq 44 \frac{m}{s}$$

$$\frac{m}{s^2} \cdot \frac{s}{1} = \frac{m}{s}$$

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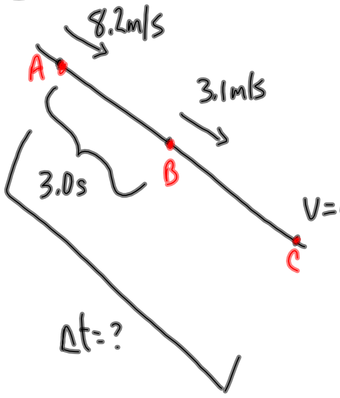

Find the acceleration between A and B:

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

$$\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$$

$$\vec{a} = \frac{3.1\,m/s\,[downhill] - 8.2\,m/s\,[downhill]}{3.0\,s}$$

$$\vec{a} = \frac{-5.1\,m/s\,[downhill]}{3.0\,s}$$

$$\vec{a} = -1.7\,m/s^2\,[downhill]$$

The acceleration between A and C is also $-1.7\,m/s^2$ [downhill].

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

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

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

$$\Delta t = \frac{\vec{v}_2 - \vec{v}_1}{\vec{a}}$$

$$\Delta t = \frac{0 - 8.2\,m/s\,[downhill]}{-1.7\,m/s^2\,[downhill]}$$

$$\Delta t = \frac{-8.2\,m/s\,[downhill]}{-1.7\,m/s^2\,[downhill]}$$ directions must match

$$\Delta t \doteq 4.8\,s$$

$$\frac{m/s}{m/s^2} = \frac{m}{s} \div \frac{m}{s^2} = \frac{m}{s} \times \frac{s^2}{m} = s$$

The skier stopped 4.8 s after she fell.

TO DO:

1. PP|80
2. Calculator Pad
3. Changing Motion