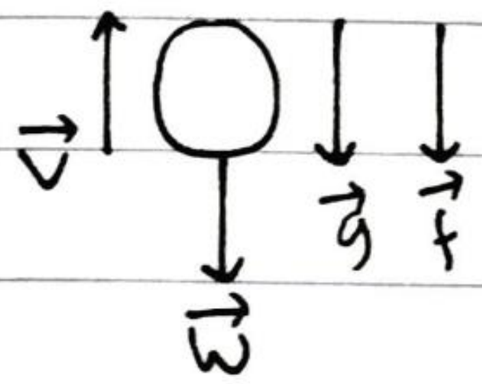
No.

Date :

Nama : Elpin Hurul Rahmaliyani

Npm : 2013022038

Prodi : Pendidikan fisika B



Berdasarkan hukum II Newton

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

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

$$(mg + bv)\hat{j} = -m\bar{a}\hat{j}$$

$$(mg + bv) = -m\vec{a} \left(\times \frac{1}{m}\right)$$

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

Substitusi nilai a

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

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

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

$$= \int_{v_0}^{v(t)} \frac{dv}{g + \frac{b}{m} v} = \int_0^t dt$$

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

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

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

$= \int_{v_0}^{v(t)} \frac{1}{u} dv = \int_0^t dt$

$= \int_{v_0}^{v(t)} \frac{1}{u} \left(\frac{m}{b} du \right) = \int_0^t dt$

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

$- \frac{m}{b} \ln \left| g + \frac{b}{m} v \right|_{v_0}^{v(t)} = t$

$- \frac{m}{b} \left(\ln \left| g + \frac{b}{m} (v(t)) \right| - \ln \left| g + \frac{b}{m} (v_0) \right| \right)$

Karena $\ln a - \ln b = \ln \frac{a}{b}$, maka

$\ln \left| \frac{g + \frac{b}{m} (vt)}{g + \frac{b}{m} (v_0)} \right| = \frac{-bt}{m}$

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

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

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

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

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

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

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

Karena : $F = W$

$$bv = mg$$

$$vT = \frac{mg}{b}$$

maka :

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

untuk $a(t)$

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

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

$$= \frac{-b}{m}(vT + v_0) e^{\frac{-bt}{m}}$$

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

untuk $y(t)$

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

$$dy(t) = v(t) - dt$$

$$\int_0^{y(t)} dy(t) = \int_0^t v(t)\, dt$$

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

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

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

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

Aproksimasi

$$e^x = 1 + \frac{x}{11} + \frac{x^2}{21} + \frac{x^3}{31} + \cdots$$

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

$$y(t) = -v_T t + \frac{m}{b} (v_T + v_0)\left(1 - 1 + \frac{bt}{m} - \frac{1}{2}\left(\frac{bt}{m}\right)^2\right)$$

$$= v_0 t - \frac{1}{2} g t^2 - \frac{1}{2} \frac{b}{m} v_0 t^2$$

$$y(t) \cdot v_0 t - \frac{1}{2} g t^2 - \frac{1}{2} \frac{b}{m} v_0 t^2$$

Untuk $b = 0$ maka

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

$v(t)$

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

$= -v_T + (v_T + v_0)(1 - bt/m)$

$= -v_T + v_T \frac{-b}{m} v_T + t v_0 \frac{-b}{m} v_0 \cdot t$

$= v_0 \frac{-b}{m} \left(\frac{mg}{b}\right) t \frac{-b}{m} v_0 t$

$v(t) = v_0 - gt \frac{-b}{m} v_0 t$

Untuk $b = 0$ maka,

$v(t) = v_0 - gt$

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

$= (-g - b/m\ v_0)(1 - bt/m)$

$= -g + g \frac{bt}{m} \frac{-b}{m} v_0 + \frac{b^2}{m^2} v_0 t$

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

maka $b = 0$

$a(t) = -g$