Simplest type of motion: \textbf{Standing Still}.

\[ x = \text{constant} = x_1 \text{ (position at the initial time, often } t_1 = 0 \text{ s)} \]

\[ v_x = 0 \text{ m/s} \]

\[ a_x = 0 \text{ m/s/s} \]
– Motion of an object **after** given a push, but then moving freely.

\[ x = mt + b = v_{1x}t + x_1 \]

\[ v_x = constant = v_{1x} \] (velocity at the initial time, often \( t_1 = 0 \) s)

\[ a_x = 0 \text{ m/s/s} \]
– Motion of an object being \textit{continually} pushed (fan cart).

\[ x = c_2 t^2 + c_1 t + c_0 = \frac{1}{2} a_x t^2 + v_{1x} t + x_1 \]

\[ v_x = mt + b = a_x t + v_{1x} \]

\[ a_x = \text{constant} \]
Graphically:

– The *slope* of the *position* graph is the *value* of the *velocity*.
– The *slope* of the *velocity* graph is the *value* of the *acceleration*.

– The *value* of the *acceleration* is the *slope* of the *velocity* graph.
– The *value* of the *velocity* is the *slope* of the *position* graph.

– The *area* of the *velocity* graph is the *displacement*, $\Delta x = x_2 - x_1$. 
What if data collection starts at $t_1 \neq 0$ s

\[x = \frac{1}{2} a_x (t - t_1)^2 + v_{1x} (t - t_1) + x_1\]

\[v_x = a_x (t - t_1) + v_{x,1}\]

\[a_x = \text{constant}\]

We can combine the first two equations to get a third equation

\[v_x^2 = v_{1x}^2 + 2a_x (x - x_1)\]
The Kinematic Equations

\[ x = \frac{1}{2} a_x (t - t_1)^2 + v_{1x} (t - t_1) + x_1 \]

\[ v_x = a_x (t - t_1) + v_{1x} \]

\[ v_x^2 = v_{1x}^2 + 2a_x (x - x_1) \]

Only valid when

\[ a_x = \text{constant} \]