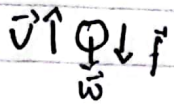


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Gerak vertikal keatas dengan pengaruh gaya gesekan $f = -bv$



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

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

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

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

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

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

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

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

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

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

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

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

$$-\frac{m}{bv} \left(\ln \left| -g - \frac{bv^2}{m} \right| \right)^v = t$$

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

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

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

$$f = -w, bv = mg, v_t = mg/bv$$

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\left[(-v_0 - v_t) \left(-\frac{m}{bv} \right) \right]$$

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

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

$y(t)$, $v(t)$, $a(t)$, diaproksimasi

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

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

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

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

$b=0$

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

$$\begin{aligned} v(t) &= V_t - (-V_0 + V_t) e^{-\frac{bv}{m}t} \\ &= V_t - (-V_0 + V_t) \left(1 - \left(-\frac{bv}{m}t \right) \right) \\ &= V_0 + \frac{bv}{m} V_0 t - g t \end{aligned}$$

$b=0$

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

$$\begin{aligned} a(t) &= \left(-g - \frac{bv}{m} V_0 \right) e^{-\frac{bv}{m}t} \\ &= \left(-g - \frac{bv}{m} V_0 \right) \left(1 - \frac{bv}{m}t \right) \\ &= -g + g \frac{bv}{m} - \frac{bv}{m} V_0 + \frac{b^2 V_0^2}{m^2} V_0 t \end{aligned}$$

$b=0$

$$a(t) = -g$$