Date

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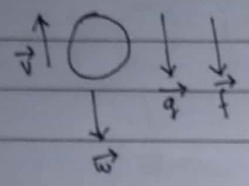
Dup

Mekanika



Berdasarkan titik II Newton :

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

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

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

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

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

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

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

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

Maka :

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

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

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

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

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

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

$\ln \left| \frac{g + \frac{b}{m} (vt)}{g + \frac{b}{m} (V_0)} \right| = -\frac{bt}{m}$

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

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

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

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

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

OKEY

Dipindai dengan CamScanner

$$v(t) = \left(\frac{mg}{b} + V_0\right) e^{\frac{-bt}{m}} - \frac{mg}{b}$$

Karena : $f = w$

$bv = mg$

$v_T = \frac{mg}{b}$, maka :

$$v(t) = (v_T + V_0)\, e^{\frac{-bt}{m}} - v_T$$

untuk $a(t)$

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

$$a(t) = (v_T + V_0)\left(\frac{-b}{m}\right) e^{\frac{-bt}{m}}$$

$$= \frac{-b}{m}(v_T + V_0)\, e^{\frac{-bt}{m}}$$

$$= \left(\frac{-b}{m} \cdot \frac{mg}{b} - \frac{b}{m} V_0\right) e^{\frac{-bt}{m}}$$

$$a(t) = \left(-g - \frac{b}{m} V_0\right) e^{\frac{-bt}{m}}$$

Untuk $y(t)$

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

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

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

$$y(t) = \int_0^t \left((v_T + V_0)\, e^{\frac{-bt}{m}} - v_T\right)$$

$$y(t) = \left[(v_T + V_0)\left(\frac{-m}{b}\right) e^{-bt/m} - v_T \times t\right]_0^x$$

$$y(t) = \left[(v_T + V_0)\left(\frac{-m}{b}\right) e^{-bt/m} - v_T t\right] - \left[(v_T + V_0)\left(\frac{-m}{b}\right)\right]$$

$$y(t) = \frac{-m}{b}(v_T + V_0)\left(e^{-bt/m} - 1\right) - v_T \cdot t$$

$$y(t) = \frac{-m}{b}(v_T + V_0)\left(1 - e^{-bt/m}\right) - v_T \cdot t$$

Aproksmasi :

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

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

$$y(t) = -v_T + \frac{m}{b}(v_T + V_0)\left(1 - e^{-bt/m}\right)$$

$$= -v_T + \frac{m}{b}(v_T + V_0)\left(1 - 1 + \frac{bt}{m} - \frac{1}{2}\left(\frac{bt}{m}\right)^2\right|$$

Dipindai dengan CamScanner

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

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

Untuk $b = 0$, maka :

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

$V(t)$

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

$= -V_T + (V_T + V_0)(1 + {}^{bt}/_{m})$

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

$= V_0 - \frac{b}{m} \left(\frac{mg}{b}\right) t - \frac{b}{m} V_0 t$

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

Untuk $b = 0$, mata

$V(t) = V_0 - gt$

$a(t) = \left(-g - \frac{b}{m} V_0\right) e^{-bt/m}$

$= (-g - b/m\, V_0)(1 - {}^{bt}/_{m})$

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

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

mata $b = 0$

$a(t) = -g .$

Dipindai dengan CamScanner