No.

Date

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Kelas : B
Prodi : Pendidikan Fisika
Tugas Mekanika

2.1. a). $f_x = m\ddot{x} = f_0 + ct$

$m\,dv = F_0 + ct$

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

$$m\int_{v_0}^{v} dv = \int_0^t (f_0 + ct)\,dt$$

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

Karena $v_0 = 0$ dan $t = 0$, 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). $F_x = m\frac{dv}{dt} = f_0 \sin ct$

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

$$v_t = -\frac{f_0}{m}\cos ct$$

No.

Date

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

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

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

c). $fx = fo \, e^{ct}$.

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

$$V(t) = \frac{fo}{m} e^{ct}$$

$$x(t) = \frac{Fo}{C^2 m} e^{ct}$$

2.2). a). $fx = fo + cx$

$$f(x) = mv \frac{dv}{dx} = Fo + cx.$$

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

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

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

b). $f(x) = mv \frac{dv}{dx} = Fo \, e^{-x}.$

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

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

No.

Date

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

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

$= \frac{F_0}{c} \sin cx.$

$v = \frac{2}{m}\left[\frac{F_0}{2} \sin cx\right]^{1/2}$

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

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

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

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

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

$U(x) = \frac{kx^2}{2}.$ Jadi energi potensialnya adalah $V(x) = \frac{kx^2}{2}$

b). dan c).

$$F = T_0 = \frac{1}{2} KA^2.$$

$$E = T_x + V(x).$$

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

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

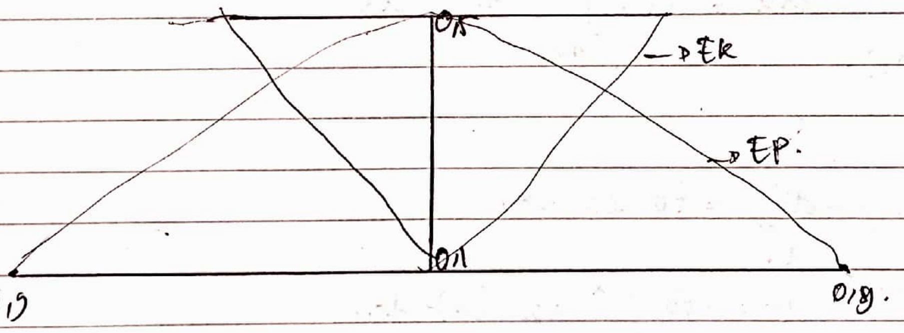
$$T(x) = \frac{k}{2} \cdot (A^2 - x^2).$$

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

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

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No.

Date

2.8). $v = \frac{b}{x^3}$

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

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

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

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

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

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

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

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

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

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

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

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

Partikel berhenti, maka $v=0$, Jadi $x_{max} = \frac{2m\sqrt{v_0}}{c}$

No.

Date

2.12. $m \cdot a_x = \Sigma f_x$.

$m \cdot a_x = -ma - c_2 V^2$

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

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

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

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

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

$y = -g - kv^2$

$dy = -2 kv \, dv$.

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

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

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

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

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

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

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

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

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

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

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No.

Date

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

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

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

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

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

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

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

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

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

$$dy = 2kv\ dv.$$

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

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

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

$$\frac{1}{2k} \ln (-g + kv^2) \Big|_0^v = x_0 - x_1.$$

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

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

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

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

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

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

No.

Date

$$V^2 = \frac{g}{k} - Be^{2kx} \quad \text{dengan} \quad B = \frac{g}{k} e^{2kx_0}.$$

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.

dengan $V=0$ 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 gerangan ke bawah dan (+) $a=0$.

$V^2 = -\frac{g}{k} e^{-2kh} e^{2k0} + \frac{g}{k}$ subsitusikan nilai $x=0$.

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

$$V_t^2 = \frac{g}{k}.$$

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

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

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

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

No.

Date

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

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

$$a_x = \frac{dv}{dt} = -kx^{-2}$$

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

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

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

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

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

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

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

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

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

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

$$du = \frac{\frac{1}{2\sqrt{b-1}} (-1) \cdot \sqrt{x} \cdot dx \; \frac{1}{2\sqrt{x}}}{x}$$

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

$$= \frac{du}{\frac{1}{\ } - \frac{v}{\ }}$$

No.

Date . .

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

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

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

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

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

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

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

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

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

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

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

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

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

No.

Date

2.15. $m.a_x = \Sigma F_x.$

$m.a = mg - C_1V - C_2V^2$

$m.a = 0.$

$mg - C_1V - C_2V^2 = 0.$

$C_2V^2 \pm C_1V - mg = 0.$

$$V_{1,2} = \frac{-C_1 \pm \sqrt{C_1^2 + 4C_2mg}}{2C_2}$$

Kita (+).

$$V_1 = \frac{-C_1 + \sqrt{C_1^2 + 4C_2mg}}{2C_2}$$

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

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