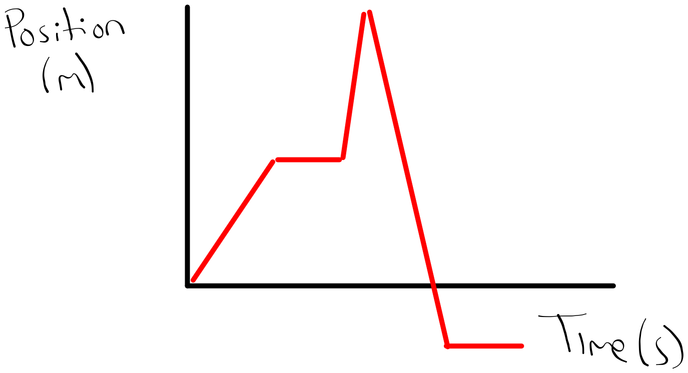
P-T Graphs



Slope = Velocity

$m = \frac{\Delta y}{\Delta t} = \frac{y_2 - y_1}{x_2 - x_1} \rightarrow \frac{d}{t}$

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

Pos⁺ slope → Moving forward

Zero slope → Stopped Moving

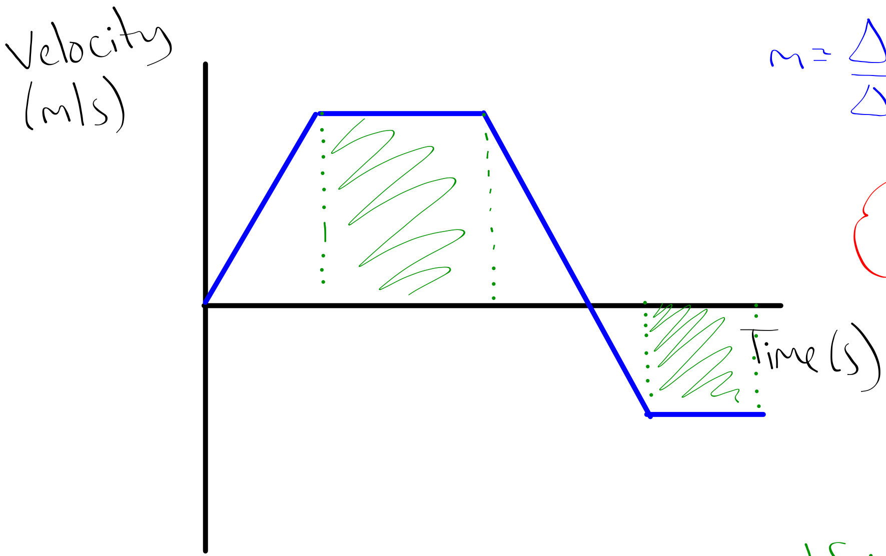
Neg⁻ slope → Moving backwards

V-T Graph

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

$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta v}{\Delta t}$

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



If: $\frac{m}{s} \times s \rightarrow m$

Slope = acceleration

Above y = 0
- Pos⁺ → Speeding up (forwards)
- Zero → Constant speed
- Neg → Slowing down (forwards)

Below y = 0
- Pos⁺ → Slowing Down (backwards)
- Zero → Constant speed
- Neg⁻ → Speeding up (backwards)

Area Under Curve = Displacement

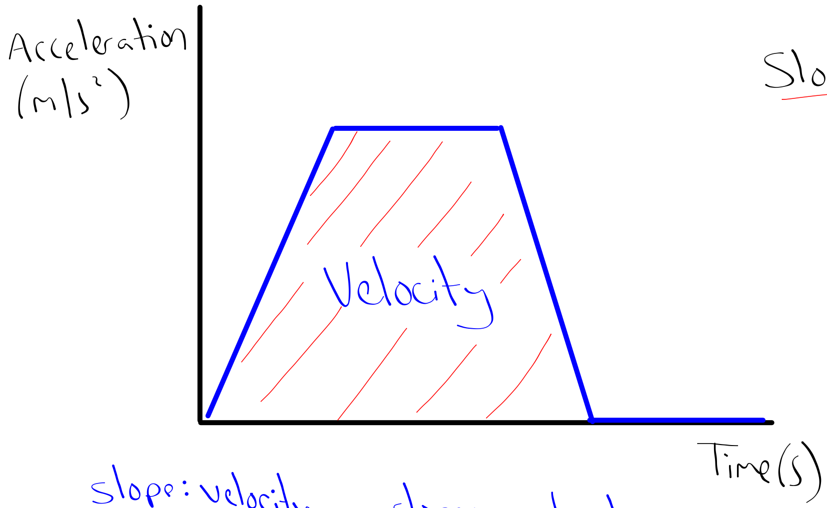
Pos⁺ = Moving Forward

Neg⁻ = Moving backwards

Recall:

- Rectangle: $A = b \times h$
- Triangle: $A = \frac{b \times h}{2}$
- Trapezoid: $A = \frac{(B + b) \times h}{2}$

Acceleration-Time Graph
(A-T Graph)

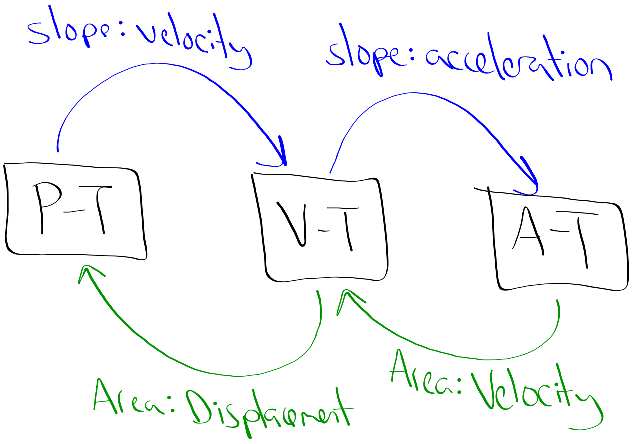


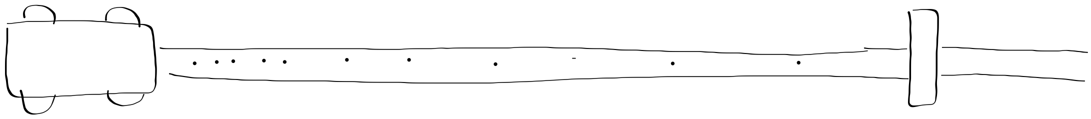
Slope: $\frac{m}{s^2} \div s$

$= \frac{m}{s^3}$ ← No meaning

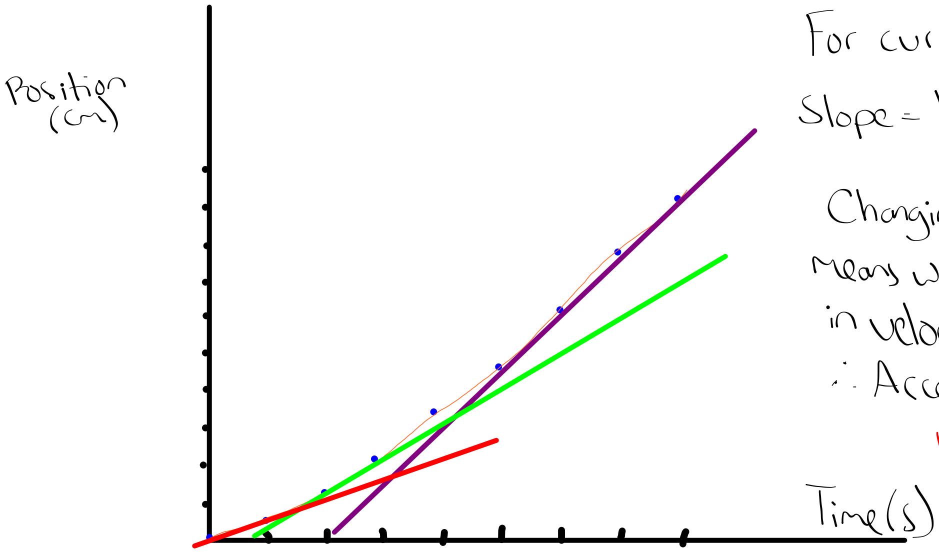
Area: $\frac{m}{s^2} \times s = \frac{m}{s}$

Velocity





Time(s)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Position(cm)	0	0.5	1.2	2.1	3.2	4.5	6.0	7.7	9.2



For curved P-T graphs

Slope = Instaneous Velocity

Changing slope values means we have a change in velocity.

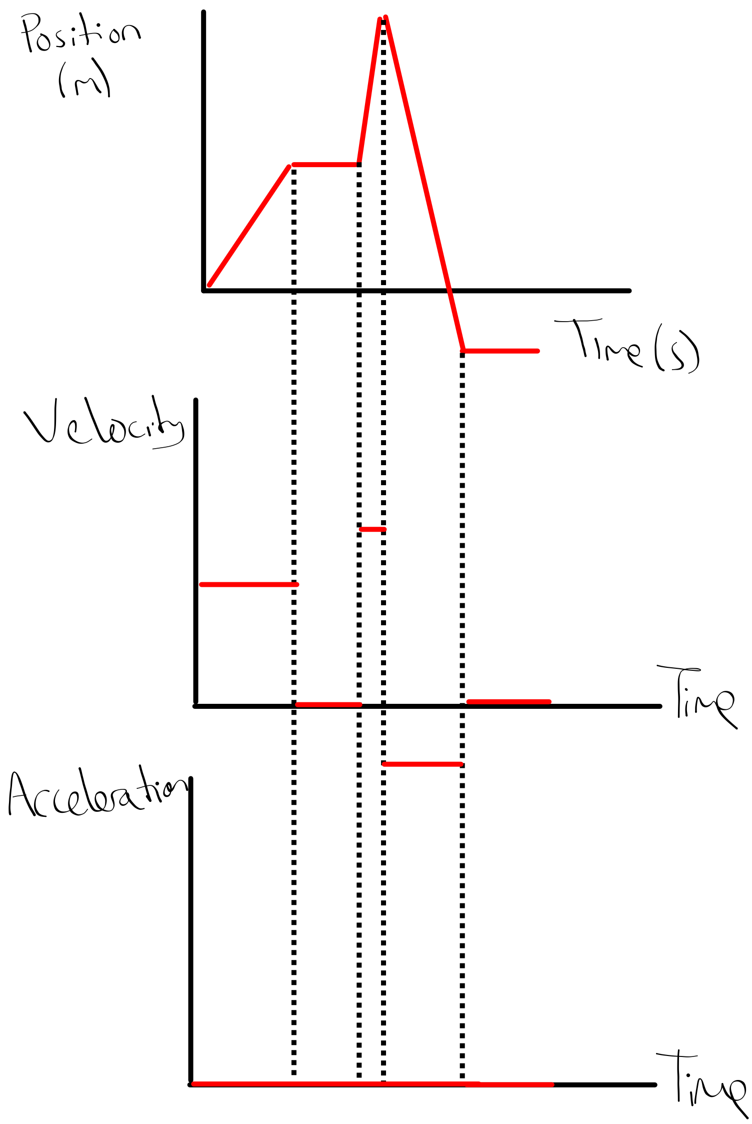
∴ Acceleration is present

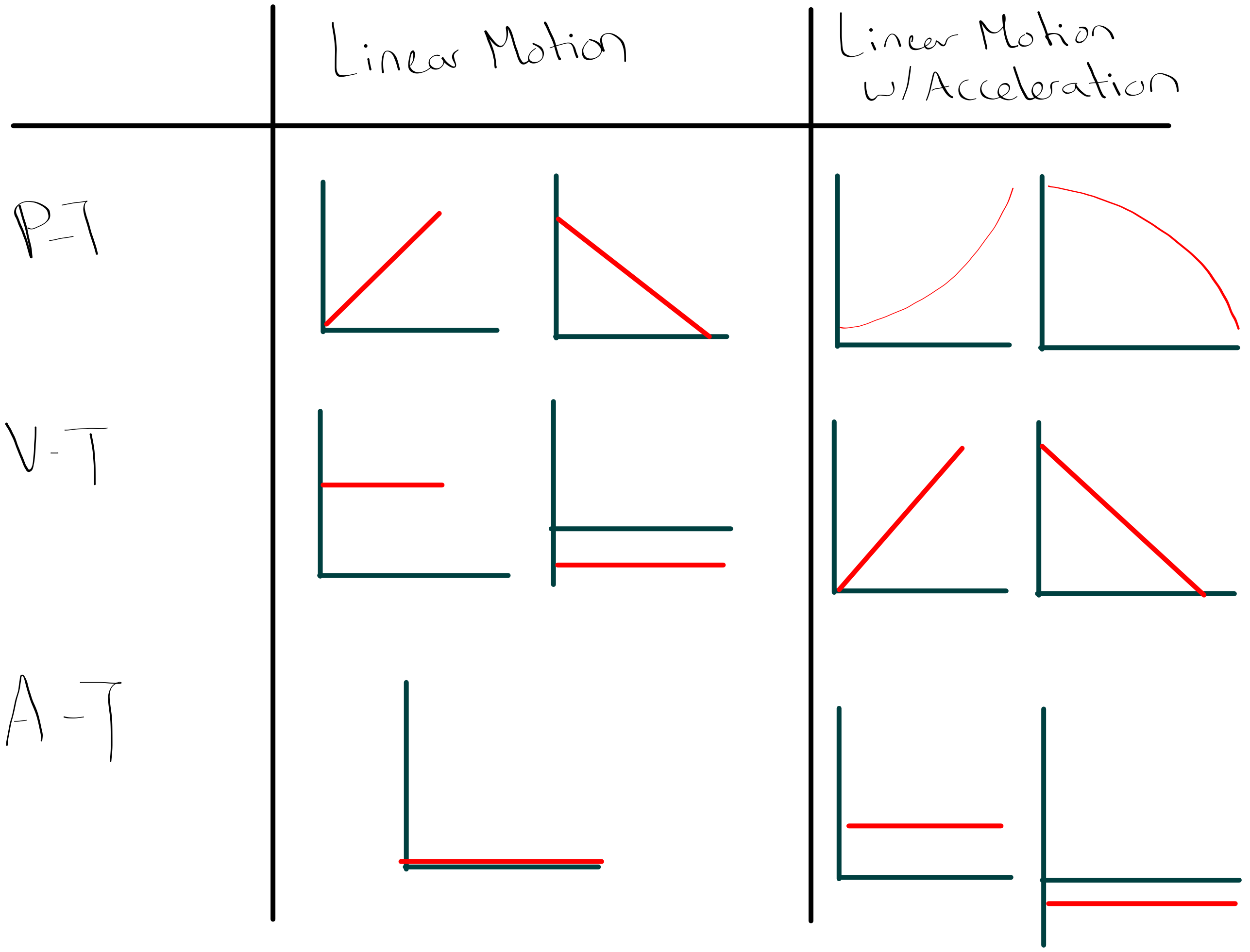
Uniform acceleration

- What would the V-T graph look like?
- What would the A-T graph look like?

V-T

A-T


Position (m)
Time (s)
Velocity
Time
Acceleration
Time


Linear Motion
Linear Motion w/ Acceleration
P-T
V-T
A-T

Kinematics Equations

- Linear Motion
- Constant acceleration

Recall:

$v = \frac{d}{t}$ $\Downarrow$ $d = v \cdot t$

$a = \frac{v}{t}$ $\Downarrow$ $v = a \cdot t$

$$a = \frac{V_f - V_i}{t} \Rightarrow V_f = V_i + at$$

$t_i = 0\,s$

$$d = v_i t + \frac{1}{2} a t^2$$

$$V_f^2 = V_i^2 + 2ad$$

Ex. You have a rocket hidden in your backpack. When class ends you fire up your rocket and head home in a straight line 15 km away. Assuming the rocket accelerates you at $250\ m/s^2$, how long will it take you to get home and binge watch "Stranger Things"?

$a = 250\ m/s^2$

$d = 15\ km = 15000\ m$

$V_i = 0\ m/s$

$t = ?$

$d = v_i t + \frac{1}{2}at^2$ ($v_i = 0$)

$d = \frac{1}{2}at^2$

$\frac{2d}{a} = t^2$

$\sqrt{\frac{2d}{a}} = t$

$\sqrt{\frac{2(15000)}{250}} = t$

$t = 10.95\ s$

What would be my speed at 6.3 seconds after take off?

$V_f = ?$

$t = 6.3\ s$

$a = 250\ m/s^2$

$V_i = 0\ m/s$

$V_f = V_i + at$ ($V_i = 0$)

$V_f = a \cdot t$

$V_f = (250\ m/s^2)(6.3\ s)$

$V_f = 1575\ m/s$

Ex. You are riding your bike over a distance of 30m. You decide to raise your velocity up to 6.2 m/s with an acceleration of 0.5 m/s^2.

A) What is your initial speed?

B) How long did it take you to cover that distance?