

$$\text{Stel } b = \frac{1}{2} c_d \rho A$$

$$\text{luchtweerstand (Drag Force): } F_d = \frac{1}{2} c_d \rho A v^2 = b v^2$$

1. Bepaal  $v(t)$
2. Wat is de eindsnelheid van de parachutist?

$$mg - F_d = ma$$

$$mg - b v^2 = m \frac{dv}{dt} \quad \text{delen door m}$$

$$\frac{dv}{dt} = g - \frac{b v^2}{m} \quad \text{factor out } \frac{b}{m}$$

$$\frac{dv}{dt} = \frac{b}{m} \left( g \frac{m}{b} - v^2 \right) \quad \text{constante } g \frac{m}{b} = k^2$$

$$\frac{dv}{dt} = \frac{b}{m} (k^2 - v^2)$$

$$\frac{dv}{dt} = -\frac{b}{m} (v^2 - k^2) \quad \text{scheiden van variabelen}$$

$$dv = -\frac{b}{m} (v^2 - k^2) dt$$

$$\frac{dv}{v^2 - k^2} = -\frac{b}{m} dt$$

$$\int \frac{dv}{v^2 - k^2} = -\frac{b}{m} \int dt$$

$$\int \frac{dv}{(v - k)(v + k)} = -\frac{b}{m} t + c_1$$

$$\frac{1}{2k} \int \left( \frac{1}{v - k} - \frac{1}{v + k} \right) dv = -\frac{b}{m} t + c_1$$

$$\frac{1}{2k} \int \left( \frac{dv}{v - k} - \frac{dv}{v + k} \right) = -\frac{b}{m} t + c_1$$

$$\frac{1}{2k} [\ln(v - k) - \ln(v + k)] = -\frac{b}{m} t + c_1$$

$$\frac{1}{2k} \ln \left( \frac{v - k}{v + k} \right) = -\frac{b}{m} t + c_1$$

$$\ln \left( \frac{v - k}{v + k} \right) = -\frac{2kb}{m} t + c_1 \quad \text{Antilog}$$

$$e^{\ln \left( \frac{v - k}{v + k} \right)} = e^{-\frac{2kb}{m} t + c_1}$$

$$\frac{v - k}{v + k} = c e^{-\frac{2kb}{m} t}$$

$$v - k = (v + k) c e^{-\frac{2kb}{m} t}$$

$$v - v c e^{-\frac{2kb}{m} t} = k + k c e^{-\frac{2kb}{m} t} = k (c e^{-\frac{2kb}{m} t} + 1)$$

$$v \left( 1 - c e^{-\frac{2kb}{m} t} \right) = k (c e^{-\frac{2kb}{m} t} + 1)$$

$$v = \frac{k(1 + c e^{-\frac{2kb}{m} t})}{1 - c e^{-\frac{2kb}{m} t}}$$