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Prodi : Pendidikan Fisika

2.1 a) $F_x = m\ddot{x} = F_e + C_t$

$$m\frac{dv}{dt} = F_0 + C_t$$

$$m.dv = (F_0 + Ct)\,dt$$

$$m\int_{v_0}^{v} dv = \int_0^t (F_0 + Ct)\,dt$$

$$m(v - v_0) = F_0(t - t_0) + \frac{C}{2}(t^2 - t_0^2)$$

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

$$mv = F_0 t + \frac{Ct^2}{2}$$

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

$$\int_{x_0}^{x} dx = \int_{x_0}^{t} \frac{1}{m}\left(F_0 t + \frac{Ct^2}{2}\right) dt$$

$$x - x_0 = \frac{1}{m}\left(\frac{F_0}{2}(t^2 - t_0^2) + \frac{C}{6}(t^3 - t_0^3)\right)$$

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

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

$$\int_0^v dv = \frac{F_0}{m}\int_0^t \sin ct \, dt$$

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

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

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

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

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

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

$$v(t) = \frac{F_0}{em} e^{ct}$$

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

2.2) a) $F_x : F_0 + Cx$

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

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

$$\frac{mv^2}{2} : F_0x + \frac{C}{2}x^2$$

$$v : \sqrt{\frac{2}{m}\left(F_0x + \frac{C}{2}x^2\right)}$$

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) $$F(x) : mv\frac{dv}{dx} : F_0 \cos Cx$$

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

$$: \frac{F_0}{C}\sin Cx$$

$$v : \frac{2}{m}\left[\frac{F_0}{C}\sin Cx\right]^{\frac{1}{2}}$$

23) a) $F_x = \frac{-dv}{dx} = F_0 + Cx$

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

b) $F_x = \frac{-dv}{dx} = F_0 e^{-Cx}$

$$\int_{u(x_0)}^{v(x)} dv = -F_0 \int_{x_0}^{x} e^{-Cx} dx$$

$$u(x) - u(x_0) = \frac{F_0}{C}\left[e^{-Cx} - e^{-(x_0)}\right]$$

c) $F_x = \frac{-du}{dx} = F_0 \cos Cx$

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

$$u(x) - u(x_0) = \frac{-F_0}{C}\left[\sin Cx - \sin Cx_0\right]$$

24) $v(x) = -\int F(x)\, dx$

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

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

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

b) dan (c)

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

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

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

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

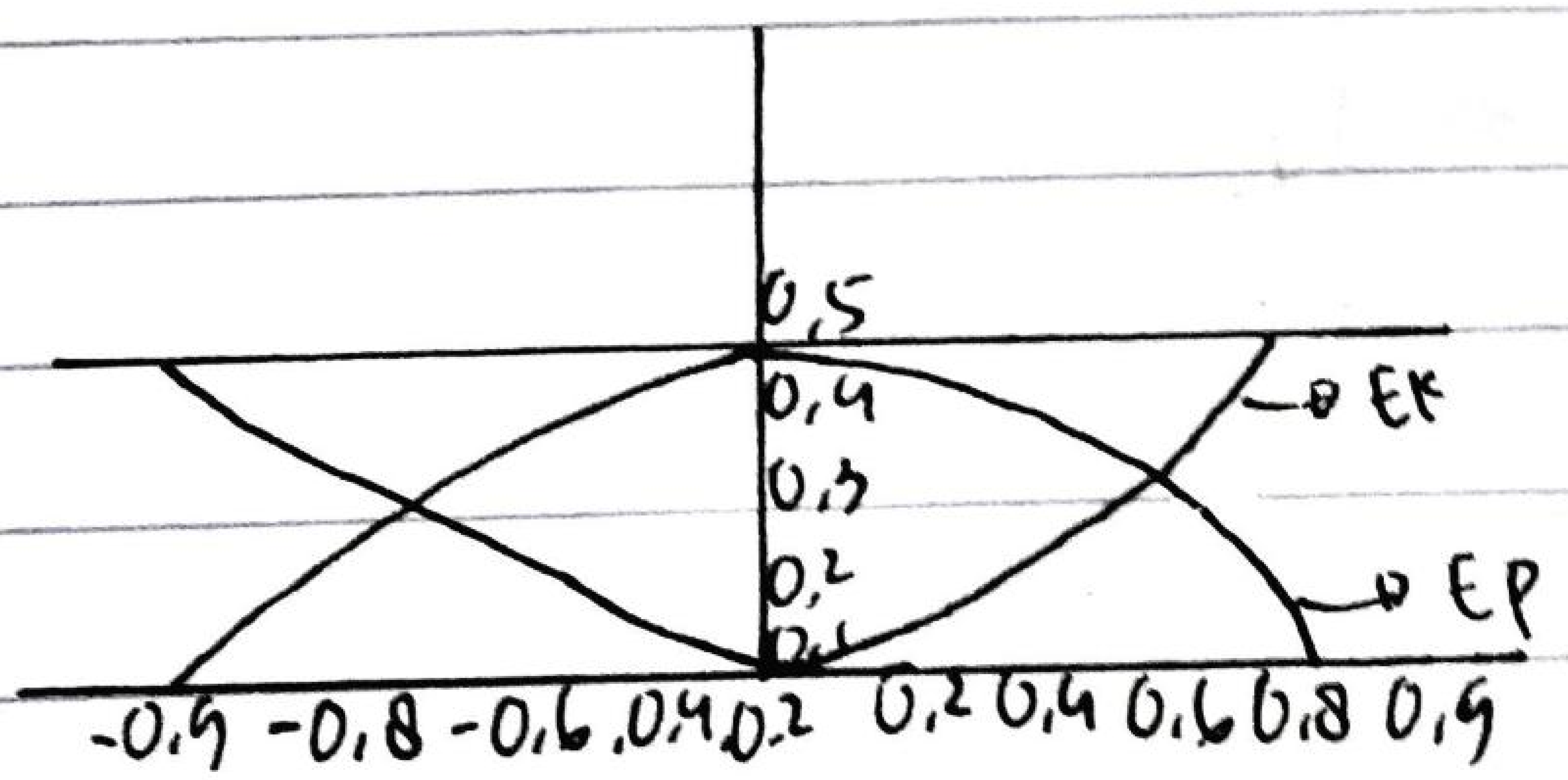
$$T(x) = \frac{k}{2} (A^2 - x^2)$$

d.) $E = V(x)$

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

$$x = \pm A$$

e.)



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

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

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

2.8 $v = \dfrac{b}{x^3}$

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

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

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

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

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

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

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

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

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

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

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

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

Partikel berhenti, maka $V = 0$. Jadi, $x_{max} = \frac{2m\sqrt{V_0}}{c}$

2.2 $m \cdot a_x = \Sigma F_x$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$A = \frac{g}{k} + V_0^2$$

$$\boxed{V^2 = Ae^{-2kx} - \frac{g}{k}}$$

$$ma_x = \Sigma F_x$$

$$m.a_x = -mg + C_2V^2$$

$$a_x = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = \frac{dv}{dx}.V$$

$$mv\frac{dv}{dx} = -mg + C_2V^2$$

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

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

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

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

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

$dy = 2kv\,dv$

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

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

$$\frac{1}{2k}\ln(-g + kv^2)\Big|_0^v = x - x_0$$

$$\frac{1}{2k}\ln\left(\frac{-g + kv^2}{-g}\right) = x - x_0$$

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

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

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

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

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

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

2.13 $V^2 = \left(\frac{g}{k} + V_0^2\right) e^{-2kx} - \frac{g}{k}$ → keatas

$V^2 = \frac{-g}{k} e^{-2kx_0} e^{2kx} + \frac{g}{k}$ → kebawah

$V = 0$ Pada gerak keatas

$0 = \left(\frac{g}{k} + V_0^2\right) e^{-2kx} \frac{-g}{k}$

$e^{-2kx} = \frac{\frac{g}{k}}{\frac{g}{k} + V_0^2}$

h adalah posisi awal u/ gerakan kebawah dan (x) a=0.

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

$V^2 = \frac{-g}{k} \cdot \frac{\frac{g}{k}}{\frac{g}{k} + V_0^2} \cdot 1 + \frac{g}{k}$

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

$V^2 = -Vt^2 = \frac{Vt^2}{Vt^2 + V_0^2} + Vt^2$

$V^2 = Vt^2 \left(1 - \frac{Vt^2}{Vt^2 + V_0^2}\right)$

$V^2 = Vt^2 \cdot \left(\frac{Vt^2 + V_0^2 - Vt^2}{Vt^2 + V_0^2}\right)$

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

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2.14 $ma_x = \sum F_x$

$$ma_x = -kx^{-2}$$

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

$$mv\,\frac{dv}{dx} = -kx^{2}$$

$$v\,\frac{dv}{dx} = \frac{-k}{m}\,x^{2}$$

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

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

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

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

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

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

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

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

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

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

$$dx = \frac{dv}{\frac{1}{-2\sqrt{x}.v\sqrt{x}} - \frac{v\sqrt{x}}{2x^{3/2}}}$$

$$= \frac{dv}{-\frac{1}{2vx} - \frac{v}{2x}}$$

$$= -\frac{dv}{\frac{1+v^2}{2xv}}$$

$$= -\frac{2xv\,dv}{v^2+1}$$

$$\sqrt{b-x} = v\sqrt{x}$$

$$b-x = v^2 x$$

$$b = x^2(v^2+1)$$

$$x = \frac{b}{u^2+1}$$

$$dx = -\frac{2bv\,du}{(v^2+1)^2}$$

$$\sqrt{\frac{mb}{2k}}\int_b^0 \sqrt{\frac{x}{b-x}}\,dx = \sqrt{\frac{mb}{2k}}\int_b^0 \frac{1}{v}(-1)^2\frac{bv\,du}{(v^2+1)^2}$$

Date :

$$\sqrt{\frac{mb}{2k}} \int_b^0 \frac{2\,bu\,dv}{(v^2+1)^2}$$

$$\int \frac{dv}{(av+b)^n} = \frac{2n-3}{2b(n-1)} \int \frac{du}{(au^2+b)^{n-1}} + \frac{v}{2b(n-1)(au^2+b)^{n-1}}$$

$$= \frac{u}{2(v^2+1)} + \frac{1}{2} \int \frac{du}{v^2+1}$$

$$\int_b^0 \frac{dv}{(u^2+1)^2} = \frac{2n-3}{2(v^2+1)}\Bigg|_b^0 + \frac{1}{2}\int_b^0 \frac{dv}{v^2+1}$$

$$\int_b^0 \frac{dv}{(v^2+1)^2} = \frac{v}{2(v^2+1)}\Bigg|_b^0 + \frac{1}{2} \arctan v \Big|_b^0$$

$$\sqrt{\frac{mb}{2k}} \int_b^0 \frac{2b\,dv}{(v^2+1)^2} = -2b\sqrt{\frac{mb}{2k}} \left(\frac{v}{2(v^2+1)}\Bigg|_b^0 + \frac{1}{2} \arctan u \Big|_b^0 \right)$$

$$= -2b\sqrt{\frac{mb}{2k}} \cdot \left(\frac{v}{2(v^2+1)}\Bigg|_0^{-\infty} + \frac{1}{2} \arctan u \Big|_0^{\infty} \right)$$

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

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

$$\pi\sqrt{\frac{mb^3}{8k}} = \int_0^t dt = t - 0$$

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

2.15 $ma = \sum F$

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

$ma = 0$

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

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

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

Pilih (+)

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

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

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