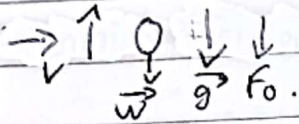


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Berdasarkan titik II Newton

$$\sum \vec{F} = m\vec{a}$$

$$\vec{W} + \vec{F} = -m\vec{a}$$

$$\langle mg + bv \rangle \hat{y} = -m\vec{a}\hat{y}$$

$$\langle mg + bv \rangle = -m\vec{a} \left\langle x \frac{1}{m} \right\rangle$$

$$g + \frac{bv}{m} = -a$$

Substitusi mulai a.

$$g + \frac{b}{m} v = -\frac{d^2 g(t)}{dt^2}$$

$$g + \frac{b}{m} v = -\frac{dv}{dt}$$

$$\frac{-dv}{g + \frac{b}{m} v} = dt$$

$$= \int_{v(t)}^v \frac{dv}{g + \frac{b}{m} v} = \int_0^t dt$$

misal: $g + \frac{b}{m} v = u$

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

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

maka: $\int_{v(t)}^v \frac{1}{v} dv = \int_0^t dt$

$$= \int_{v(t)}^v \frac{1}{v} \left\langle \frac{m}{v} du \right\rangle = \int_0^t dt$$

$$-\frac{m}{b} \ln |v| = t$$

$$-\frac{m}{b} \ln \left| g + \frac{b}{m} v \right| \frac{v(t)}{v} = t$$

$$= \frac{m}{b} \left(\ln \left| g + \frac{b}{m} \langle v(t) \rangle \right| - \ln \left| \frac{g + \frac{b}{m} \langle v \rangle}{m} \right| \right)$$

karena: $\ln a - \ln b = \ln \frac{a}{b}$.

maka:

$$\ln \left| g + \frac{b}{m} \langle v(t) \rangle \right| = -\frac{bt}{m}$$

Contoh: $\left\langle \ln \left| \frac{g + \frac{b}{m} \langle t \rangle}{g + \frac{b}{m} v_0} \right| \right\rangle = e^{-\frac{bt}{m}}$

$$g + \frac{b}{m} v(t) = e^{-\frac{bt}{m}}$$

$$g + \frac{b}{m} v_0$$

$$g + \frac{b}{m} v(t) = \left\langle g + \frac{b}{m} v_0 \right\rangle e^{-\frac{bt}{m}}$$

$$\frac{b}{m} v(t) = \left\langle g + \frac{b}{m} v_0 \right\rangle e^{-\frac{bt}{m}} - g$$

$$v(t) = \frac{m}{b} \left\langle \frac{g + \frac{b}{m} v_0}{m} \right\rangle e^{-\frac{bt}{m}}$$

$$v(t)^2 = \left\langle \frac{mg + v_0}{b} \right\rangle e^{-\frac{bt}{m}} - \frac{mg}{b}$$

karena, $F = W$

$$bv = mg$$

$$v_T = \frac{mg}{b}, \text{ maka.}$$

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

untuk $a(t)$

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

$$\begin{aligned} a(t) &= (v_T + v_0) \left(-\frac{b}{m}\right) e^{-\frac{bt}{m}} \\ &= -\frac{b}{m} (v_T + v_0) e^{-\frac{bt}{m}} \\ &= \left(-\frac{b}{m} \cdot \frac{mg}{b} - \frac{b}{m} v_0\right) e^{-\frac{bt}{m}} \end{aligned}$$

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

untuk $y(t)$.

$$dy(t) = v(t) \cdot dt$$

$$\int_0^t dy(t) = \int_0^t v(t) dt$$

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

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

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

$$y(t) = -\frac{m}{b} (v_T + v_0) (e^{-\frac{bt}{m}} - 1) - v_T \cdot t$$

- Aproksimasi

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

$$y(t) = -v_T \cdot \frac{m}{b} (v_T + v_0) (1 - e^{-\frac{bt}{m}})$$

$$= -V_T \cdot t + \frac{m}{b} \langle V_T + V_0 \rangle \langle 1 - e^{-bt/m} \rangle$$

$$= V_T \cdot t + \frac{m}{b} \langle V_T + V_0 \rangle \left(1 - 1 + \frac{bt}{m} - \frac{1}{2} \left(\frac{bt}{m} \right)^2 \right)$$

$$= V_0 t = \frac{1}{2} g t^2 - \frac{1}{2} \frac{b}{m} V_0 t^2$$

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

* untuk $b=0$ maka.

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

$$V(t) = \langle V_T + V_0 \rangle e^{-bt/m} - V_T$$

$$= -V_T + \langle V_T + V_0 \rangle \langle 1 - bt/m \rangle$$

$$= -V_T + V_T - \frac{b}{m} V_T + \dots + V_0 - \frac{b}{m} V_0 t$$

$$= V_0 - \frac{b}{m} \langle \frac{mg}{b} \rangle + \frac{b}{m} V_0 t$$

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

untuk $b=0$ maka.

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

$$a(t) = \langle -g - b/m V_0 \rangle e^{-bt/m}$$

$$= \langle -g - b/m V_0 \rangle \langle 1 - bt/m \rangle$$

$$= -g + g \frac{bt}{m} - \frac{b}{m} V_0 + \frac{b^2}{m^2} V_0 t$$

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

maka $b=0$

$$a(t) = -g$$