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Kelas : B.
Prodi : Pendidikan Fisika
Tugas Mekanika. Problem bab. 4. General Motion of a Particle in three dimentions.

4.1) a). $V = Cxyz + C$.

Jawab: $\vec{F} = -\vec{\nabla} V = -\hat{i}\frac{\partial V}{\partial x} - \hat{j}\frac{\partial V}{\partial y} - \hat{k}\frac{\partial V}{\partial z}$

$= -C(\hat{i}yz + \hat{j}xz + \hat{k}xy)$

b). $V = \alpha x^2 + \beta y^2 + \gamma z^2 + C$.

Jawab: $\vec{F} = -\vec{\nabla} V = -\hat{i}\, 2\alpha x + \hat{j}\, 2\beta y + \hat{k}\, 2\gamma z$.

c). $V = Ce^{-(\alpha x + \beta y + \gamma z)}$

Jawab: $\vec{F} = -\vec{\nabla} V = Ce^{-(\alpha x + \beta y + \gamma z)} (\hat{i}x + \hat{j}\beta + \hat{k}\gamma)$.

d). $V = Cr^n$ dalam koordinat bola.

Jawab: $\vec{F} = -\vec{\nabla} V = -\hat{e}_r \frac{\partial V}{\partial r} - \hat{e}_\theta \frac{1}{r}\frac{\partial V}{\partial \theta} - \hat{e}_\phi \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}$

4.2) a). $F = \hat{i}x + \hat{j}y + \hat{k}z$.

Jawab: $\vec{\nabla} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x & y & z \end{vmatrix} = 0$. (Konservatif).

b). $F = \hat{i}x - \hat{j}y + kz^2$

Jawab: $\vec{\nabla} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x & y & z^2 \end{vmatrix} = \hat{k}(-1-1) \neq 0$ (Non Konservatif).

c). $F = \hat{i}x + \hat{j}y + kz^3$.

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$$\vec{\nabla}\times\vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x & y & z^3 \end{vmatrix}$$

$= \hat{k}(1-1)$

$= 0$ .. (konservatif).

d). $F = -kr^{-n}\, e_r$ dalam koordinat bola.

Jawab:

$$\vec{\nabla}\times\vec{F} = \frac{1}{r^2 \sin\theta} \begin{vmatrix} \hat{e}_r & \hat{e}_\theta r & \sin\theta \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \phi} \\ -kr & 0 & 0 \end{vmatrix}.$$

$= 0$. (konservatif).

4.3) a) $F = \hat{i}xy + \hat{j}cx^2 + \hat{k}z^3$.

Jawab:

$$\vec{\nabla}\times\vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ xy & cx^2 & z^3 \end{vmatrix}$$

$= \hat{k}\,(2cx - x)$

$2cx - x = 0$.

$c = \frac{1}{2}$.

b). $F = \hat{i}\,(z/y) + c\hat{j}\,(xz/y^2) + \hat{k}\,(x/y)$.

Jawab:

$$\vec{\nabla}\times\vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ \frac{z}{y} & \frac{cxz}{y^2} & \frac{x}{y} \end{vmatrix}$$

$$= \hat{i}\left(\frac{-x}{y} - \frac{cx}{y^2}\right) + \hat{j}\left(\frac{1}{y} - \frac{1}{y}\right) + \hat{k}\left(\frac{cz}{y^2} + \frac{z}{y^2}\right).$$

$= -\frac{x}{y^2} - \frac{cx}{y^2} = 0$. $c = -1$.

dan $\frac{cz}{y^2} + \frac{z}{y^3} = 0$. $c = 1$.

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4.4) a). Jawaban:

E = konstan = $V(x,y,z) + \frac{1}{2}mv^2$

Pada asalnya $E = 0 + \frac{1}{2}mv^2$.

Pada (1,1,1) $E = \alpha + \beta + y + \frac{1}{2}mv^2 = \frac{1}{2}mv^2$.

b) Jawaban:

$$V_0 - \frac{2}{m}(\alpha + \beta + y) = 0.$$

$$V_0 = \left[\frac{2}{m}(\alpha + \beta + y)\right]^{1/2}.$$

c). Jawaban:

$$m\ddot{x} = F_x = \frac{-\partial V}{\partial x}.$$

$$m\ddot{x} = -\alpha$$

$$m\ddot{y} = -\frac{\partial V}{\partial y} = -2\beta y.$$

$$m\ddot{z} = -\frac{\partial V}{\partial z} = -3yz^2.$$

4.5) Pertimbangkan 2 fungsi gaya.

a). $F = \hat{i}x + \hat{j}y$.

Jawab:

$\vec{F} = \hat{i}x + \hat{j}y$.

pd. $x = y$ $\quad d\vec{r} = \hat{i}dx + \hat{j}dy$.

$$\int_{(0,0)}^{(1,1)} \vec{F}\cdot d\vec{r} = \int_0^1 F_x\cdot dx + \int_0^1 F_y\cdot dy$$

$$= \int_0^1 x\cdot dx + \int_0^1 y\cdot dy.$$

$$= 1.$$

Pada lintasan sepanjang sumbu $x = d\vec{r} = \hat{i}dx$ dan pada garis. $x = 1$ $d\vec{r} = \hat{j}dy$.

$\int_{(0,0)}^{(1,1)} \vec{F}\cdot d\vec{r} = \int_0^1 F_x\cdot dx + \int_0^1 F_y\cdot dy = 1.$ F = konservatif.

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b). $\vec{F} = \hat{i}y - \hat{j}x$.

di $x = y$ = $\int_{(0,0)}^{(1,1)} \vec{F} \cdot d\vec{r} = \int_0^1 F_x \cdot dx + \int_0^1 F_y \cdot dy$

$= \int_0^1 y \cdot dx - \int_0^1 x \cdot dy$.

saat $x = y$ $\int_{(0,0)}^{(1,1)} \vec{F} \cdot d\vec{r} = \int_0^1 F_x \cdot dx - \int_0^1 y \cdot dy = 0$.

Pada sumbu x = $\int_{(0,0)}^{(1,1)} \vec{F} \cdot d\vec{r} = \int_0^1 F_x \cdot dx = \int_0^1 y \cdot dx$

dan dengan. $y = 0$ pd sb x $\int_{(0,0)}^{(1,0)} \vec{F} \cdot d\vec{r} = 0$.

Pada garis $x = 1$. $\int_{(1,0)}^{(1,1)} \vec{F} \cdot d\vec{r} = \int_0^1 F_y \cdot dy = \int_0^1 x \, dy$.

dan dengan $x = 1$. $\int_{(1,0)}^{(1,1)} \vec{F} \cdot d\vec{r} = \int_0^1 dy = 1$.

Pada jalur ini $\int_{(0,0)}^{(1,1)} \vec{F} \cdot d\vec{r} = 0 + 1 = 1$, $\vec{F}$ = tidak konservatif

4.6) Jawaban:

Dari contoh 2.3.2 , $V(z) = -mg \dfrac{r_e^2}{(r_e + z)}$.

$V(z) = -mgr_e \left(1 + \dfrac{z}{r_e}\right)^{-1}$.

$V(z) = -mgr_e \left(1 - \dfrac{z}{r_e} + \dfrac{z^2}{r_e} + \dots\right)$.

$V(z) = -mgr_e + mgz - \dfrac{mgz^2}{r_e} + \dots$

dengan $-mgr_e$ sebuah konstan.

$V(z) \approx mgz \left(1 - \dfrac{z}{r_e}\right)$.

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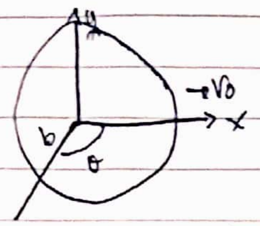
$$\vec{F} = -\vec{\nabla} V = -\hat{k}\frac{\partial}{\partial z} V(z)$$
$$= -\hat{k}mg\left[1 - \frac{z}{re} + z\left(-\frac{1}{re}\right)\right]$$

$$\vec{F} = -kmg\left(1 - \frac{2z}{re}\right).$$
$$m\ddot{x} = F_x = 0.$$
$$m\dot{z}\frac{d\dot{z}}{dz} = -mg\left(1 - \frac{2z}{r_z}\right).$$
$$= \int_{v_z}^{0} \dot{z}\, d\dot{z} = -g\int_0^{m}\left(1 - \frac{2z}{re}\right) dz.$$
$$-\frac{1}{2}V_0{}^2{}_z = -g\left(h - \frac{h^2}{re}\right).$$
$$h^2 - reh + \frac{reV_0{}^2{}_z}{2g} = 0.$$
$$h - reh + \frac{reV_0{}^2{}_z}{2g} = 0$$
$$h = \frac{re}{2} - \frac{1}{2}\sqrt{re^2 - \frac{2reV_0{}^2{}_z}{gre}} \qquad (h, z \ll re).$$
$$h = \frac{re}{2} - \frac{re}{2}\sqrt{1 - \frac{2V_0{}^2{}_z}{gre}}$$
$$(1+x)^{1/2} = 1 + \frac{x}{2} - \frac{x^2}{4} + \cdots$$
$$h = \frac{re}{2} - \frac{re}{2} + \frac{V^2{}_{0z}}{2g} + \frac{V^4{}_{0z}}{4gre} + \cdots$$
$$h \simeq \frac{V_0{}^2{}_z}{2g}\left(1 + \frac{V_{0z}^2}{2gre}\right)$$

dari contoh 2.3.2 $h = \frac{V_0^2}{2g}\left(1 - \frac{V_0^2}{2gre}\right)^{-1}.$

dan dengan $(1-x)^{-1} \simeq 1 + x$, $h \simeq \frac{V_0^2}{2g}\left(1 + \frac{V_0^2}{2gre}\right)$

4.7) Jawaban:



$\vec{r} = \hat{i}b\cos\theta - \hat{j}b\sin\theta$

$\theta = \omega t = \frac{V_0 t}{b}$, jadi $r = -\hat{i}V_0\sin\theta - \hat{j}V_0\cos\theta$

relatif ke tanah, $\vec{v} = \hat{i}V_0(1-\sin\theta)\hat{j}V_0\cos\theta$

Partikel keluar tapi $y = -b\sin\theta$ dan $V_{0y} = -V_0\cos\theta$.
Jadi $V_y = V_{0y} - gt = -V_0\cos\theta - gt$ dan $y = -b\sin\theta - V_0 t\cos\theta - \frac{1}{2}gt^2$
tinggi maksimum $V_y = 0$.

$$t = -\frac{V_0\cos\theta}{\theta}$$

$$h = -b\sin\theta - V_0\left(\frac{-V_0\cdot\cos\theta}{g}\right)\cos\theta - \frac{1}{2}g\left(\frac{-V_0\cdot\cos\theta}{g}\right)^2$$

$$h = -b\sin\theta = \frac{V_0^2\cos^2\theta}{2g}$$

h maksimum terjadi untuk. terjadi untuk $\frac{dh}{d\theta} = 0 = -b\cos\theta - \frac{2V_0\cos\theta\sin\theta}{2g}$

$$\sin\theta = \frac{-gb}{V_0^2}$$

$$\cos^2\theta = 1 - \sin^2\theta = \frac{V_0^4 - g^2b^2}{V_0^4}$$

$$h_{max} = \frac{gb^2}{V_0^2} + \frac{V_0^4 \cdot g^2b^2}{2gV_0^2} = \frac{gb^2}{2V_0^2} + \frac{V_0^2}{2g}$$

Lumpur meninggalkan roda di $\theta = \sin^{-1}\left(-\frac{gb}{V_0^2}\right)$.

4.8) Jawaban:

$x = R\cos\Phi$ dan $x = V_{0x} + (V_0\cos\alpha).t$

Jadi $t = \frac{R\cos\Phi}{V\cos\alpha}$

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$y = R \sin \phi$ dan $y = V - gt = -\frac{1}{2}gt^2 = (V_0 \sin \alpha)t - \frac{1}{2}gt^2$

$$R \sin \phi = (V_0 \sin \alpha) \frac{R \cos\phi}{V_0 \cos\alpha} - \frac{1}{2} g \left(\frac{R \cos \phi}{V_0 . \cos \alpha}\right)^2$$

$$\sin \phi = \tan\alpha \cos \phi - \frac{gR^2 \cos^2\phi}{2V_0^2 \cos^2\alpha}$$

$$R = \frac{2 V_0^2 \cos^2\alpha \cdot (\tan\alpha \cos\alpha - \sin\phi)}{g \cos\phi} \quad \frac{2V_0^2 \cos\alpha}{g \cos^2\phi} \cdot (\sin\alpha \cos\phi - \cos\alpha \sin\phi)$$

$\sin(\theta + \phi) = \sin\theta \cos\phi + \cos\theta \sin\phi \rightarrow$ sifat.

$$R = \frac{2V_0^2 \cos\alpha}{g \cos^2\phi} \sin(\alpha - \phi)$$

Rmaks untuk $(\theta + \phi)$

$$\frac{dR}{dx} = 0$$

$$= \frac{2V_0^2}{g \cos^2\phi} (-\sin\alpha . \sin(\alpha-\phi) + \cos\alpha \cos(\alpha - \phi))$$

$= \cos\theta \cos\phi - \sin\theta \cdot \sin\phi$ jadi $\cos(2\alpha - \phi) = 0$.

$$2\alpha - \phi = \frac{\pi}{2}$$

$$R_{max} = \frac{2V_0^2}{g\cos^2\phi} \cos\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \sin\left(\frac{\pi}{4} - \frac{\phi}{2}\right)$$

$$\sin\left(\frac{\pi}{4} - \frac{\phi}{2}\right) = \cos\left[\frac{\pi}{2} - \left(\frac{\pi}{4} - \frac{\phi}{2}\right)\right] = \cos\left(\frac{\pi}{4} + \frac{\phi}{2}\right)$$

$$R_{max} = \frac{2V_0^2}{g\cos^2\phi} \cos^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right)$$

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$$R_{max} = \frac{2V_0^2}{g\cos^2\phi}\left[\frac{1}{2}\cos\left(\frac{\pi}{2}+\phi\right)+\frac{1}{2}\right].$$

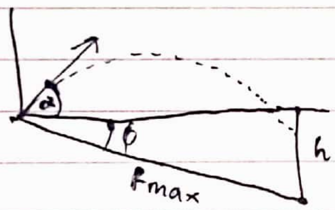
$$= \frac{V_0^2}{g\cos^2\phi}\left[\cos\left(\frac{\pi}{2}+\phi\right)+1\right].$$

menggunakan sifat $\cos\left(\frac{\pi}{2}+\theta\right) = -\sin\theta$.

$$R_{max} = \frac{V_0^2}{g(1-\sin\phi)}(1-\sin\phi).$$

$$= \frac{V_0^2}{g(1+\sin\phi)}$$

4.9). a).



$$R = \frac{2V_0^2}{g}\,\frac{\cos\alpha\cdot\sin(\alpha+\phi)}{\cos^2\phi}.$$

$-\varphi = \ldots\ R_{max} = V_0^2(1+\sin\varphi)$ dan $2\alpha = \frac{\pi}{2} = \varphi$

$$R_{max} = \frac{h}{\sin\varphi} = \frac{V_0^2}{g}\,\frac{(1+\sin\varphi)}{\cos^2\varphi} = \frac{V_0^2}{g(-\sin\varphi)}.$$

$$\sin\varphi = \frac{gh}{V_0^2}\Big/\left(1+\frac{gh}{V_0^2}\right).$$

$$\sin\varphi = \sin\left(\frac{\pi}{2}-2x\right)$$
$$= \cos 2\alpha$$
$$= 1-2\sin^2\alpha.$$

$$1-\sin^2\alpha = \frac{gh}{V_0^2}\Big/\left(1+\frac{gh}{V_0^2}\right).$$

$$2\sin^2\alpha = \frac{2}{\csc^2\alpha} =$$
$$= 1-\frac{gh}{V_0^2}\Big/\left(1+\frac{gh}{V_0^2}\right)$$

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$$= \frac{1}{1+\frac{gh}{V_0^2}}$$

$$= \csc^2\alpha$$
$$= 2\left(1+\frac{gh}{V_0^2}\right)$$

4.12) a). Jawab:

x dan z adalah posisi bola.

$x = V_0 t \cdot \cos \tfrac{1}{2}\theta_0$, $z = V_0 t \cos \tfrac{1}{2}\theta_0 \sin\theta_0 - \tfrac{1}{2} g t^2$.

Sejak $V_R = V_0 \cos \frac{1}{2}\theta$

$$R = \frac{V_0^2}{g} \cos^2 \frac{1}{2}\theta_0^2 \sin 2\theta.$$

maks $\frac{dR}{d\theta} = 0$.

$$\frac{dR}{d\theta} = \frac{V_0^2}{g}\left(2\cos^2\frac{1}{2}\theta \cos^2\theta_0 - \cos\frac{1}{2}\theta_0 \sin\frac{1}{2}\theta_0 \sin^2\theta_0\right) = 0.$$

$$2\cos^2\frac{1}{2}\theta_0 \cos^2\theta_0 = \cos\frac{1}{2}\theta_0 \sin\frac{1}{2}\theta_0 \sin^2\theta_0.$$

$2\cos^2\theta_0 = 1+\cos^2\theta_0$ dan $\sin^2\theta = 2\sin\theta_0 . \sin 2\theta_0$

didapatkan. $(1+\cos\theta_0)(2\cos^2\theta_0 - 1) . = \sin\theta_0 \sin\theta_0 \cos\theta_0 = (1-\cos^2\theta \cos\theta_0.)$.

atau. $(1+\cos\theta_0)(3\cos^2\theta_0 - \cos\theta_0 - 1) = 0$.

hanya akar positif yang berlaku adalah θ, $0 \leq \theta \leq \frac{\pi}{2}$.

$\cos\theta_0 = \frac{1}{6}(1+\sqrt{13}) = 0{,}7676$ $\theta_0 = 39°$.

b). Untuk $V_0 = 25$ m/s $R_{mak} = 55{,}4$ m $\theta_0 = 39°51$

maksi $\frac{dz}{dt} = 0$.

$V_0 \cos\frac{1}{2}\theta_0 \sin\theta_0 = gT$ atau $T = \frac{V_0 \cos\frac{1}{2}\theta_0 \sin\theta_0}{g}$

atau $H = \frac{V_0^2}{2g}\cos^2\frac{1}{2}\theta_0 \sin^2\theta$ maks tetap. di θ.

maks pd ketinggian ttp terjadi $\frac{dH}{d\alpha} = 0$

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$$\frac{dH}{d\alpha} = \frac{V_0^2}{2g}\left(2\cos^2\tfrac{1}{2}\theta_0 \sin\theta_0 \cos\theta_0 - \cos\tfrac{1}{2}\theta_0 \sin\tfrac{1}{2}\theta_0 . \sin^2\theta\right) = 0.$$

$$(1+\cos\theta_0)\sin\theta_0\cos\theta_0 = \frac{1}{2}\sin\theta_0 \sin^2\theta_0$$
$$= \frac{1}{2}\sin\theta_0\,(1-\cos^2\theta_0).$$

$$\sin\theta_0\,(1+\cos\theta_0)(3\cos\theta_0 - 1) = 0.$$

$\sin\theta_0 = 0.$ $\cos\theta_0 = -1.$

Jadi $H_{max} = 18,5$ m $\theta_0 = \cos^{-1}\frac{1}{3} = 70,32°.$

4.13) Jawaban:

r menggantikan x

$z = \frac{\dot{z}_0}{\dot{r}_0} r - \frac{g}{2\dot{r}_0^2} r^2$ dimana $\dot{r}_0 = V_0 \cos\theta_0$, $\dot{z}_0 = V_0 . \sin\theta_0$

$z = r\tan\theta_0 - \frac{gr^2}{2V_0^2}\sec^2\theta.$ syak $\sec^2\theta_0 = 1 + \tan^2\theta.$

$$\frac{gr^2}{2V_0^2}\tan\theta_0 - r\tan\theta + z + \frac{gr^2}{2V_0^2} = 0.$$

(r,z) titik koordinat.

$$\tan\theta_0 = \frac{1}{gr}\left[V_0^2 \pm (V_0^4 - gzV_0^2 - g^2r^2)^{1/2}\right]$$

$V_0^4 - 2gzV_0^2 - g^2r^2 \geq 0.$

Permukaan kritis oleh karena itu $V_0^4 - 2gz - g^2r^2 = 0.$

4.17) Jawab:

$$m\ddot{x} = F_x = -\frac{\partial V}{\partial x} = -kx = -\pi^2 m x.$$

$$\dot{x} = A\cos\left(\sqrt{\frac{k}{m}}\,t + \alpha\right) = A\cos(\pi\alpha + \alpha).$$

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$$m\ddot{y} = -\frac{\partial V}{\partial y} = 4\pi^2 m a.$$

$$y = \beta \cos (2\pi t + \beta)$$

$$m\ddot{z} = -\frac{\partial V}{\partial z} = -9\pi^2 m z.$$

$$z = (\cos (3\pi t + \gamma)).$$

Sejak $x = y = z$ pada saat $t = 0$ $\quad \alpha = \beta = \gamma = -\frac{\pi}{2}.$

$$x = A.\cos \left(\pi t . \frac{\pi}{2}\right) = A \sin \pi t.$$

$$\dot{x}_0 = A\pi . \cos \pi t.$$

$$V_0{}^2 = \dot{x}_0{}^2 + \dot{y}_0{}^2 + \dot{z}_0{}^2 \quad \text{dan} \quad \dot{x}_0 = \dot{y}_0 = \dot{z}_0.$$

$$\dot{x}_0 = \frac{V_0}{\sqrt{3}} = A\pi.$$

$$A = \frac{V_0}{\pi\sqrt{3}}.$$

$$x = \frac{V_0}{\pi\sqrt{3}} \sin \pi t.$$

$$y = \beta . \sin 2\pi t, \quad \dot{y} = 2\beta\pi \cos 2\pi t.$$

$$\dot{y}_0 = \frac{V_0}{\sqrt{3}} = 2\pi.$$

$$\beta = \frac{V_0}{2\pi\sqrt{3}}.$$

$$y = \frac{V_0}{2\pi\sqrt{3}} \sin 2\pi t$$

$$z = C \sin 3\pi t$$

$$\dot{z}_0 = \frac{V_0}{\sqrt{3}} = 3\pi t \qquad \dot{z} = 3C\pi \cos \pi t$$

$$C_0 = \frac{V_0}{3\pi\sqrt{3}} \quad \rightarrow z = \frac{V_0}{3\pi\sqrt{3}} \sin 3\pi t$$

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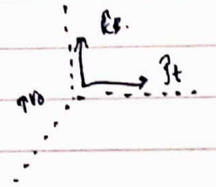
Sijak. $\omega_x = \pi$, $\omega_y = 2\pi$. dan $\omega_z = 3\pi$ maka $T_{min} = \frac{2\pi n_1}{\omega_x} = \frac{2\pi n_2}{\omega_y} = \frac{2\pi n_3}{\omega_z}$

Waktu maks pada $n_1 = 1$, $n_2 = 2$, $n_3 = 3$.

$t_{min} = \frac{2\pi}{2} = 2$

2.20) Jawab.



$$\vec F = q(\vec E + \vec v + \vec B).$$

$$\vec v \times \vec B = (\hat i \dot x + \hat j \dot y + \hat k \dot z) = \hat i \dot y B - \hat j \dot x B.$$

$$\vec F = \hat i q \dot y B + \hat j q (E - \dot x B).$$

$$m\ddot x = F_x = q\dot y B.$$

$$\dot x - \dot x_0 = \frac{qB}{m} y.$$

$$m\ddot y = F_y = qE - q\dot x B = qE - qB\left(\dot x_0 + \frac{qB}{m} y\right).$$

$$\ddot y = \frac{qE}{m} - \frac{qB\dot x}{m} - \left(\frac{qB}{m}\right)^2 y = \frac{eE}{m} + \frac{EB\dot x}{m} - \left(\frac{eB}{m}\right)^2 y.$$

$$\ddot y + \omega^2 y = -\frac{eE}{m} + \omega \dot x_0.$$

$$y = \frac{1}{\omega^2}\left(-\frac{eE}{m} + \omega x\right) + A\cos(\omega t + \theta_0).$$

$$\dot y = -A\omega \sin(\omega t + \theta).$$

$\dot y_0 = 0$, Jadi $\theta_0 = 0$ $\quad A = -\frac{1}{\omega^2}\left(\frac{eE}{m} + \omega x_0\right)$

$y = a(1 - \cos \omega t)$, $\quad a = \frac{1}{\omega^2}\left(-\frac{eE}{m} + \omega \dot x_0\right)$

$$\dot x = \dot x_0 + \frac{qB}{m} y = \dot x - \omega y = \dot x_0 - \omega a(1 - \cos \omega t).$$