Gabarito da P1 - Física I - IO 2013
Turno

① $\vec{v} = A\cos(\omega t)\hat{x} + B(\sin(\omega t)+1)\hat{y}$

(a) $\vec{a} = \frac{d\vec{v}}{dt} = -\omega A \sin(\omega t)\hat{x} + \omega B\cos(\omega t)\hat{y}$

$\vec{F} = m\vec{a} = -m\omega A\sin(\omega t)\hat{x} + m\omega B\cos(\omega t)\hat{y}$

$\vec{F}(t) = -2\times10^{-7}\pi \sin\left(\frac{\pi}{4}t\right)\hat{x} + 3{,}5\pi\times10^{-7}\cos\left(\frac{\pi}{4}t\right)\hat{y}$

$\vec{F}(t) = -6{,}28\times10^{-7}\sin\left(\frac{\pi}{4}t\right)\hat{x} + 11\times10^{-7}\cos\left(\frac{\pi}{4}t\right)\hat{y}$

$\vec{F}(0) = \underline{11\times10^{-7}\hat{y}}$ (N)

$\vec{F}(2) = \underline{-6{,}28\times10^{-7}\hat{x}}$ (N)

(b) $\vec{r} = \vec{r}(0) + \int_0^t \vec{v}(t')dt'$

$\vec{r} = c\hat{z} + \frac{A}{\omega}\sin(\omega t)\hat{x} - \left\{\frac{B}{\omega}[\cos(\omega t)-1] - Bt\right\}\hat{y}$

$\vec{r} = 0{,}51\sin\left(\frac{\pi}{4}t\right)\hat{x} - \left\{0{,}89\left[\cos\left(\frac{\pi}{4}t\right)-1\right] - 0{,}7t\right\}\hat{y} - 20\hat{z}$

$\vec{r}(0) = -20\hat{z}$

$\vec{r}(2) = 0{,}51\hat{x} + 2{,}29\hat{y} - 20\hat{z}$

$\langle\vec{v}\rangle = \frac{\Delta\vec{r}}{\Delta t}$

$\langle\vec{v}\rangle = \underline{0{,}26\hat{x} + 1{,}15\hat{y}}$

(c) $P_{ot} = \vec{F} \cdot \vec{v}$ $\quad \vec{v}(0) = A\hat{x} + B\hat{y} = 94\hat{x} + 97\hat{y}$

$\vec{v}(2) = 2B\hat{y} = 1,4\hat{y}$

$P(0) = 1,1\,10^{-6} \times 97 = \underline{\underline{977 \times 10^{-6}\ W}}$

$P(2) = \underline{\underline{0}}\ W$

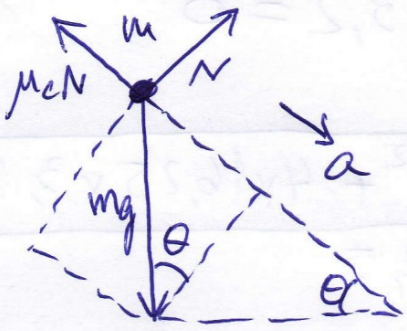
(d) $W = \Delta K \quad K = \frac{1}{2} m v^2$

$W = 10^{-6} \left(v^2(2) - v^2(0) \right)$

$W = 10^{-6} \left(1,4^2 - 0,4^2 - 0,7^2 \right)$

$W = 10^{-6} \left(1,96 - 0,16 - 0.49 \right) = \underline{\underline{1,31 \times 10^{-6}\ J}}$

② (a)



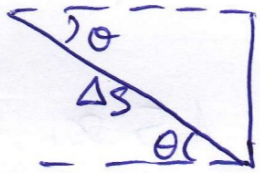
$N = mg\cos\theta$

$ma = mg\,\text{sen}\theta - \mu_c mg\cos\theta$

$a = g(\text{sen}\theta - \mu_c\cos\theta) = 10(0,6 - 0,375\times 0,8)$

$a = \underline{3,0\ m/s^2}$

(b) $v = \sqrt{2a\Delta s}$



$\Delta s = \frac{y_0}{\text{sen}\theta}$

$v = \sqrt{2a\frac{y_0}{\text{sen}\theta}} = \sqrt{\frac{2\times 3\times 1,6}{0,6}} = \sqrt{16} = \underline{4\ m/s}$

(c) $E_0 = mgy_0 = 0,4\times 10\times 1,6 = 6,4\ J$

$E_1 = \frac{1}{2}kx_1^2 + |W_{at_1}|$

$|W_{at_1}| = \mu_c mg\cos\theta\frac{y_0}{\text{sen}\theta} + \mu_c mg x_1$

$|W_{at_1}| = \frac{0,375\times 0,4\times 10\times 0,8\times 1,6}{0,6} + 0,375\times 0,4\times 10\,x_1$

$|W_{at_1}| = 3,2 + 1,5x_1 \qquad E_1 = 16,25x_1^2 + 1,5x_1 + 3,2 = 6,4$

$\Rightarrow 16,25x_1^2 + 1,5x_1 - 3,2 = 0$

$$16{,}25\,x_1^2 + 1{,}5\,x_1 - 3{,}2 = 0$$

$$x_1 = \frac{-1{,}5 + \sqrt{1{,}5^2 + 4 \times 16{,}25 \times 3{,}2}}{32{,}5} = \underline{0{,}4\,m}$$

(a) $E_2 = mgy_2 + |W_{at1}| + |W_{et2}|$

$|W_{at1}| = 3{,}2 + 1{,}5\,x_1 = 3{,}2 + 1{,}5 \times 0{,}4 = 3{,}8\,J$

$|W_{at2}| = \mu_c mg\,x_1 + \mu_c mg \frac{\cos\theta}{\sin\theta}\,y_2$

$|W_{at2}| = 1{,}5\,x_1 + \frac{0{,}375 \times 0{,}4 \times 10 \times 0{,}8}{0{,}6}\,y_2$

$|W_{at2}| = 0{,}6 + 2{,}0\,y_2$

$3{,}2 + 1{,}5 \times 0{,}4$

$E_2 = 4\,y_2 + 3{,}8 + 0{,}6 + 2{,}0\,y_2 = E_0 = 6{,}4\,J$

$6\,y_2 = 6{,}4 - 3{,}8 - 0{,}6 = 2$

$\underline{y_2 = 0{,}33\,m}$