Kinematics equations in 1-D (assume \( t_0 = 0 \))

\[
\frac{\Delta x}{\Delta t} = v \\
\frac{\Delta v}{\Delta t} = a
\]

For \( a = \) constant we get:

\[
x = x_o + v_o t + \frac{1}{2}at^2 \\
v^2 = v_o^2 + 2a(x-x_o) \\
v = v_o + at
\]

**Newton’s Laws of Motion** (\( F \) and \( a \) are vectors)

1\(^{st}\). Objects have inertia.

2\(^{nd}\). \( \sum F = ma \), the net force on a body causes acceleration.

3\(^{rd}\). \( F_{AB} = -F_{BA} \), 3\(^{rd}\) law pairs do not act on the same body.

**Equilibrium**

For a body in equilibrium:

\[ \sum F = 0 \]

**Friction**

Static Friction:

\[ f_{s,\text{max}} = \mu_s N \]

\( f_s \) increases with applied force until applied force exceeds \( f_{s,\text{max}} \), then object starts moving.

Kinetic Friction:

\[ f_k = \mu_k N \]

\( f_k \) is a constant.

**Springs**

Hooke's Law:

\[ F = -kx, \]

where the equilibrium position of the spring is \( x = 0 \).

**Tension**

Tension in a massless string is transmitted perfectly.