Gabarito P2 Física 1 - Io 2013

FRB

① (a) $M_T \vec{v}_T + m\vec{v} = (M_T + m)(\vec{v}_T + \Delta\vec{v}_T)$

$(M_T+m)\Delta\vec{v}_T = (M_T - M_T - m)\vec{v}_T + m\vec{v} = m(\vec{v} - \vec{v}_T)$

$$\Delta\vec{v}_T = \frac{m}{M_T+m}(\vec{v} - \vec{v}_T) = \frac{m}{M_T}\frac{1}{\left(1+\frac{m}{M_T}\right)}(\vec{v} - \vec{v}_T)$$

$$\Delta\vec{v}_T \approx \frac{m}{M_T}\vec{v} \qquad \left[\vec{v} \gg \vec{v}_T \;;\; \frac{m}{M_T} \ll 1\right]$$

$$\Delta\vec{v}_T = -\frac{m}{M_T} v\,\hat{x}$$

(b) $|\Delta\vec{v}_T| = \frac{m}{M_T} v = 10^{-5} \times 10^6 = 10\ m/s$

(c) $K_T = \frac{1}{2} M_T v_T^2 \qquad \Delta K_T \approx \frac{dK_T}{dv_T}\Delta v_T$

$\Delta K_T \approx M_T v_T \Delta v_T \qquad \Delta v_T = -10\ m/s$

$\Delta K_T = -6\times10^{24} \times 3,0\times10^{4} \times 10 = -1,8\times10^{30}\ J$

(d) $\Delta K_a = \frac{1}{2} m v_T^2 - \frac{1}{2} m v^2 \approx -\frac{1}{2} m v^2$

$\Delta K_a = -\frac{1}{2}\, 10^{-5} \times 6\times10^{24} \times 1\times10^{6\times2}$

$\Delta K_a = -3\times10^{31}\ J$

(e) $\vec{J} = \Delta \vec{P}_T = M_T \Delta \vec{v}_T = -6 \times 10^{25} \hat{x}\ Ns$

$$|\langle F \rangle| = \frac{6 \times 10^{25}}{120 \times 10^{-3}} = \frac{6 \times 10^{25}}{1,2 \times 10^{-1}} = 5 \times 10^{26}\ N$$

(f) $$\omega_0 = \frac{2\pi}{24 \times 3600} = \frac{2 \times 3,14}{8,64 \times 10^4} = 7,2 \times 10^{-5}\ rad/s$$

$$\omega = \omega_0 \times \frac{24}{25} = 6,9 \times 10^{-5}\ rad/s$$

$$\Delta\omega = -0,3 \times 10^{-5} \approx -3 \times 10^{-6}\ rad/s$$

(g) $$L_{z'} = -I_T \omega_0 + m v R_T \operatorname{sen}\theta = -I_T \omega$$

$$I_T \Delta\omega = -m v R_T \operatorname{sen}\theta$$

$$\operatorname{sen}\theta = -\frac{I_T \Delta\omega}{m v R_T} = -\frac{0,33 M_T R_T^2 \Delta\omega}{10^{-5} M_T v R_T}$$

$$\operatorname{sen}\theta = \frac{+0,33 \times 6,4 \times 10^6 \times 3 \times 10^{-6}}{10^{-5} \times 10^6}$$

$$\operatorname{sen}\theta = 0,63 \qquad \theta = 39^\circ \quad (38^\circ)$$

(h) $$\Delta I_{z'} = m R_T^2 \qquad \frac{\Delta I_{z'}}{I_T} = \frac{10^{-5} M_T R_T^2}{0,33 M_T R_T^2} = 3 \times 10^{-5} \ll 1$$

(i) $$\Delta K_R = \frac{dK_R}{d\omega} \Delta\omega = I_T \omega \Delta\omega \qquad \left(K_R = \frac{1}{2} I_T \omega^2\right)$$

$$\Delta K_R = -0,33 \times 6 \times 10^{24} \times 6,4^2 \times 10^{12} \times 7,2 \times 10^{-5} \times 3 \times 10^{-6}$$

$$\Delta K_R = -1,7 \times 10^{28}\ J$$

(j) $$\Delta E_{INT} = -\Delta K_T - \Delta K_R - \Delta K_a = +1,8 \times 10^{30} + 1,7 \times 10^{28} + 3 \times 10^{31}$$

$$\Delta E_{INT} \approx 3,2 \times 10^{31}\ J \gg 5 \times 10^{23}\ J$$