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Prodi : Pendidikan Fisika
Kelas : B

Tugas Mekanika

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

$$\frac{m\,dv}{dt} = F_0 + ct$$

$$m\,dv = (f_0 + ct)\,dt$$

$$m\int_{v_0}^{v} dv = \int_0^t (t_0 + ct)\,dt$$

$$m(v - v_0) = f_0\,(t - t_0) + \frac{c}{2}\,(t^2 - t_0^2$$

Karena $v_0 = 0$ dan $t_0 = 0$, maka :

$$mv = f_0 t + \frac{ct^2}{2}$$

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

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

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

$$x = \frac{1}{m}\left[\frac{f_0 t^2}{2} + \frac{ct^3}{6}\right]$$

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

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

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

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

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

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

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

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

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

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

2.2. a) $F_x = F_0 + Cx$

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

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

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

$$v = \sqrt{\frac{2}{m}\left(F_0 x + \frac{cx^2}{2}\right.}$$

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) $f(x) = -\frac{dU}{dx} = F_0 + Cx$

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

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

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

c) $Fx = -\frac{dU}{dx} = F_0 \cos cx$

$\int_{U(x_0)}^{U(x)} dU = -F_0 \int_{x_0}^{x} \cos(cx)\, dx$

$U(x) - U(x_0) = -\frac{F_0}{C}\left[\sin(cx) - \sin(cx_0)\right]$

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)

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

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

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

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

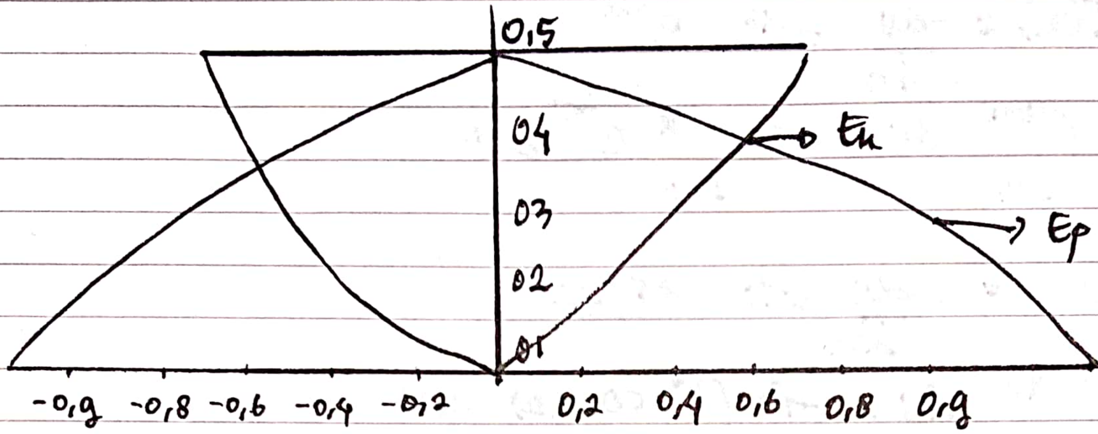
$T(x) = \frac{k}{2}(A^2 - x^2)$

d) $E = V(x)$

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

$x = \pm A$

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 $v = \frac{b}{x^3}$

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

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

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

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

2.11 $f(x) = -Cv^{\frac{3}{2}}$

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

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

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

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

$$= -\frac{m}{c}\left.\frac{v^{\frac{1}{2}}}{\frac{1}{2}}\right|_{v_0}^{v}$$

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

Partikel berhenti, maka $v=0$, Jadi

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

2.12 $m a_x = \sum F_x$

$$m a_x = -mg - c_2 v^2$$

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

$$m\frac{dv}{dx} = -mg - c_2 v^2$$

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

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

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

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

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

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

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

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

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

$$v^2 = \frac{vt^2 + v_0^2}{vt + v_0^2}$$

$$v = \frac{vt + v_0}{\sqrt{vt^2 + v_0}}$$

2.14 $max = \Sigma fx$

$$m a_x = -kx^{-2}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\sqrt{\frac{mb}{2k}}\int_b^0 \sqrt{\frac{x}{b-x}}\ dx = \sqrt{\frac{mb}{2k}}\int_b^0 \frac{1}{v}(-1)^2 \frac{6v\ dv}{(v^2+1)^2}$$

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

$$\int \frac{dv}{(av+b)^n} = \frac{v}{2(v^2+1)}\Bigg|_b^0 + \frac{1}{2}\int_b^0 \frac{dv}{v^2+1}$$

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

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

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

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

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

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

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

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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 (+)

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

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

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