RISOLUZIONE I PROVA DI VERIFICA FISICA I

3 MAR 2016

ESERCIZIO n. 1

$\bar{a} \equiv (1, 3, -5) \quad \bar{b} \equiv (2, -1, -3)$

$[a] = m/s \quad [b] = kg/s \quad h = \frac{1}{2} m$

$(\bar{a} \cdot h\bar{b}) = h(\bar{a} \cdot \bar{b}) = \frac{1}{2}(+2 - 3 + 15) = 7 \frac{m^2 kg}{s^2}$

$(h\bar{a} \times \bar{b}) \rightarrow h\bar{a} \equiv (\frac{1}{2}, \frac{3}{2}, -\frac{5}{2})$

$$h\bar{a} \times \bar{b} \Rightarrow \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{1}{2} & \frac{3}{2} & -\frac{5}{2} \\ 2 & -1 & -3 \end{vmatrix} = +\hat{i}\left(-\frac{9}{2} - \frac{5}{2}\right) + -\hat{j}\left(-\frac{3}{2} + \frac{10}{2}\right) + +\hat{k}\left(-\frac{1}{2} - \frac{6}{2}\right) =$$

$$= -\frac{14}{2}\hat{i} - \frac{7}{2}\hat{j} - \frac{7}{2}\hat{k} = -7\hat{i} - 3.5\hat{j} - 3.5\hat{k}$$

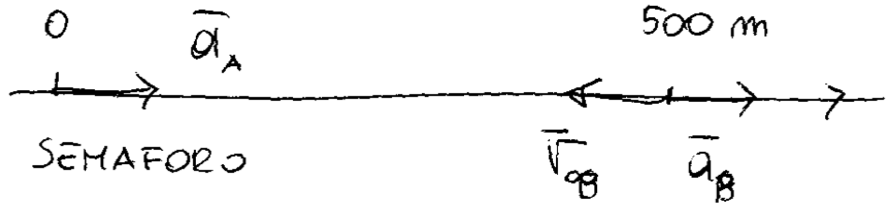
$[h\bar{a} \times \bar{b}] = m \frac{m}{s} \frac{kg}{s} = \frac{m^2 kg}{s^2}$

Con $[a] = [b] = kg\, m/s$

$\bar{a} + \bar{b} = 3\hat{i} + 2\hat{j} - 8k \quad [\bar{a} + \bar{b}] = kg\, m/s$

$\bar{a} - \bar{b} = -\hat{i} + 4\hat{j} - 2\hat{k} \quad [\bar{a} - \bar{b}] = kg\, m/s$

ESERCIZIO n. 2



$|\bar{a}_A| = 2\ m/s^2$

$|\bar{v}_{0B}| = 45\ m/s$

$|\bar{a}_B| = 3\ m/s^2$

$d = 500\ m$

MOTO DI A

MOTO UNIF. ACCELERATO
IN CUI LA VELOCITA' AUMENTA

$$x_A(t) = x_{0A} + v_{0Ax}t + \frac{1}{2}a_{Ax}t^2 \ ; \quad v_{Ax}(t) = v_{0Ax} + a_{Ax}t$$

$$\begin{cases} x_{0A} = 0 \\ v_{0Ax} = 0 \\ a_{Ax} = +2\ m/s^2 \end{cases} \Rightarrow \begin{cases} x_A(t) = \frac{1}{2}2t^2 = t^2 \\ v_{Ax}(t) = +2t \end{cases}$$

MOTO DI B

MOTO UNIF. ACCELERATO CON VELOCITA' CHE DIMINUISCE

$$\begin{cases} x_B(t) = x_{0B} + v_{0Bx}t + \frac{1}{2}a_{Bx}t^2 \\ v_{Bx}(t) = v_{0Bx} + a_{Bx}t \end{cases}$$

$x_{0B} = +500\ m \ ; \quad v_{0Bx} = -45\ m/s \ ; \quad a_{Bx} = +3\ m/s^2$

$$\begin{cases} x_B(t) = +500 - 45t + \frac{1}{2}3t^2 \\ v_{Bx}(t) = -45 + 3t \end{cases}$$

SI INCONTRANO IN t^* IN CUI

$$x_A(t^*) = x_B(t^*)$$

$$t^{*2} = 500 - 45t^* + 1.5t^{*2}$$

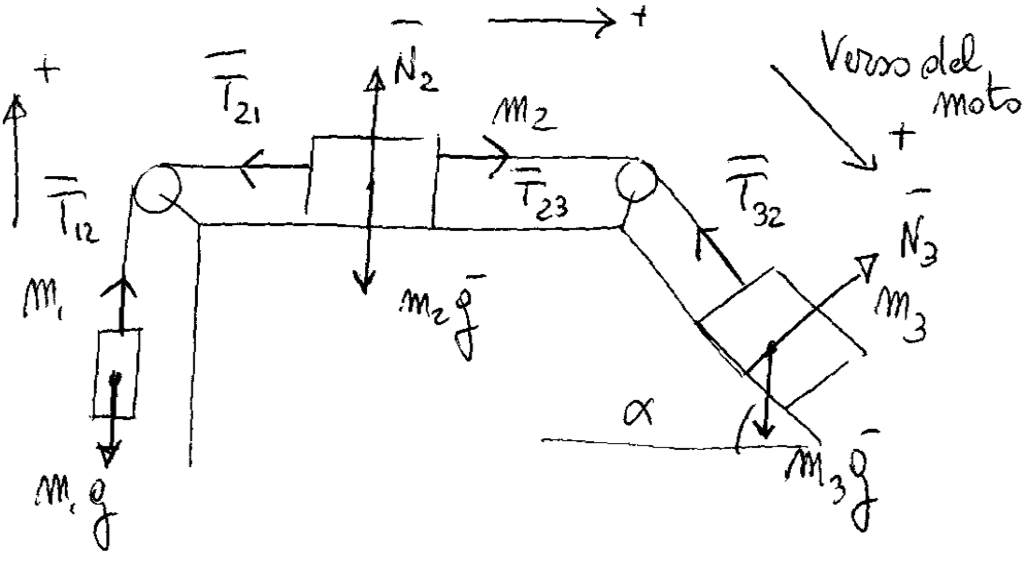
RISOLVENDO $t^* = 13\ s$ - SOSTITUENDO

$x_A(t^*) = x_B(t^*) = 169\ m$

$v_{Ax}(t^*) = 26\ m/s$

$v_{Bx}(t^*) = -6\ m/s$

ESERCIZIO n. 3



$m_1 = 7\ kg$

$m_2 = 11\ kg$

$m_3 = 3\ kg$

$\alpha = 30°$

MASSA m_1

$$\bar{T}_{12} + m_1 \bar{g} = m_1 \bar{a}_1$$

$$\boxed{+T_{12} - m_1 g = m_1 a_{1x}}$$

MASSA m_2

$$\overline{T}_{21} + \overline{T}_{23} + \overline{N}_2 + m_2\overline{g} = m_2\overline{a}_2$$

$$x)\quad -T_{21} + T_{23} = m_2 a_{2x}$$

$$y)\quad +N_2 - m_2 g = 0$$

MASSA m_3

$$+\overline{T}_{32} + m_3\overline{g} + \overline{N}_3 = m_3\overline{a}_3$$

$$x)\quad -T_{32} + m_3 g \sin\alpha = m_3 a_{3x}$$

$$y)\quad +N_3 - m_3 g \cos\alpha$$

METTENDO A SISTEMA

$$\begin{cases} +T_{12} - m_1 g = m_1 a_{1x} \\ -T_{21} + T_{23} = m_2 a_{2x} \\ -T_{32} + m_3 g \sin\alpha = m_3 a_{3x} \end{cases}$$

CON

$$a_{1x} = a_{2x} = a_{3x} = a_x$$

$$|\overline{T}_{12}| = |\overline{T}_{21}| = T_1$$

$$|\overline{T}_{23}| = |\overline{T}_{32}| = T_2$$

$$\begin{cases} +T_1 - m_1 g = m_1 a_x \\ -T_1 + T_2 = m_2 a_x \\ -T_2 + m_3 g \sin\alpha = m_3 a_x \end{cases}$$

$$\cancel{+T_1} - m_1 g \cancel{-T_1} \cancel{+T_2} \cancel{-T_2} + m_3 g \sin\alpha = (m_1 + m_2 + m_3)a_x$$

$$a_x = \left(\frac{-m_1 + m_3 \sin\alpha}{m_1 + m_2 + m_3} \right) g \qquad a = -2.57 \ m/s^2$$

$$T_1 = m_1 (a_x + g) \qquad T_1 = 50.61 \ N$$

$$T_2 = m_2 a_x + T_1 \qquad T_2 = 22.34 \ N$$

SE NON CONOSCIAMO IL VALORE DI m_3,

CON LE STESSE IPOTESI

$$a_x = \left(\frac{-m_1 + m_3 \sin\alpha}{m_1 + m_2 + m_3} \right) g$$

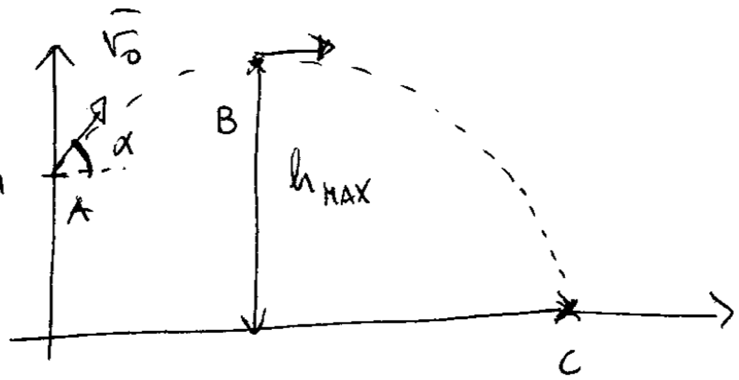
$$a_x = 0 \qquad m_1 = m_3^* \sin\alpha \qquad m_3^* = \frac{m_1}{\sin\alpha}$$

$$m_3^* = 14 \ Kg$$

SE $m_3 < m_3^*$ m_1 SCENDE

SE $m_3 > m_3^*$ m_1 SALE

ESERCIZIO n. 4



$m = 2\,Kg$

$h = 15\,m$

$|\bar{v}_0| = 50\ m/s$

$\alpha = 25°$

$$\bar{r}(t) = \bar{r}_0 + \bar{v}_0 t + \frac{1}{2}\bar{a}t^2$$

$$\begin{cases} x(t) = x_0 + v_{0x}t + \frac{1}{2}a_x t^2 \\ y(t) = y_0 + v_{0y}t + \frac{1}{2}a_y t^2 \end{cases} \qquad \begin{cases} v_x(t) = v_{0x} + a_x t \\ v_y(t) = v_{0y} + a_y t \end{cases}$$

$$\begin{cases} x_0 = 0 \\ y_0 = +15\,m \end{cases} \quad \begin{cases} v_{0x} = +v_0 \cos\alpha = 45.3\ m/s \\ v_{0y} = +v_0 \sin\alpha = 21.1\ m/s \end{cases} \quad \begin{cases} a_x = 0 \\ a_y = -g \end{cases}$$

$$\begin{cases} x(t) = 45.3\,t \\ y(t) = 15 + 21.1\,t^2 - \frac{1}{2}gt^2 \end{cases} \qquad \begin{cases} v_x(t) = v_{0x} = 45.3\ m/s \\ v_y(t) = +21.1 - gt \end{cases}$$

NEL PUNTO DI MASSIMA QUOTA $v_y(t^*) = 0 \quad t^* = 2.15\,s$

LA MASSIMA QUOTA E' $h_{MAX} = y(t^*) = 37.71\ m$

IL TEMPO DI VOLO t_v : $y(t_v) = 0 \quad t_v = 4.93\ s$

$$\begin{cases} v_x(t_v) = v_{0x} = 45.3\ m/s \\ v_y(t_v) = -27.2\ m/s \end{cases}$$

VELOCITA' FINALE

$|\bar{v}_F| = 52.8\ m/s$

E' UN SISTEMA IN CUI SI CONSERVA L'ENERGIA MECCANICA QUINDI

$$E^A_{TOT} = E^B_{TOT} = E^C_{TOT}$$

$$E^A_{TOT} = \frac{1}{2} m v_0^2 + mgh = 2500 + 294 = 2794\,J$$

$$E^B_{TOT} = \frac{1}{2} m v_{0x}^2 + mg h_{MAX} = 2052 + 739.1 \simeq 2794\,J$$

$$E^C_{TOT} = \frac{1}{2} m v_F^2 \simeq 2794\,J$$

CONSIDERANDO LA RESISTENZA DELL'ARIA $|v_f|$ DIMINUISCE DEL 10%

$$|v_F^*| = 47.52$$

$$E^C_{TOT*} = \frac{1}{2} m v_f^{*2} = 2258\,J$$

$$E_{DISS} = E^C_{TOT} - E^C_{TOT*} \qquad E_{DISS} \simeq 536\,J$$