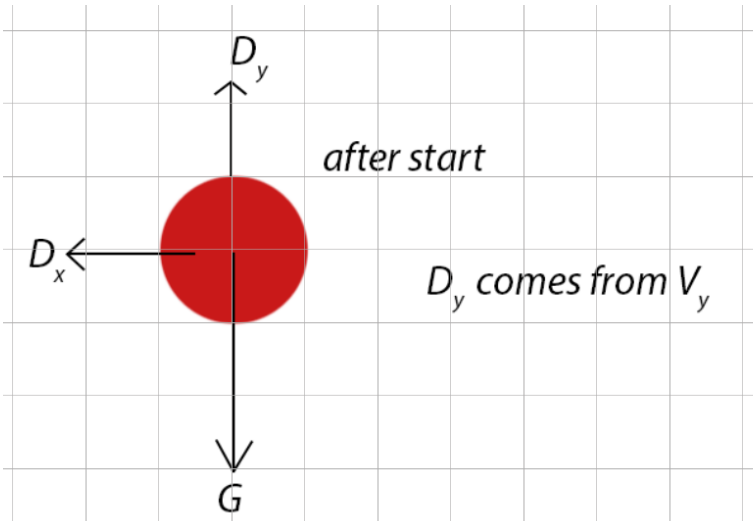
Vertical Total Force Equation

Drag Equation:

$$D = C_d \times A \times \rho \times \frac{V^2}{2}$$

Newton Force Law:

$$F = m \times a$$



We are gonna find total vertical force

(G-Dy)

$$ma = mg - D \qquad a = \frac{dv}{dt}$$

$$\frac{mdv}{mdt} = \frac{mg}{m} - \frac{D}{m}$$

$$\frac{dv}{dt} = -\frac{D}{m} + g \qquad D = k \times V^2$$

$$\frac{dv}{dt} = -\frac{k \times V^2}{m} + g$$

$$\frac{dv}{dt} = -\frac{k}{m}\left(V^2 - \frac{mg}{k}\right)$$

$$\frac{dv}{V^2 - \frac{mg}{k}} = -\frac{k}{m} \times (dt)$$

$$\int_0^{V'} \frac{1}{V^2 - \frac{mg}{k}} \times dv = \int_0^{t'} -\frac{k}{m} \times dt$$

$$\frac{k \times \ln\left(\frac{\left|kV' - \sqrt{gkm}\right|}{\left|kV' + \sqrt{gkm}\right|}\right)}{2\sqrt{gkm}} = -\frac{k}{m}(t')$$

$$\ln\left(\frac{|kV' - \sqrt{gkm}|}{|kV' + \sqrt{gkm}|}\right) = -\frac{2\sqrt{gkm}}{m}(t')$$

[No need to use absolute values for here because our range (0,+∞)y , (0,+∞)x]

[For the correct value range we are gonna multiply with (-1) upper side]

$$\ln\left(\frac{-kV' + \sqrt{gkm}}{kV' + \sqrt{gkm}}\right) = -\frac{2\sqrt{gkm}}{m}(t')$$

$$\frac{-kV' + \sqrt{gkm}}{kV' + \sqrt{gkm}} + 1 - 1 = e^{-\frac{2t'\sqrt{gkm}}{m}}$$

$$\frac{2\sqrt{gkm}}{kV' + \sqrt{gkm}} - 1 = e^{-\frac{2t'\sqrt{gkm}}{m}}$$

$$\frac{2\sqrt{gkm}}{kV' + \sqrt{gkm}} = e^{-\frac{2t'\sqrt{gkm}}{m}} + 1$$

$$\frac{2\sqrt{gkm}}{e^{-\frac{2t'\sqrt{gkm}}{m}} + 1} = kV' + \sqrt{gkm}$$

$$\frac{2\sqrt{gkm}}{e^{-\frac{2t'\sqrt{gkm}}{m}} + 1} - \sqrt{gkm} = kV'$$

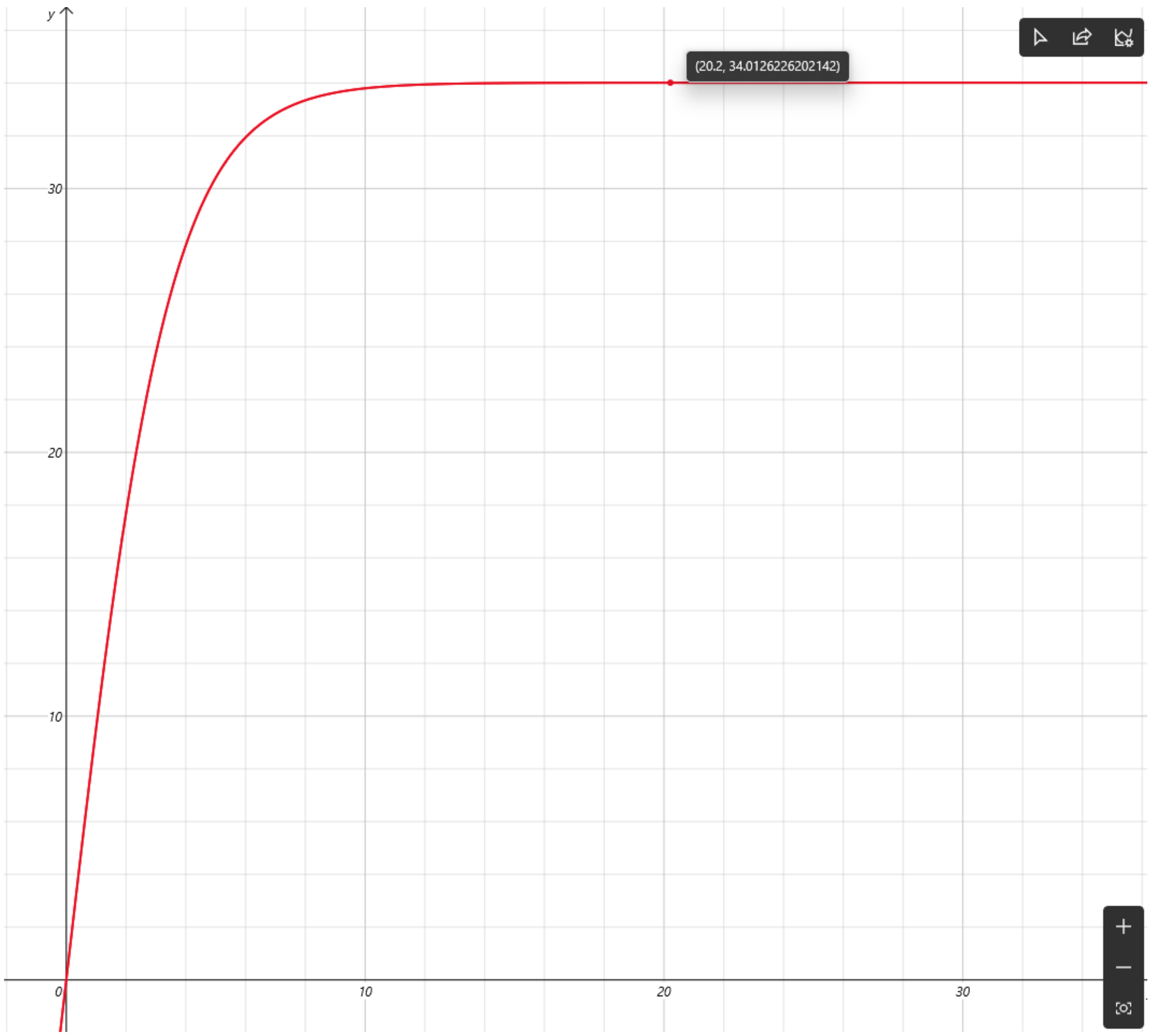
$$\frac{\frac{2\sqrt{gkm}}{e^{-\frac{2t'\sqrt{gkm}}{m}} + 1} - \sqrt{gkm}}{k} = V'$$

$$\frac{\frac{\sqrt{gkm}-e^{-\frac{2t'\sqrt{gkm}}{m}}\times\sqrt{gkm}}{e^{-\frac{2t'\sqrt{gkm}}{m}}+1}}{k}=V'$$

$$\frac{\frac{\sqrt{gkm}\times\left(1-e^{-\frac{2t'\sqrt{gkm}}{m}}\right)}{e^{-\frac{2t'\sqrt{gkm}}{m}}+1}}{k}=V'$$

$$\frac{\sqrt{gkm}\times(1-e^{-\frac{2t'\sqrt{gkm}}{m}})}{(e^{\frac{-2t'\sqrt{gkm}}{m}}+1)\times k}=V'$$

$$\frac{\sqrt{gkm}\times(1-e^{-\frac{2x\sqrt{gkm}}{m}})}{(e^{\frac{-2x\sqrt{gkm}}{m}}+1)\times k}=y$$



$$C_d = 0{,}48$$

$$A = 0{,}00441786466 40625m^2$$

$$\rho = 1{,}15923kg/m^3$$

$$g = 9{,}80665m/s^2$$

$$m = 0{,}145kg$$

$$k = 0{,}0012291171010850812 5$$

$$\sqrt{gkm} = 0{,}0418062265315421854068843434 0944$$