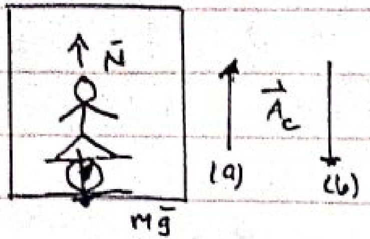
Kelas : B

S.1 A 120-lb Person stand on a bathroom spring Scale while riding in an elevator. If the elevator For has (a) upward and (b) downward acceleration of g/4, what is the weight indicated on the scale in each case?

Jawab : (a)



$\vec{N} + m\vec{g} - m\vec{A}_o = 0$

$N - mg - mA_o = N - mg - m\frac{g}{4} = N - \frac{5}{4} mg = 0$

$W' = N = \frac{5}{4} mg = \frac{5}{4} W$

$W' = 150$ lb

(b) $N - mg + m\left(\frac{g}{4}\right) = 0$ $W' = W - \frac{W}{4} = 3/4\, W$

$W' = 90$ lb

S.2 An ultracentrifuge has a rotational speed of 500 rps. (a) Find the centrifugal force on a 1-μg particle in the sample chamber if the particle is 5 cm from the rotational axis. (b) Express the result as the ration of the centrifugal force to the wight of the particle.

Jawab : (a) $\vec{F}_{cent} = -m\vec{\omega} \times (\vec{\omega} \times \vec{r})$

untuk $\vec{\omega} \perp \vec{r}$. $\vec{F}_{cent} = m\omega^2 r' \hat{e}_r$

$\omega = 500\ s^{-1} = 1000\pi\, s^{-1}$

$F_{cent} = 10^{-6} \times (1000\pi)^2 \times 5\,\hat{e}_r = 5\pi^2$

(b) $\frac{F_{cent}}{F_g} = \frac{m\omega^2 r'}{mg} = \frac{(1000\pi)^2\, 5}{980} = 5{,}04 \times 10^4$

5.3 A plumb line is held steady while being carried along in a moving train. If the mass of the plumb bob is m, find the tension in the cord and the deflection from the local vertical if the train is accelerating forward with constant acceleration g/10. (Ignore any effects of earth's rotation)

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$$m\vec{g} + \vec{T} - m\vec{A} = 0$$

$$-mg\,\hat{j} + T\cos\theta\,\hat{j} + T\sin\theta\,\hat{i} - m\left(\frac{g}{10}\right)\hat{i} = 0$$

$$T\cos\theta = mg.$$

$$T\sin\theta = \frac{mg}{10}$$

$$\tan\theta = \frac{1}{10}, \quad \theta = 5{,}71^\circ$$

$$T = \frac{mg}{\cos\theta} = 1{,}005\, mg$$

5.4 If in problem 5.3, the plumb line is not held steady but oscillates as a simple pendulum, find the period of oscillation for small amplitude.

$\Rightarrow \quad \vec{g}' = \vec{g} - \vec{A}_0 = g\hat{j} - \frac{g}{10}\hat{i}$

Untuk osilasi kecil pada pendulum sederhana:

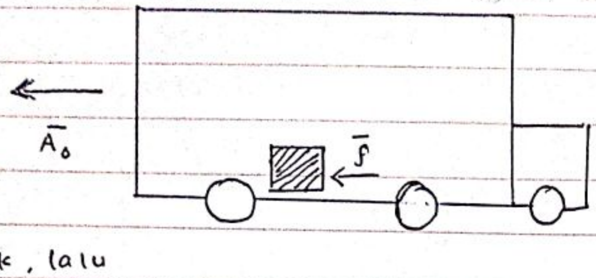
$$T = 2\pi\sqrt{\frac{l}{g'}}$$

$$g' = \sqrt{g^2 + \left(\frac{g}{10}\right)^2} = 1{,}005\, g$$

$$T = 2\pi\sqrt{\frac{l}{1{,}005\, g}} = 1{,}995\,\pi\sqrt{\frac{l}{g}}$$

5.5. A hauling truck is traveling on a level road. The driver suddenly applies the brakes, causing the truck to decelerate by a amount $g/2$. This causes a box in the rear of the truck to slide forward. If the coefficient of sliding friction between the box relative to (a) the truck and (b) the road.

Jawab : (a) $f = -Nmg$ in the frictional force acting on the



box, lalu

$$\vec{f} - m\bar{A}_0 = m\vec{a}$$

Sekarang, f adalah real force, maka

(b) $$a = \frac{f}{m} = -\frac{Nmg}{m} = -Ng = -\frac{g}{3}$$

$A = -\frac{g}{2}$ from above, $ma - mA_0 = ma'$ maka

(a) $$a' = a - A_0 = -\frac{g}{3} + \frac{g}{2} = \frac{g}{6}$$

5.6. The position of a particle in a fixed inertial frame of reference in give by the vector

$$r = i(x_0 + R\cos \Omega t) + jR\sin \Omega t$$

Where x_0, R, and Ω are constants

(a) Show that the particle moves in a circle with constant speed

(b) Find two coupled. First-order differential equations of motion that relate the components of position, x' and y', and the components of velocity, $\dot{x}'$ and $\dot{y}'$ of the particle relative to a frame of reference rotationg with an agular velocity.

$\omega = k\omega$

(c) Letting to fixed and rotating frames of reference coincide at times $t = 0$ and letting $u' = x' + iy'$, Find $u(t)$ assuming that $\Omega \neq -\omega$

Jawab: (a) $\vec{r} = \hat{i}(x_0 + R\cos\Omega t) + \hat{j}R\sin\Omega t$

$\dot{\vec{r}} = -\hat{i}\Omega R\sin\Omega t + \hat{j}\Omega R\cos\Omega t$

$\dot{\vec{r}}\cdot\dot{\vec{r}} = v^2 = \Omega^2 R^2 \qquad = \underline{v = \Omega R}$

(b) $\dot{\vec{r}}' = \dot{\vec{r}} - \vec{\omega}\times\vec{r}$ ketika $\vec{r} = \hat{i}x' + \hat{j}y'$

$= -\hat{i}\Omega R\sin\Omega t + \hat{j}\Omega R\cos\Omega t - \omega\hat{k}\times(\hat{i}x' + \hat{j}y')$

$= -\hat{i}\Omega R\sin\Omega t + \hat{j}\Omega R\cos\Omega t - \hat{j}\omega x' + \hat{i}\omega y'$

$\dot{x}' = \omega y' - \Omega R\sin\Omega t$

$\dot{y}' = -\omega x' + \Omega R\cos\Omega t$

(c) Let $u' = x' + iy' \qquad = i = \sqrt{-1}$!

$\dot{u}' = \dot{x}' + i\dot{y}' = \omega y' - \Omega R\sin\Omega t - i\omega x' + i\Omega R\cos\Omega t$

$i\omega u' = \quad = -\omega y' + i\omega x'$

$\rightarrow \dot{u}' + i\omega u' = -\Omega R\sin\Omega t + i\Omega R\cos\Omega t = i\Omega R e^{i\Omega t}$

$u' = Ae^{-i\omega t} + Be^{i\Omega t}$

$\dot{u}' = -i\omega Ae^{-i\omega t} + i\Omega Be^{i\Omega t}$

$+ \; i\omega u' = i\omega Ae^{-i\omega t} + i\omega Be^{i\omega t}$

$\rightarrow \dot{u}' + i\omega u' = i(\omega + \Omega)Be^{i\omega t}$ maka $B = \dfrac{\Omega R}{\omega + \Omega}$

$u' = A + B = x'(0) + iy'(0) = x_0 + R$

$\rightarrow A = x_0 + R - B = x_0 + R - \dfrac{\Omega R}{\omega + \Omega}$ maka $A = x_0 + \dfrac{\omega R}{\omega + \Omega}$

$$u' = \left[x_0 + \frac{\omega R}{\omega + \Omega}\right]e^{-i\omega t} + \frac{\Omega R}{\omega + \Omega}e^{i\omega t}$$