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Prodi : Pendidikan Fisika
Kelas : B

Tugas Mekanika.

2.1 a.) $F_x = m\ddot{x} = F_0 + ct$

$$\frac{mdV}{dt} = F_0 + Ct$$

$$mdV = (F_0 + ct)\,dt$$

$$m\int_{V_0}^{V} dV = \int_0^t (t_0 + ct)\,dt$$

$$m(V - V_0) = F_0(t - t_0) + \frac{c}{2}(t^2 - t_0^2)$$

Karena $V_0 = 0$ dan $t_0 = 0$, maka :

$$mV = F_0 t + \frac{ct^2}{2}$$

$$V(t) = \frac{1}{m}\left(F_0 t + \frac{ct^2}{2}\right) = \frac{dx}{dt}$$

$$\int_{x_0}^{x} dx = \int_{t_0}^{t} \frac{1}{m}\left(f_0 t + \frac{ct^2}{2}\right) dt$$

$$x - x_0 = \frac{1}{m}\left(\frac{f_0}{2}(t^2 - t_0^2) + \frac{c}{6}(t^3 - t_0^3)\right)$$

$$x = \frac{1}{m}\left[\frac{F_0 t^2}{2} + \frac{ct^3}{6}\right]$$

b) $F_x = m\frac{dV}{dt} = F_0 \sin ct$

$$\int_0^V dV = \frac{F_0}{m}\int_0^t \sin ct\ dt$$

$$V(t) = -\frac{F_0}{mc}\cos ct$$

$$x(t) = \int_0^x dt$$

$$x(t) = -\frac{F_0}{mc}\int_0^t \cos ct\ dt$$

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$$x(t) = -\frac{F_0}{mc^2} \sin ct$$

c.) $F_x = F_0 e^{ct}$

$$V(t) = \frac{F_0}{m} \int_0^t e^{ct} dt$$

$$V(t) = \frac{F_0}{cm} e^{ct}$$

$$x(t) = \frac{F_0}{c^2 m} e^{ct}$$

22 a.) $F_x = F_0 + Cx$

$$F(x) = mv \frac{dv}{dx} = F_0 + cx$$

$$\int_{v_0}^{v} mv\, dv = \int_0^x (F_0 + Cx)) dx$$

$$\frac{mv^2}{2} = F_0 x + \frac{c}{2} x^2$$

$$V = \sqrt{\frac{2}{m}\left(F_0 x + \frac{c}{2} x^2\right)}$$

b.) $F(x) = mv \frac{dv}{dx} = F_0 e^{-cx}$

$$\frac{1}{2} mv^2 = -\frac{F_0}{c} e^{-cx}$$

$$V = \frac{2}{m}\left[-\frac{F_0}{c} e^{-cx}\right]^{\frac{1}{2}}$$

c.) $F(x) = mv \frac{dv}{dx} = F_0 \cos Cx$

$$\frac{1}{2} mv^2 = \int_0^x F_0 \cos Cx$$

$$= \frac{F_0}{2} \sin Cx$$

$$V = \frac{2}{m}\left[\frac{F_0}{2} \sin Cx\right]^{\frac{1}{2}}$$

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(2.3) a.) $F_x = -\frac{dV}{dx} = F_0 + Cx$

$$u(x) = -\left[F_0 x + \frac{c}{2} x^2\right] + C$$

b.) $F_x = -\frac{dV}{dx} = F_0 e^{-cx}$

$$\int_{u(x_0)}^{u(x)} dV = -F_0 \int_{x_0}^{x} e^{-cx} dx$$

c.) $F_x = -\frac{dV}{dx} = F_0 \cos cx$

$$\int_{u(x_0)}^{u(x)} dV = -F_0 \int_{x_0}^{x} \cos(x)\, dx$$

$$u(x) - u(x_0) = \frac{-F_0}{c}\left[\sin(x) - \sin(x_0)\right]$$

(2.4) $V(x) = -\int F(x)\, dx$

a) $V(x) = -\int(-kx)\, dx$

$$V(x) = \frac{kx^2}{2}$$

Jadi, energi potensial $V(x) = \frac{kx^2}{2}$

b.) dan c)

$$E = T_0 = \frac{1}{2} kA^2$$

$$E = T(x) + V(x)$$

$$T(x) = E - V(x)$$

$$T(x) = \frac{1}{2} kA^2 - \frac{1}{2} kx^2$$

$$T(x) = \frac{k}{2}(A^2 - x^2)$$

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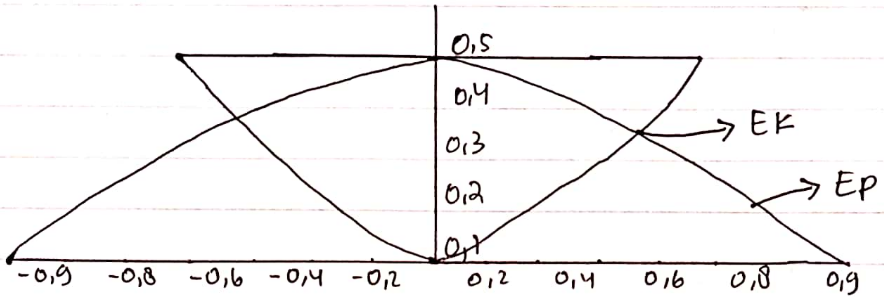
d) $E = V_{cx}$

$$\frac{1}{2}kA^2 = \frac{1}{2}kx^2$$

$$x = \pm A$$

e.)



Hasilnya : a) $V(x) = \frac{kx^2}{2}$

b) $T(x) = \frac{k^2}{2}(A - x^2)$

c) $E = T_0 = \frac{1}{2}kA^2$

2.8 $V = \frac{b}{x^3}$

$$F = m\frac{dv}{dt} = m\frac{dv}{dx}\frac{dx}{dt}$$

$$= mv\frac{dv}{dx}$$

$$\frac{dv}{dx} = -\frac{3b}{x^4}$$

$$F = m\left(\frac{b}{x^3}\right)\left(\frac{-3b}{x^4}\right) = -\frac{3mb^2}{x^7}$$

2.11 $F(v) = -cv^{\frac{3}{2}}$

$$= m\frac{dv}{dt} = m\frac{dv}{dx}\frac{dx}{dt}$$

$$= m\frac{dv}{dt}$$

$$-cv^{\frac{3}{2}} = m\frac{dv}{dx}$$

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$$\int_0^x dx = \int_{v_0}^{v} -\frac{mv}{cv^{\frac{3}{2}}}\, dv$$

$$x = -\frac{m}{c}\int_{v_0}^{v}\frac{dv}{\sqrt{v}} = -\frac{m}{c}\int_{v_0}^{v} v^{-\frac{1}{2}}\, dv$$

$$= -\frac{m}{c}\,\frac{v^{\frac{1}{2}}}{\frac{1}{2}}\Big|_{v_0}^{v}$$

$$= \frac{2m}{c}\left(\sqrt{v_0} - \sqrt{v}\right)$$

Partikel berhenti, maka $v=0$, jadi

$$x_{max} = \frac{2m\sqrt{v_0}}{c}$$

(2.12) $m \cdot a_x = \sum F_x$

$$m \cdot a_x = -mg - C_2 v^2$$

$$a_x = \frac{dv}{dt} = \frac{dv\, dx}{dx\, dt} = \frac{dv}{dx}\cdot v$$

$$m\frac{dv}{dx} = -mg - C_2 v^2$$

$$v\frac{dv}{dx} = -g - \frac{c^2}{m}v^2$$

$$k = \frac{c^2}{m}$$

$$\int_{v_0}^{v}\frac{v\, dv}{-g-kv^2} = \int_0^x dv$$

$$y = -y - kv^2$$

$$dy = -2\, kv\, dv$$

$$v\, dv = -\frac{1}{2k}\, dy$$

$$\int_{v_0}^{v}\frac{-1\, dy}{2ky} = \int_0^x dx$$

$$\frac{-1}{2k}\ln(y)\Big|_{v_0}^{v} = x\Big|_0^x$$

$$\frac{-1}{2k}\ln(-g-kv^2)\Big|_{v_0}^{v} = x$$

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$$-\frac{1}{2k} \ln\left(\frac{-g - kv^2}{-g - kv_0^2}\right) = x$$

$$\frac{-g - kv^2}{-g - kv_0^2} = e^{-2kx}$$

$$-g - kv^2 = (-g - kv_0^2)\, e^{-2kx}$$

$$kv^2 = (g + kv_0^2)\, e^{-2kx} - \frac{g}{k}$$

$$A = \frac{g}{k} + v_0^2$$

$$\boxed{v^2 = A e^{-2kx} - \frac{g}{k}}$$

$$m \cdot a_x = \Sigma F_x$$

$$m \cdot a_x = -mg + C_2 v^2$$

$$a_x = \frac{dv}{dt} = \frac{dv}{dx}\,\frac{dx}{dt} = \frac{dv}{dx} \cdot v$$

$$mv \frac{dv}{dx} = -mg + C_2 v^2$$

$$C \cdot \frac{dv}{dx} = -g + \frac{C_2}{m} v^2$$

$$k = \frac{C_2}{m}$$

$$v \frac{dv}{dx} = -g + kv^2$$

$$\int_0^v \frac{v\,dv}{-g + kv^2} = \int_0^x dx$$

$$y = -g + kv^2$$

$$dy = 2kv\, dv$$

$$v\,dv = \frac{1}{2k}\, dy$$

$$\int_0^v \frac{1}{2k} \frac{dy}{y} = \int_{x_0}^x dx$$

$$\frac{1}{2k} \ln(y)\Big|_0^v = x\Big|_{x_0}^x$$

$$\frac{1}{2k} \ln(-g + kv^2)\Big|_0^v = x - x_2$$

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$$\frac{1}{2k} \ln\left(\frac{-g + kv^2}{-g}\right) = x - x_2$$

$$\frac{-g + kv^2}{g} = e^{2k} (x - x_0)$$

$$-g + kv^2 = -g e^{2k(x-x_0)}$$

$$kv^2 = -g e^{2k(x-x_0)} + y$$

$$v^2 = -\frac{g}{k} e^{2kx_0} e^{2kx} + \frac{g}{k}$$

$$B = \frac{g}{k} e^{2kx_0}$$

$$\boxed{v^2 = \frac{g}{k} - Be^{2kx}}$$

2.13 $v^2 = \left(\frac{g}{k} + v_0^2\right) e^{-2kx} - \frac{g}{k}$ ke atas

$v^2 = -\frac{g}{k} e^{-2kx_0} e^{2kx} + \frac{g}{k}$ ke bawah

$v = 0$ pada gerak ke atas

$$0 = \left(\frac{g}{k} + v_0^2\right) e^{-2kx} - \frac{g}{k}$$

$$e^{-2kh} = \frac{\frac{g}{k}}{\frac{g}{k} + v_0^2}$$

h adalah posisi awal untuk gerakan kebawah dan (t) $a = 0$,

$v^2 = -\frac{g}{k} e^{-2kh} e^{2k0} + \frac{g}{k}$ sub $x = 0$

$$v^2 = -\frac{g}{k} \cdot \frac{\frac{g}{k}}{\frac{g}{k} + v_0^2} \cdot 1 + \frac{g}{k}$$

$$v_t^2 = \frac{g}{k}$$

$$v^2 = -v_t^2 \cdot \frac{v_t^2}{v_t^2 + v_0^2} + v_t^2$$

$$v^2 = v_t^2 \left(1 - \frac{v_t^2}{v_t^2 + v_0^2}\right)$$

$$v^2 = v_t^2 \left(\frac{v_t^2 + v_0^2 - v_t^2}{v_t^2 + v_0^2}\right)$$

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$$V^2 = \frac{V_t^2 + V_0^2}{V_t + V_0^2}$$

$$V = \frac{V_t + V_0}{\sqrt{V_t^2 + V_0}}$$

2.14

$$m a_x = \Sigma F_x$$

$$m . a_x = -k x^{-2}$$

$$a_x = \frac{dV}{dt} = -k x^{-2}$$

$$V \frac{dV}{dx} = -\frac{k}{m} x^{-2}$$

$$\int_0^v v \, dV = -\frac{k}{m} \int_b^x x^{-2} \, dx$$

$$\frac{v}{2} \Big|_0^v = -\frac{k}{m} (-1) x^{-1} \Big|_0^x$$

$$\frac{V^2}{2} = \frac{k}{m} (x^{-1} - b^{-1})$$

$$V^2 = \frac{2k}{m} \left(\frac{b-x}{bx} \right)$$

$$V = \frac{dx}{dt}$$

$$\sqrt{\frac{2k}{m} \left(\frac{b-x}{m} \right)} = \frac{dx}{dt}$$

$$\int_b^0 \frac{dx}{\sqrt{\frac{2k}{m} \left(\frac{b-x}{bx} \right)}} = \int_0^t dt$$

$$\int_b^0 \frac{dx}{\sqrt{\frac{2k}{m} \left(\frac{b-x}{bx} \right)}} = \sqrt{\frac{mb}{2k}} \int_b^0 \sqrt{\frac{x}{b-x}} \, dx$$

$$u = \frac{\sqrt{b-x}}{\sqrt{x}}$$

$$dU = \frac{\frac{1}{2\sqrt{b-x}} (-1) . \sqrt{x} \, dx \, \frac{1}{2\sqrt{x}}}{x}$$

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$$dx = \frac{dU}{\frac{1}{-2\sqrt{x}\cdot V\sqrt{x}} - \frac{V\sqrt{x}}{2x^{\frac{3}{2}}}}$$

$$= \frac{dU}{\frac{1}{2V_x} - \frac{V}{2x}}$$

$$= \frac{-dU}{\frac{1+V^2}{2xV}}$$

$$= -\frac{2xV\ dV}{V^2+1}$$

$$dx = -\frac{2bV\ dV}{(V^2+1)^2}$$

$$\sqrt{\frac{mb}{2K}}\int_b^0 \sqrt{\frac{x}{b-x}}\,dx = \sqrt{\frac{mb}{2K}}\int_b^0 \frac{1}{V}(-1)^2\frac{bV\ dV}{(V^2+1)^2}$$

$$= \sqrt{\frac{mb}{2K}}\int_b^0 \frac{2bV\ dV}{(V^2+1)^2}$$

$$\int\frac{dU}{(aV+b)^n} = \frac{V}{2(V^2+1)}\Big|_b^0 + \frac{1}{2}\int_b^0\frac{dV}{V^2+1}$$

$$\int_b^0\frac{dU}{(V^2+1)^2} = \frac{U}{2(V^2+1)}\Big|_b^0 + \frac{1}{2}\ \text{arc tan } V\Big|_b^0$$

$$-\sqrt{\frac{mb}{2K}}\int_b^0\frac{2b\ dU}{(V^2+1)^2} = -2b\sqrt{\frac{mb}{2K}}\left(\frac{V}{2(U^2+1)}\Big|_b^0 + \frac{1}{2}\ \text{arc tan } V\Big|_b^0\right)$$

$$= -2b\sqrt{\frac{mb}{2K}}\cdot\left(\frac{V}{2(V^2+1)}\Big|_0^{-\infty} + \frac{1}{2}\ \text{arc tan } V\Big|_0^{-\infty}\right)$$

$$= -2b\sqrt{\frac{mb}{2K}}\cdot\left(0-0+\frac{1}{2}\cdot\left(\frac{-\pi}{0}-0\right)\right)$$

$$= -\pi\sqrt{\frac{mb^3}{8K}}$$

$$\pi\sqrt{\frac{mb^3}{8K}} = \int_0^t dt$$

$$t = \pi\sqrt{\frac{mb^3}{8K}}$$

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2.15 $ma = \Sigma F$

$ma = mg - C_1 V - C_2 V^2$

$ma = 0$

$mg - C_1 V - C_2 V^2 = 0$

$C_2 V^2 - C_1 V - mg = 0$

$$V_{1,2} = \frac{-C_1 \pm \sqrt{C_1^2 + 4C_2 mg}}{2C_2}$$

Pilih (+)

$$V_1 = \frac{-C_1 + \sqrt{C_1^2 + 4C_2 mg}}{2C_2}$$

$$V_1 = V_t = \frac{-C_1}{2C_2} + \sqrt{\left(\frac{C_1}{2C_2}\right)^2 + \frac{mg}{C^2}}$$

$$V_t = \frac{-C_1}{2C_2} + \sqrt{\left(\frac{C_1}{2C_2}\right)^2 + \frac{mg}{C_2}}$$