Task:

1. You're riding a unicorn at 25 m/s and come to a uniform stop at a red light 20 m away. What's your acceleration?

Solution:

Due to Newton's second law:

$\sum F = ma$

$a = \frac{\sum F}{m}$

$a = \dot{v}$

$v = \int a\,dt = at + v_0$

$t = \left(\frac{v - v_0}{a}\right)$

$v = \dot{s}$

$$s = \int v\,dt = \int (at + v_0)\,dt = \frac{at^2}{2} + v_0 t + s_0 = \frac{a\left(\frac{v - v_0}{a}\right)^2}{2} + v_0\left(\frac{v - v_0}{a}\right) + s_0 =$$

$$= \frac{v^2 - 2vv_0 + {v_0}^2}{2a} + \frac{vv_0 - {v_0}^2}{a} + s_0 = \frac{v^2 - {v_0}^2}{2a} + s_0$$

Given:

$s = 20\ m,$

$v_0 = 25\frac{m}{s}$

$s_0 = 0\ m$

$v = 0\frac{m}{s}$

$$20\ m = -\frac{\left(25\frac{m}{s}\right)^2}{2a}$$

$$a = -\frac{\left(25\frac{m}{s}\right)^2}{20\ m} = -31.25\frac{m}{s^2}$$

Answer:

$a = -31.25\frac{m}{s^2}$