SOLUZIONI

1) a) $v_f = a t \qquad a = \frac{26.9}{10} = 2.7\ m/sec^2$

b) $\frac{1}{2} M g \mu_s = M a \quad \rightarrow \quad \mu_s = \frac{2a}{g} = 0.55$

c) $F = M a \quad \rightarrow \quad F = 4050\ N$

2) Moto delle bombe lungo l'asse y

$$\begin{cases} v_y = g t + v_{0y} = g t \\ y = \frac{1}{2} g t^2 \\ x = v_0 t \end{cases} \quad \rightarrow \quad t = \left(\frac{2h}{g}\right)^{1/2} = 14.2\ sec.$$

Spostamento lungo l'asse x delle bombe nel tempo di caduta $t = 14.2$ sec.

$$s = x = v_0 t = 1.18\ Km$$

$$tg\,\vartheta = \frac{h}{s} = 0.85 \quad \rightarrow \quad \vartheta = 40^0$$

3) Equazioni del moto delle tre masse.

$$m_2 a_2 = T_2 - m_2 g \ ; \quad m_3 a_3 = m_3 g - T_3 ; \quad m_1 a_1 = T_3 - T_2 \cos\vartheta - m_1 g \sin\vartheta$$

con $\quad a_2 \cos\vartheta = a_1 = a_3 = a$

$$a = \frac{m_3 - m_2 \cos\vartheta - m_1 \sin\vartheta}{m_1 + m_2 + m_3} \cdot g$$

$$T_2 = g\, m_3 \frac{\{ m_1 (1 + \sin\vartheta) + m_2 (1 + \cos\vartheta)\}}{m_1 + m_2 + m_3}$$

La reazione su m_1 è:

$$R = T_2 \sin\vartheta - m_1 g \cos\vartheta$$

e per $a = 0 \quad \rightarrow \quad T_2 = m_2 g \ ; \quad T_3 = m_3 g$

$$m_3 = m_2 \cos\vartheta + m_1 \sin\vartheta$$

e per $R = 0$ avremo

$$m_2 \sin\vartheta - m_1 \cos\vartheta = 0$$

$$m_2 = \frac{m_1}{tg\,\vartheta} \ ; \quad m_3 = \frac{m_1}{\sin\vartheta} \quad \Rightarrow \quad m_1 = m_2 \ ; \quad m_3 = m_1 \sqrt{2} = 1.4\ Kg.$$

4) Equazioni del moto delle singole masse

$$\begin{cases} F - T_3 = m_3 a \\ T_{23} - T_{12} = m_2 a \\ T_{21} = m_1 a \end{cases} \qquad \begin{array}{l} T_3 = T_{23} \\ T_{12} = T_{21} \end{array}$$

$$a = T_{21}/m_1 = 4\ m/sec^2$$

$$T_{23} - m_1 a = m_2 a \rightarrow T_{23} = (m_1 + m_2)\, a = 440\ N$$

$$F = T_{23} + m_3 a = (m_1 + m_2 + m_3)\, a = 760\ N$$

$$F_{max} \rightarrow T_{23} = T_0 = (m_1 + m_2)\, a = \frac{m_1 + m_2}{m_1 + m_2 + m_3} F$$

$$F_{max}\ 1727.3\ N.$$

5) Equazioni del moto

$$\begin{cases} T - F_A = M a_M & \text{moto massa } M \\ mg - 2T = m a_m & \text{" " } m \end{cases}$$

$F_A = +\mu g M$, $a_M \neq a_m$

$S(t) = 2 s(t)$ $\qquad S(t)$ spostamento massa M

$\Downarrow$ $\qquad s(t)$ " " m

$a_m = a_M/2$

$$a_M = 2g \frac{(m - 2M\mu)}{m + 4M}$$

$v^2 - v_0^2 = 2a(s - s_0)$ per un moto uniformemente accelerato

$$v^2 = 2al = 4gl \frac{m - 2M\mu}{m + 4M}$$

$$m = \frac{4M(v^2 + 2\mu g l)}{4gl - v^2} = 78.4\ gr.$$

6) Equazioni del moto delle masse

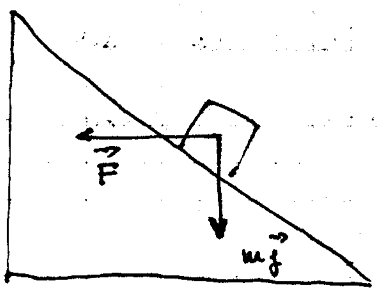
$$\begin{cases} m_1 g - T = m_1 a \\ T - F_A = m_2 a \end{cases} \qquad F_A = \mu m_2 g$$

$$a = g \cdot \frac{m_1 - m_2 \mu}{m_1 + m_2} = 0.14 \text{ m/sec}^2$$

$$T = m_1 (g - a) = 48.4 \text{ N}$$

Equilibrio: $a = 0 \qquad T = F_A \rightarrow \mu = 0.17$

7) Forza d'attrito : $F_A = \mu \, (F \operatorname{sen}\theta + mg\cos\theta)$



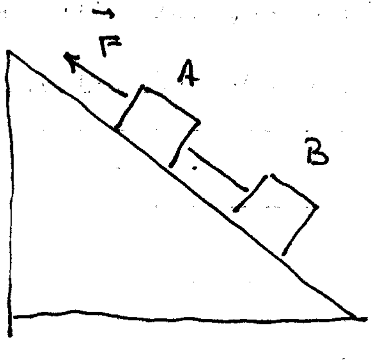
$$L_A = -\mu l \, (F \operatorname{sen}\theta + mg\cos\theta) = -8.51 \text{ Joule}$$

Equazione del moto del blocco da solo:

$$-mg\operatorname{sen}\theta + F\cos\theta - \mu\,(F\operatorname{sen}\theta + mg\cos\theta) = ma$$

$$a = 3.2 \text{ m/sec}^2 \; ; \quad v = \sqrt{2la} = 3.6 \text{ m/sec}$$

8) Le equazioni del moto sono



$$\begin{cases} F - T - m_A g \operatorname{sen}\alpha - \mu m_A g \cos\alpha = m_A a \\ T - m_B g \operatorname{sen}\alpha - \mu m_B g \cos\alpha = m_B a \end{cases}$$

$$a = \frac{1}{m_A} \left\{ F - g m_A (\operatorname{sen}\alpha + \mu\cos\alpha) - T \right\}$$

$$T - m_B g (\operatorname{sen}\alpha + \mu\cos\alpha) = \frac{m_B}{m_A} \left\{ F - g m_A (\operatorname{sen}\alpha + \mu\cos\alpha) - T \right\}$$

$$t = \frac{m_A + m_B}{2 m_B} T_0 = 50 \text{ sec.}$$