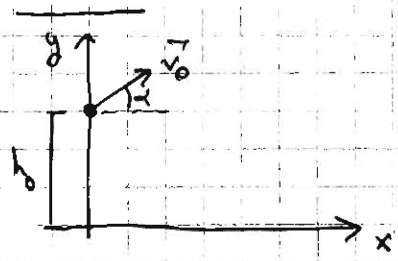
Compito dell' 11/01/2008

Pb. 1



$$\begin{cases} x(t) = v_0 \cos\alpha \; t \\ y(t) = h_0 + v_0 \sin\alpha \; t - \frac{1}{2} g t^2 \end{cases}$$

$$\begin{cases} v_x(t) = v_0 \cos\alpha \\ v_y(t) = v_0 \sin\alpha - g t \end{cases}$$

1) tempo di caduta $\Rightarrow$ $y(t_c) = 0$ $\Rightarrow$

$$h_0 + v_0 \sin\alpha \; t - \frac{1}{2} g t^2 = 0$$

$$g t^2 - 2 v_0 \sin\alpha \; t - 2 h_0 = 0$$

$$t_c = \frac{v_0 \sin\alpha \pm \sqrt{(v_0 \sin\alpha)^2 - 2 h_0 g}}{g}$$

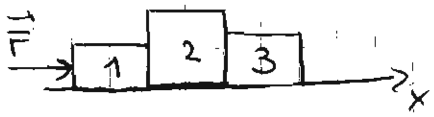
soluzione fisica. Quella col segno "−" è < 0!

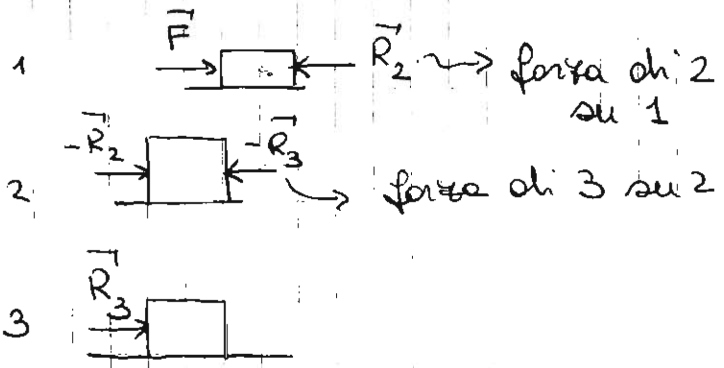
2) $$v_y(t_c) = v_0 \sin\alpha - \left(\frac{v_0 \sin\alpha}{\cancel{g}} - \frac{\sqrt{(v_0 \sin\alpha)^2 - 2 h_0 g}}{\cancel{g}} \right) \cancel{g}$$

$$= \sqrt{(v_0 \sin\alpha)^2 - 2 h_0 g}$$

3) $$x(t_c) = v_0 \cos\alpha \left(\frac{v_0 \sin\alpha + \sqrt{(v_0 \sin\alpha)^2 - 2 h_0 g}}{g} \right)$$

Pb. 2





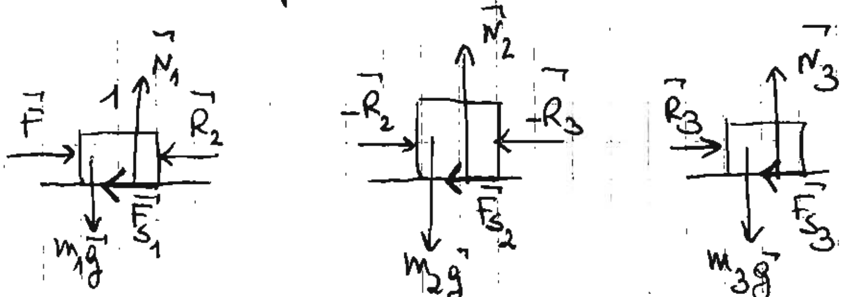
$$\begin{cases} \vec{F} + \vec{R}_2 = m_1 \vec{a}_1 \\ -\vec{R}_2 - \vec{R}_3 = m_2 \vec{a}_2 \\ \vec{R}_3 = m_3 \vec{a}_3 \end{cases} \xrightarrow[\text{l'asse } x]{\text{lungo}} \begin{cases} F - R_2 = m_1 a_1 \\ R_2 - R_3 = m_2 a_2 \\ R_3 = m_3 a_3 \end{cases}$$

4) So che $a_1 = a_2 = a_3 \equiv a \Rightarrow \begin{cases} F - R_2 = m_1 a \\ R_2 - R_3 = m_2 a \\ R_3 = m_3 a \end{cases}$

$$\Rightarrow \quad F = (m_1 + m_2 + m_3)\, a \qquad a = \frac{F}{m_1 + m_2 + m_3}$$

5) $R_2 = F - m_1 a = F - \dfrac{m_1 F}{m_2 + m_3 + m_1} = \dfrac{m_2 + m_3}{m_1 + m_2 + m_3} F$

6) Adesso le forze sono:



$\vec{a}_1 = \vec{a}_2 = \vec{a}_3 = 0$

$$x \begin{cases} F - R_2 - F_{s_1} = 0 \\ R_2 - R_3 - F_{s_2} = 0 \\ R_3 - F_{s_3} = 0 \end{cases} \qquad \begin{matrix} F_{s_1} \le \mu_s N_1 \\ F_{s_2} \le \mu_s N_2 \\ F_{s_3} \le \mu_s N_3 \end{matrix}$$

$$y \begin{cases} N_1 - m_1 g = 0 \\ N_2 - m_2 g = 0 \\ N_3 - m_3 g = 0 \end{cases} \Rightarrow \begin{matrix} N_1 = m_1 g \\ N_2 = m_2 g \\ N_3 = m_3 g \end{matrix} \quad \Rightarrow$$

$$F_{s_1} + F_{s_2} + F_{s_3} \le \mu_s (m_1 + m_2 + m_3) g$$

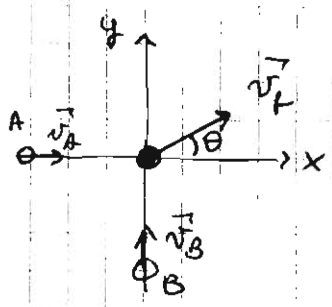
$$F_{s_1} + F_{s_2} + F_{s_3} = F \Rightarrow$$

$$F \le \mu_s (m_1 + m_2 + m_3) g \Rightarrow \mu_{s_{min}} = \frac{F}{(m_1 + m_2 + m_3) g}$$

<u>Pb. 3</u>

Urto anelastico $\Rightarrow$ cons. della q. di moto $\Rightarrow$

$$m_A \vec{v}_A + m_B \vec{v}_B = (m_A + m_B) \vec{v}_f$$



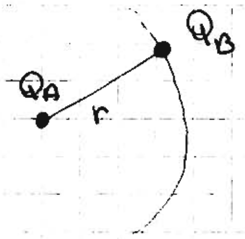
$$\Rightarrow m_A v_A = (m_A + m_B) v_{fx}$$

$$m_B v_B = (m_A + m_B) v_{fy}$$

$$\Rightarrow 7) \quad tg\,\theta = \frac{v_{fy}}{v_{fx}} = \frac{m_B v_B}{m_A v_A}$$

$$8) \quad v_f = \frac{\sqrt{(m_A v_A)^2 + (m_B v_B)^2}}{(m_A + m_B)}$$

Pb. 4



$Q_A \equiv Q$

9) $V = k_e \dfrac{Q_A}{r}$

10) $\underbrace{- m_B \dfrac{v_B^2}{\cancel{r}}}_{\text{acc. centripeta}} = k_e \dfrac{Q_A Q_B}{r^{\cancel{2}}}$

$\Rightarrow \cancel{-} m_B v_B^2 = \cancel{-} k_e \dfrac{Q^2}{r}$

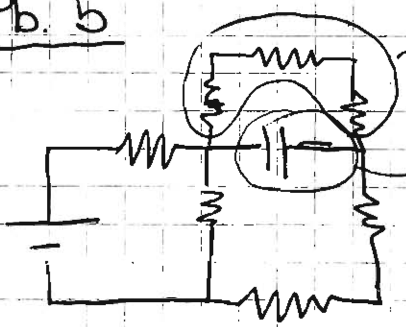
$v_B = \sqrt{\dfrac{k_e Q^2}{m_B r}}$

11) $E_B = \dfrac{1}{2} m_B v_B^2 - k_e \dfrac{Q^2}{r} = \dfrac{1}{2} \cancel{m_B} \dfrac{k_e Q^2}{\cancel{m_B} r} - k_e \dfrac{Q^2}{r}$

$= - \dfrac{1}{2} k_e \dfrac{Q^2}{r}$

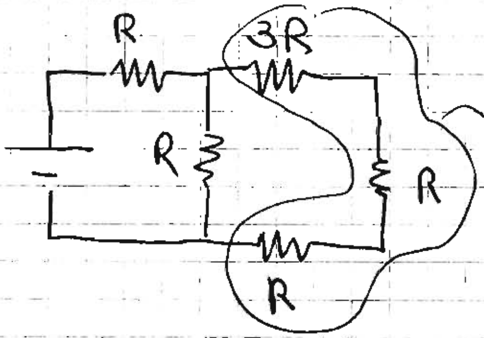
Pb. 5

12)

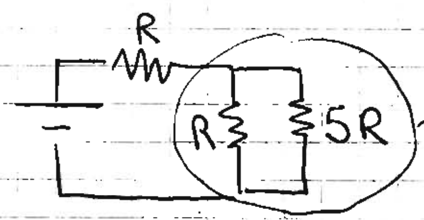


3 resistenze in serie $\Rightarrow R_{tot} = 3R$

in condizioni stazionarie, il ramo col condensatore è come se fosse aperto $\Rightarrow$

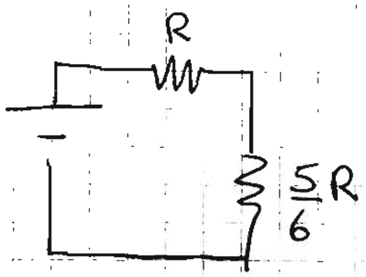


Resistenze in serie $\Rightarrow R_{tot} = 5R$

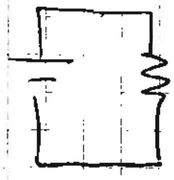


resist. in parallelo $\Rightarrow \dfrac{1}{R_{tot}} = \dfrac{1}{R} + \dfrac{1}{5R} \Rightarrow$

$$\Rightarrow \quad R_{tot} = \frac{5}{6} R$$



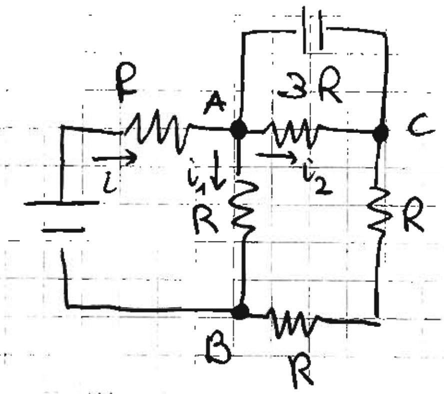
$$=$$



$$R + \frac{5}{6} R = \frac{11}{6} R$$

$$\Rightarrow \quad \varepsilon = \frac{11}{6} R\, i \qquad i = \frac{6\varepsilon}{11R}$$

13)



$$i_1 + i_2 = i \qquad \text{nodo A}$$

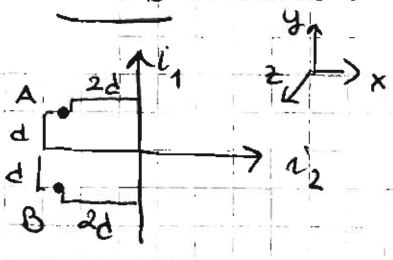
$$5\cancel{R}\, i_2 = \cancel{R}\, i_1 = \Delta V_{AB}$$

$$\Rightarrow \quad i_2 = \frac{i}{6}$$

$$\Delta V_{AC} = 3R\, i_2 = \cancel{3} R \frac{i}{\cancel{6}\,2}$$

$$E = \frac{1}{2} C\, \Delta V_{AC}^2 = \frac{1}{2} C \left(R \frac{i}{2}\right)^2 = \frac{1}{2} C \left(\frac{3\varepsilon}{11}\right)^2$$

Pb. 6



14)
$$\vec{B}_A = \vec{B}_1 + \vec{B}_2 =$$
$$= \frac{\mu_0}{2\pi} \frac{i_1}{2d} \hat{z} + \frac{\mu_0}{2\pi} \frac{i_2}{d} \hat{z}$$
$$= \frac{\mu_0}{2\pi} \left(\frac{\cancel{2} i_2}{\cancel{2} d} + \frac{i_2}{d} \right) \hat{z} = \frac{\mu_0}{\pi} \frac{i}{d} \hat{z}$$

15)
$$\vec{B}_B = \vec{B}_1 + \vec{B}_2 = \frac{\mu_0}{2\pi} \frac{i_1}{2d} \hat{z} - \frac{\mu_0}{2\pi} \frac{i_2}{d} \hat{z} = 0$$