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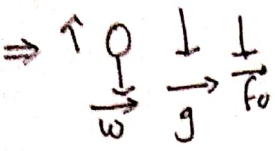

- Berdasarkan hukum II Newton

$$\Sigma \vec{F} = m\vec{a}$$
$$\vec{w} + \vec{f} = -m\vec{a}$$
$$(mg + bv)\hat{y} = -m\vec{a}\hat{y}$$
$$(mg + bv) = (-1)\vec{a}\left(-\frac{1}{m}\right)$$
$$g + \frac{bv}{m} = -a$$

- Subsitusi nilai a

$$g + \frac{b}{m}v = -\frac{d^2 g(t)}{dt}$$
$$g + \frac{b}{m}v = \frac{-dv}{dt}$$
$$\frac{-dv}{g + \frac{b}{m}v} = dt$$
$$\int_{v(x)} \frac{dv}{g + \frac{b}{m}v} = \int_0^t dt$$

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

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

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

$$= \int_0^{v(x)} \frac{1}{v}\left(\frac{m}{v}\,du\right) = \int_0^t dt - \frac{m}{b}\ln|v| = t - \frac{m}{b}\ln\left|g + \frac{b}{m}v\right|_v^{v(t)} = t$$
$$= \frac{m}{b}\left(\ln\left|g + \frac{b}{m}(v(t))\right| - \ln\left|\frac{g+b}{m}(v^2)\right|\right)$$

Karena : $\ln a - \ln b = \ln \frac{a}{b}$

Maka :

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

contoh : $\left(\ln\left|\frac{g + \frac{b}{m}(t)}{g + \frac{b}{m}v_0}\right|\right) = e^{-\frac{bt}{m}}$

$$g + \frac{b}{m}v(t) = e^{-\frac{bt}{m}}$$
$$g + \frac{b}{m}v_0$$
$$g + \frac{b}{m}v(t) = \left(g + \frac{b}{m}v_0\right)e^{-bt\ln}$$
$$\frac{b}{m}v(t) = \left(g + \frac{b}{m}v_0\right)e^{-\frac{bt}{m}} - g\left(x - \frac{m}{b}\right)$$
$$v(t) = \frac{m}{b}\left(\frac{g+b}{m}v_0\right)e^{-\frac{bt}{m}} - [redacted]$$
$$v(t)^2 = \left(\frac{mg}{b} + v_0\right)e^{-\frac{bt}{m}} - \frac{mg}{b}$$

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 $a(t)$

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

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

untuk $y(t)$

$$dy(t) = v(t)\,dt$$
$$\int_0^{y(t)} dy(t) = \int_0^t v(t)\,dt$$
$$y(t) = \int_0^t (vT + v_0)e^{-\frac{bt}{m}} - vT)$$
$$y(t) = \left((vt + v_0)\left(-\frac{m}{b}\right)e^{-\frac{bt}{m}} - vT\cdot T\right)_0^x$$
$$y(t) = \left[(vt + v_0)\left(-\frac{m}{b}\right)e^{-\frac{bt}{m}} - vt^t\right) - \left((vt + v_0)\left(-\frac{m}{b}\right)\right)$$
$$y(t) = -\frac{m}{b}(vt + v_0)\left(e^{-\frac{bt}{m}} - 1\right) - vT\cdot t$$

- Aproksimasi

$$e^{-\frac{bt}{m}} = 1 - \frac{bt}{m} + \frac{1}{2}\left(\frac{bt}{m}\right)^2 + \cdots$$
$$y(t) = -vT\cdot\frac{m}{b}(vt + v_0)\left(1 - e^{-\frac{bt}{m}}\right)$$
$$= -vT\cdot t + \frac{m}{b}(vt + v_0)\left(1 - e^{-\frac{bt}{m}}\right)$$
$$= -vT\cdot t + \frac{M}{b}(vt + v_0)\left(1 * 1 + \frac{bt}{M} - \frac{1}{2}\left(\frac{bt}{M}\right)^2\right)$$
$$= v_0 t + \frac{1}{2}gt^2 - \frac{1}{2}\frac{b}{M}v_0 t^2$$
$$y(t) = v_0 t - \frac{1}{2}gt^2 - \frac{1}{2}\cdot\frac{b}{M}v_0 t^2$$

untuk $b = 0$ maka,

$$y(t) = v_0 t - \frac{1}{2}gt^2$$
$$v(t) = (vt + v_0)e^{-\frac{bt}{m}} - vT$$
$$= -vT + (vT + v_0)(1 - bt/m)$$
$$= -vT + vt - \frac{b}{m}vt + \cdots + v_0 - \frac{b}{M}v_0 t$$
$$= v_0 - \frac{b}{M}\left(\frac{mg}{b}\right) + -\frac{b}{M}v_0 t$$
$$v(t) = v_0 - gt - \frac{b}{M}v_0 t$$

untuk $b = 0$ maka

$$v(t) = v_0 + gt$$
$$a(t) = \left(-g - \frac{b}{M}v_0\right)e^{-\frac{bt}{m}}$$
$$= \left(-g - \frac{b}{M}v_0\right)\left(1 - \frac{bt}{M}\right)$$
$$= -g + g - \frac{bt}{m} - \frac{b}{M}v_0 + \frac{b^2}{M^2}v_0 t$$

$$\rightarrow a(t) = -g - \frac{b}{M}v_0 + \left(\frac{b^2}{M^2}v_0 + \frac{gb}{M}\right)$$

Maka $b = 0$

$$a(t) = -g$$

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