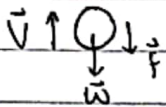


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Meningkau benda yang ingin bergerak vertikal ke atas dengan pengaruh gaya gesekan kuadratik $f = -bv^2$



$$\Sigma F = m \cdot a$$

$$-w - f = m \cdot a$$

$$-mg - bv^2 = m \cdot a$$

$$\int_{v_0}^{v_t} \frac{dv}{-g - \frac{bv^2}{m}} = \int_0^t dt$$

$$\int_{v_0}^{v_t} \frac{f}{v - g - \frac{bv}{m}} dv = \int_0^t dt$$

Misal $-g - \frac{bv}{m} = u$

$$-\frac{b}{m} dv = du$$

$$dv = \frac{m}{b} du$$

$$\int \frac{1}{u} \left(-\frac{m}{b} du \right) = -\frac{m}{b} \int \frac{1}{u} du = \frac{m}{b} \ln(u)$$

$$\int_{v_0}^{v_t} \frac{1}{-g - \frac{bv^2}{m}} dv = \int_0^t dt$$

$$-\frac{m}{bv} \ln(u) = t$$

$$-\frac{m}{bv} \ln \left[-g - \frac{bv^2}{m} \right]_{v_0}^{v_t} = t$$

$$-\frac{m}{bv} \left(\ln \left[-g - \frac{bv^2}{m} \right] \right)_{v_0}^{v_t} = t$$

$$\frac{-g - \frac{bv_t}{m}}{-g - \frac{bv_0}{m}} = e^{\frac{-bv^2}{m}}$$

$$-g - \frac{b}{m} v_t = \left(-g - \frac{b}{m} v_0 \right) e^{\frac{-bv^2}{m}}$$

$$v_t = -\frac{mg}{bv} - \left(-\frac{mg}{bv} - v_0 \right) e^{\frac{-bv}{m}}$$

$$f = -w$$

$$bv = mg$$

$$v_T = \frac{mg}{bv}$$

$$v(t) = v_T - (v_T - v_0) e^{\frac{-bvt}{m}}$$

$$a(t) = dv(t)$$

$$dt$$

$$= \frac{d}{dt} (v_T - (v_0 - v_T) e^{\frac{-bvt}{m}})$$

$$= 0 - (-v_0 + v_T) \left(-\frac{bv}{m} \right) e^{\frac{-bvt}{m}}$$

$$= \frac{bv}{m} (-v_0 + v_T) e^{\frac{-bvt}{m}}$$

$$= -\frac{bv}{m} \left(v_0 + \frac{bv}{m} v_T \right) e^{\frac{-bvt}{m}}$$

$$= \left(\frac{bv}{m} - \frac{mg}{bv} - \frac{bv}{m} v_0 \right) e^{\frac{-bvt}{m}}$$

$$a(t) = \left(-g - \frac{b}{m} v_0 \right) e^{\frac{-bvt}{m}}$$

$$v(t) = dy(t)$$

$$dt$$

$$\int_{y_0}^{y_t} dy(t) = \int_0^t v(t) dt$$

$$y(t) = \int_0^t v_T - (v_0 + v_T) e^{\frac{-bvt}{m}}$$

$$y(t) = \left[v_T t - (-v_0 + v_T) \left(-\frac{m}{bv} \right) e^{\frac{-bvt}{m}} \right]_0^t$$

$$y(t) = \left[v_T t - (-v_0 + v_T) \left(-\frac{m}{bv} \right) e^{\frac{-bvt}{m}} \right] - \left[(-v_0 + v_T) \left(-\frac{m}{bv} \right) \right]$$

$$y(t) = v_T t - \left(-\frac{m}{bv} \right) (-v_0 + v_T) \left(e^{\frac{-bvt}{m}} \right)$$

$$y(t) = V_T + \frac{m}{bv} (-V_0 + V_T) (1 - e^{-\frac{bv}{m}t})$$

$$y(t) = V_T + \frac{m}{bv} (-V_0 + V_T) (1 - e^{-\frac{bv}{m}t})$$

$$V(t) = V_T - (-V_0 + V_T) e^{-\frac{bv}{m}t}$$

$$a(t) = \left(-g - \frac{bv}{m} V_0 \right) e^{-\frac{bv}{m}t}$$

Diaprosimasi

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

$$e^{-\frac{bv}{m}t} = 1 - \frac{bv}{m}t + \frac{1}{2} \left(\frac{bv}{m}t \right)^2 + \dots$$

$$y(t) = V_T + \frac{m}{bv} (-V_0 + V_T) (1 - e^{-\frac{bv}{m}t})$$

$$y(t) = V_T + (-V_0 + V_T) \left(t - \frac{1}{2} \frac{bv}{m} t^2 \right)$$

$$y(t) = V_0 + \frac{1}{2} \frac{bv}{m} V_0 t^2 + \frac{1}{2} \frac{bv}{m} \left(\frac{-mg}{bv} \right) t^2$$

$$b = 0$$

$$y(t) = V_0 + \frac{1}{2} g t^2$$

$$V(t) = V_T - (-V_0 + V_T) e^{-\frac{bv}{m}t}$$

$$V(t) = V_T - (-V_0 + V_T) (1 - (-\frac{bv}{m}t))$$

$$V(t) = V_0 + \frac{bv}{m} V_0 t - g t$$

$$b = 0$$

$$V(t) = V_0 - g t$$

$$a(t) = \left(-g - \frac{bv}{m} V_0 \right) e^{-\frac{bv}{m}t}$$

$$a(t) = \left(-g - \frac{bv}{m} V_0 \right) \left(1 - \frac{bv}{m}t \right)$$

$$a(t) = -g + g \frac{bv}{m} - \frac{bv}{m} V_0 + \frac{b^2 V_0}{m^2} V_0 t$$

$$b = 0$$

$$V(t) = -g$$