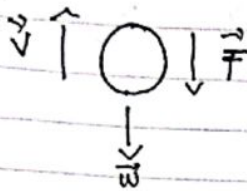


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Kuadrat $f = -bv^2$ dengan pengaruh gaya gesekan benda bergerak vertikal ke atas.



$$\sum F = m \cdot a$$

$$-\vec{w} \cdot \vec{F} = m \cdot a$$

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

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

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sekarang

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

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

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

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

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

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

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

$$\frac{-m}{bv} \left(\ln \left(\frac{-g \times bv^2/m}{-g \times bv^2/m} \right) \right) \Big|_{v_0}^{v_t} = t$$

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

$$\frac{-g - \frac{bv_0}{m}}{-g - \frac{bv_0}{m}}$$

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

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

$$F = -w$$

$$bv = mg$$

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

$$v(t) = v_t - (v_t - v_0) e^{-\frac{bv_t}{m}}$$

$$a(t) = \frac{dv(t)}{dt}$$

$$= \frac{d}{dt} (v_t - (-v_0 + v_t) e^{-bv_t/m})$$

$$= 0 - (v_0 + v_t) \left(-\frac{bv}{m} \right) e^{-bv_t/m}$$

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

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

$$v(t) = \frac{dy(t)}{dt}$$

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

$$y(t) = \int_0^t v_t - (-v_0 + v_t) e^{-bv_t/m} dt$$

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

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

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

$$y(t) = V_T t - \frac{m}{bv} \left(-v_0 + V_T \right) \left(1 - e^{-bvt/m} \right)$$

$$y(t) = V_T t - \frac{m}{bm} \left(-v_0 - V_T \right) \left(1 - e^{-bvt/m} \right)$$

$$v(t) = V_T - \left(-v_0 + V_T \right) e^{-bvt/m}$$

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

lalu diaprokan :

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

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

$$y(t) = V_T t - \frac{m}{bv} \left(-v_0 - V_T \right) \left(1 - e^{-bvt/m} \right)$$

$$y(t) = V_T t - \left(-v_0 + V_T \right) \left(t - \frac{1}{2} \frac{bv}{m} t^2 \right)$$

$$y(t) = v_0 t + \frac{1}{2} \times \frac{bv}{m} = v_0 t^2 + \frac{1}{2} \times \frac{bv}{m} \left(\frac{-mg}{bv} \right) t^2$$

untuk $b=0$

$$y(t) = v_0 t - \frac{1}{2} g t^2$$

$$v(t) = V_T - \left(-v_0 + V_T \right) e^{-bvt/m}$$

$$v(t) = V_T - \left(-v_0 + V_T \right) \left(1 - \left(-\frac{bvt}{m} \right) \right)$$

$$v(t) = v_0 + \frac{bv}{m} \cdot v_0 t - g t$$

untuk $b=0$

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

$$a(t) = \left(-g - \frac{bv}{m} v_0 \right) \left(1 - \frac{bvt}{m} \right)$$

$$a(t) = -g + g \cdot \frac{bvt}{m} - \frac{bv}{m} v_0 + \frac{b^2 v^2}{m} t^2$$

untuk $b=0$

$$v_t = -g$$