No
Date

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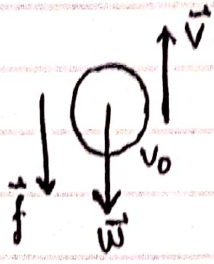
Gerak Vertikal ke Atas + Gaya Gesek Kuadratik



* $f = -bv^2$

Hk. 2 Newton :

$\Sigma F = m \cdot a$

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

$-m.g - bv^2$

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

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

Misal : $-g - bv/m = u$

$-b/m \, dv = du$

$dv = m/b \cdot du$

$$\int \frac{1}{4} \left(-\frac{m}{b} - du\right) = -\frac{m}{b} \int \frac{1}{4} du$$

$$= \frac{m}{b} \ln(u)$$

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

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

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

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

$$\frac{-g - bv_t/m}{-g - bv_0/m} = e^{-\frac{bv^2}{m}}$$

$$-g - b/m \, v_t = \left(-g - \frac{b}{m} v_0\right) e^{-\frac{bv^2}{m}}$$

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

a) $f = -w$, $bv = mg$, $v_T = mg/bv$

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

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

$$= \frac{d}{dt}\left(v_T - (-v_0 + v_T) e^{-bv_t/m}\right)$$

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

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

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

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$= \frac{bv}{m} - \frac{mg}{bv} - \frac{bv}{m} V_0 \Big) e^{-\frac{bV_t}{m}}$

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

- $V(t) = \frac{dy(t)}{dt}$

$\int_{y_0}^{y_x} dy(t) = \int_0^t V(t)\, dt$

$y(t) = \int_0^t V_T - (-V_0 + V_T)\, e^{-\frac{bV_t}{m}}$

$y(t) = \left[V_{Tt} - (-V_0 + V_T)\left(-\frac{m}{bv}\right) e^{-\frac{bV_t}{m}} \right]_0^t$

$y(t) = \left[V_{Tt} - (-V_0 + V_T)\left(-\frac{m}{bv}\right) e^{-\frac{bV_t}{m}} \right] - \left[(-V_0 - V_T)\left(-\frac{m}{bv}\right) \right]$

$y(t) = V_{Tt} - \left(-\frac{m}{bv}\right)(-V_0 + V_T)\left(e^{-\frac{bV_t}{m}}\right)$

$y(t) = V_{Tt} - \frac{m}{bv}(-V_0 + V_T)\left(1 - e^{-\frac{bV_t}{m}}\right)$

$y(t) = V_T t - \frac{m}{bm}(-V_0 - V_T)\left(1 - e^{-\frac{bV_t}{m}}\right)$

$V(t) = V_T - (-V_0 + V_t)\, e^{-\frac{bV_t}{m}}$

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

Diaproksimasi

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

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

$y(t) = V_T t - \frac{m}{bv}(-V_0 - V_T)\left(1 - e^{-\frac{bV_t}{m}}\right)$

$y(t) = V_{Tt} - (-V_0 + V_T)\left(t - \frac{1}{2}\frac{bv}{m} t^2\right)$

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

$b = 0$

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

$\rightsquigarrow V(t) = V_T - (-V_0 + V_T)\, e^{-\frac{bV_t}{m}}$

$= V_T - (-V_0 + V_T)\left(1 - \left(-\frac{bV_t}{m}\right)\right)$

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

$b = 0$

$V(t) = V_0 - gt$

$\rightsquigarrow a(t) = \left(-g - \frac{bv}{m} V_0\right) e^{-\frac{bV_t}{m}}$

$= \left(-g - \frac{bv}{m} V_0\right)\left(1 - \frac{bV_t}{m}\right)$

$a(t) = -g + g\frac{bV_t}{m} - \frac{bv}{m} V_0 + \frac{b^2 v^2}{m^2} V_0 t$

$b = 0$

$V(t) = -g$

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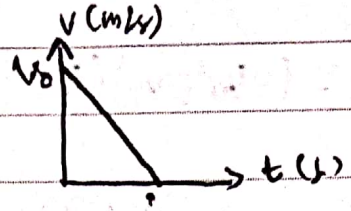
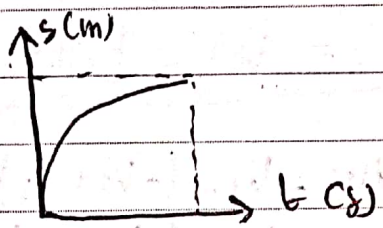
Grafik GVA v-t



Grafik GVA y-t



Grafik GVA a-t