

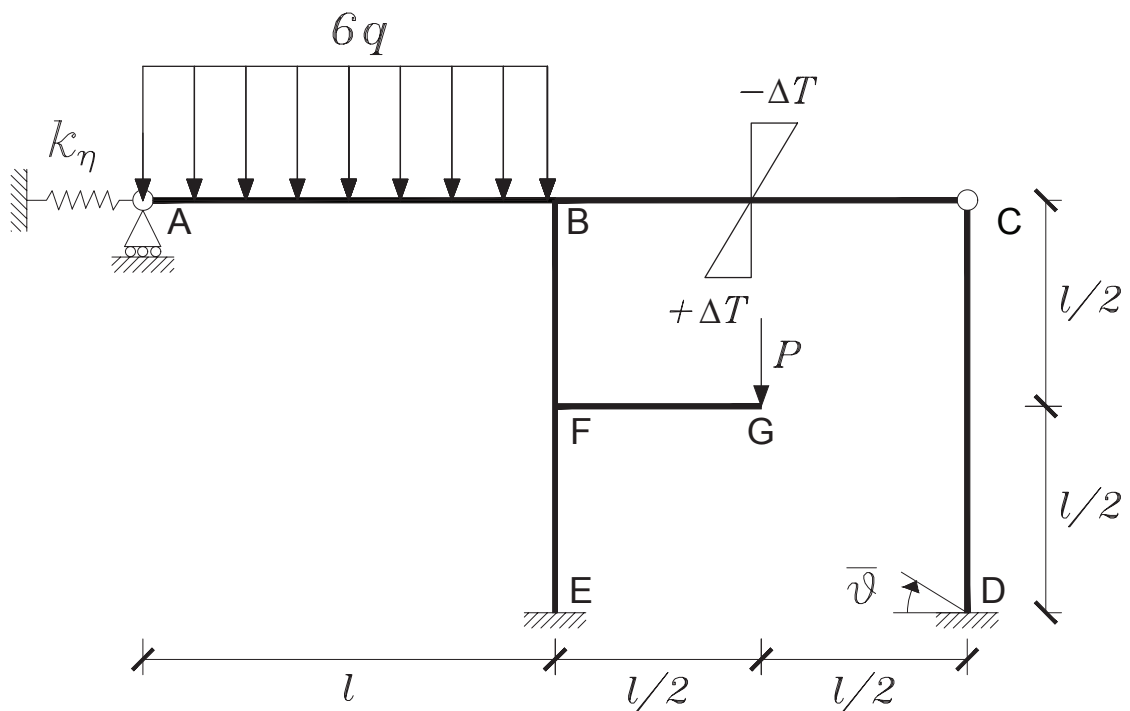
TECNICA DELLE COSTRUZIONI

TEMA ESAME DEL 13 GENNAIO 2020

DOCENTI:

PROF. GIOVANNI A. PLIZZARI

DURATA: 2 ORE.



$$k_{\eta} = 5 \frac{EJ}{l^3} \qquad \frac{\alpha \Delta T}{h} = \frac{7 q l^2}{8 EJ}$$

$$\bar{\vartheta} = \frac{7 q l^3}{2 EJ} \qquad P = ql$$

Esercizio

Dato il telaio in figura, **si richiedono i grafici di:**

1. Momento flettente (con il valore e la posizione dei massimi);
2. Taglio;
3. Azione assiale;
4. Deformata qualitativa con posizione dei flessi.

Si assuma $EA \rightarrow \infty$, $EJ = \text{costante}$.

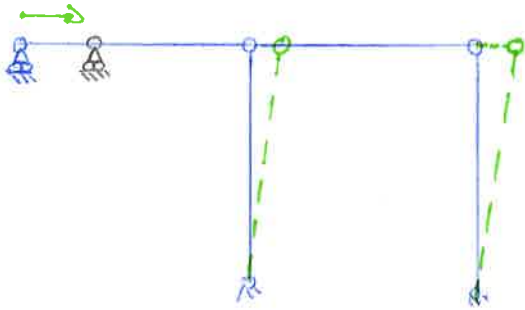
I grafici possono essere realizzati in matita, mentre i calcoli necessari per lo sviluppo del tema devono essere in tratto non cancellabile. Il tutto deve essere riportato chiaramente.

1) ANALISI CINEMATICA

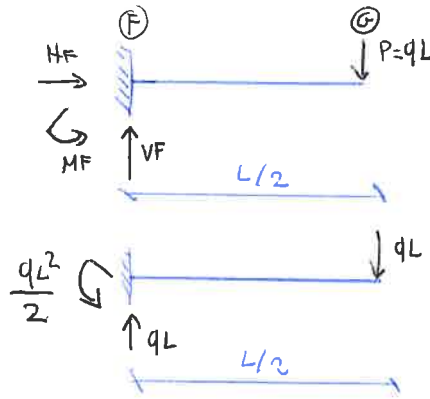
6 GdL } 4 IPERVINCOLATA
10 GdV

2) SPOSTABILITA' DEI NODI

STRUTTURA A NODI SPOSTABILI

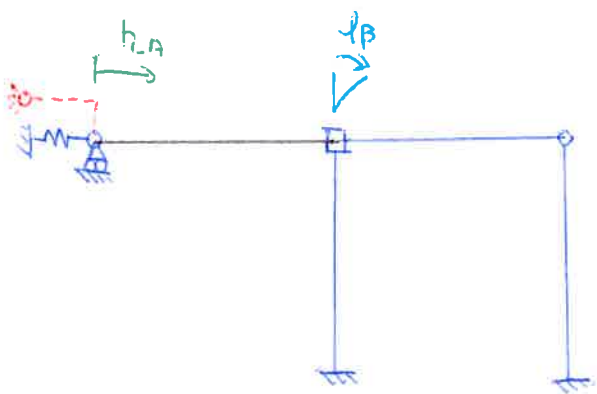


APPENDICE ISOSTATICA



$$\begin{aligned} \sum H = 0 \quad H_F = 0 \\ \sum V = 0 \quad V_F = qL \\ \sum M = 0 \quad M_F = \frac{qL^2}{2} \end{aligned}$$

3) STRUTTURA DI SERVIZIO
SCELTA INCOGNITE



4) EQUAZIONI DI EQUILIBRIO

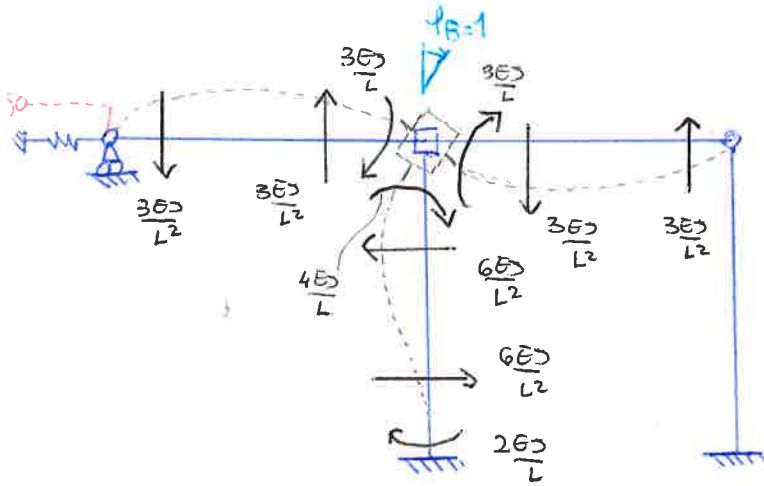
$$\begin{cases} \sum m_B = m_B \varphi + m_B h_A + m_B \bar{q} + m_B \Delta t + \theta = 0 \\ \sum h_A = h_A \varphi + h_A h_A + h_A \bar{q} + h_A \Delta t + \theta = 0 \end{cases}$$

RISOLUZIONE

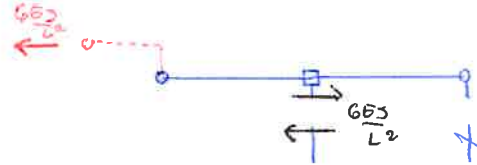
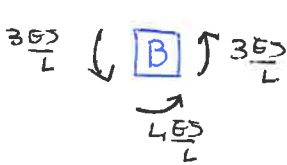
CONVENZIONE
ADOTTATA

$\curvearrowright \rightarrow \oplus$ $\leftarrow \ominus$

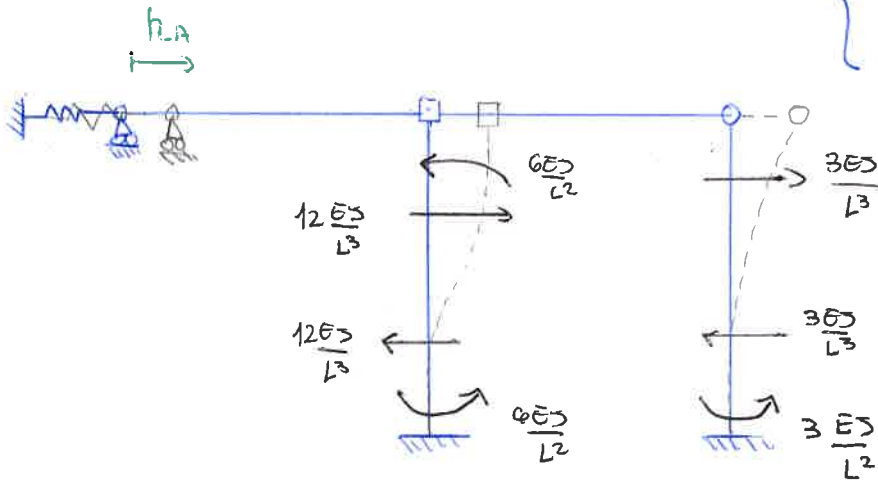
$$\begin{cases} \psi_B = 1 \\ \eta_A = \eta = \Delta T = \theta = 0 \end{cases}$$



$$\begin{cases} m_{B\ell} = 3\frac{\epsilon}{L} + 4\frac{\epsilon}{L} + 3\frac{\epsilon}{L} = 10\frac{\epsilon}{L} \\ n_{A\ell} = 6\frac{\epsilon}{L^2} \end{cases}$$

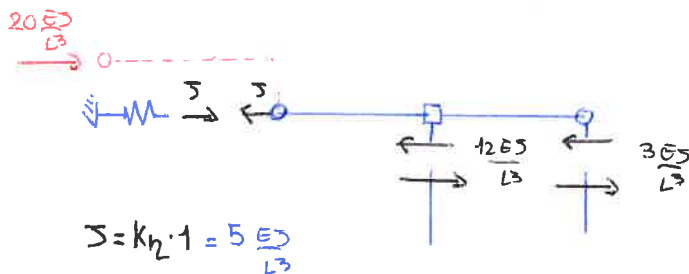


$$\begin{cases} \eta_A = 1 \\ \psi_B = \eta = \Delta T = \theta = 0 \end{cases}$$



$$\begin{cases} m_{Bh} = -6\frac{\epsilon}{L^2} \\ n_{Ah} = -3\frac{\epsilon}{L^3} - 12\frac{\epsilon}{L^3} - k_h \cdot 1 = \\ = -15\frac{\epsilon}{L^3} - k_h = -20\frac{\epsilon}{L^3} \end{cases}$$

\uparrow
 $5\frac{\epsilon}{L^3}$

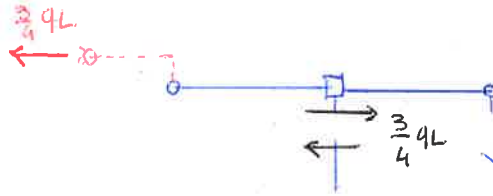
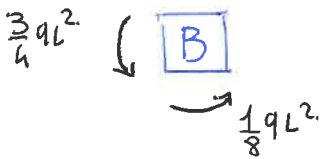
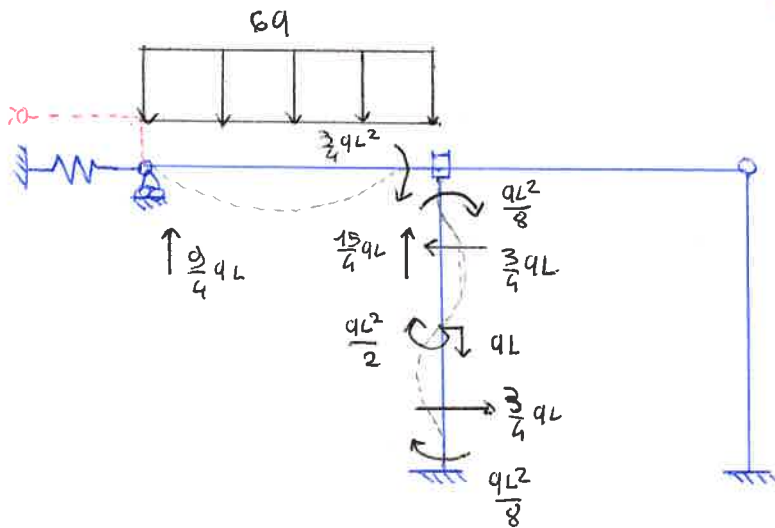


CARICHI

CONVENZIONE $\downarrow \rightarrow M + \uparrow \leftarrow \ominus \rightarrow$

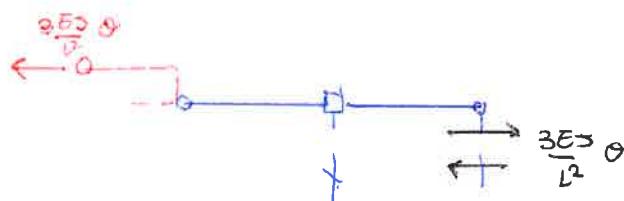
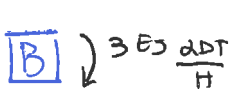
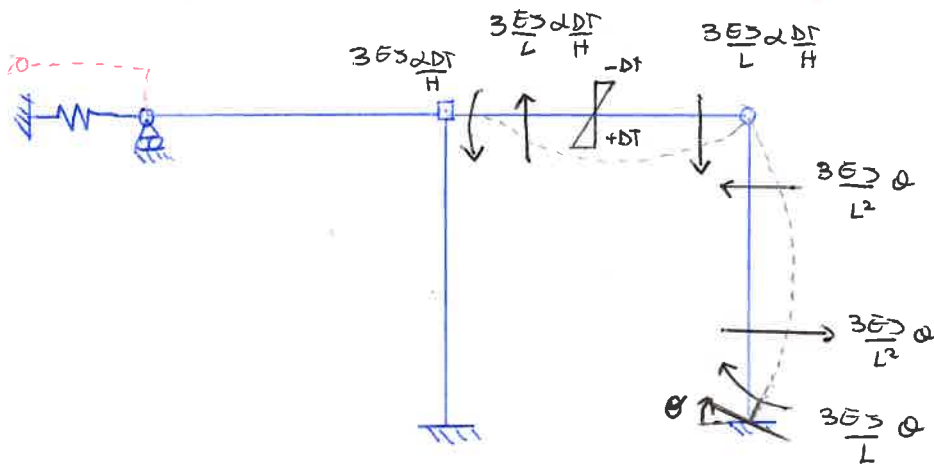
$q \neq 0$
 $\psi_B = \psi_A = \Delta T = \theta = 0$

$m_B \bar{q} = \frac{3}{4} qL^2 + \frac{1}{8} qL^2 = \frac{7}{8} qL^2$
 $h_A \bar{q} = \frac{3}{4} qL$



$\Delta T \neq 0$
 $\theta \neq 0$
 $\psi_B = \psi_A = q = 0$

$m_{B \Delta T} = -3ES \frac{\alpha \Delta T}{H} = -\frac{21}{8} qL^2$
 $h_{A \Delta T} = 3ES \frac{\alpha \Delta T}{L} = \frac{21}{2} qL$
 $\frac{1}{2} \frac{qL^3}{ES}$



SISTEMA RISOLVENTE

$$\begin{cases} \sum m_B = m_B \varphi + m_B h_A + m_B \bar{q} + m_B \Delta T + \theta = \varphi \\ \sum h_A = h_A \varphi + h_A h_A + h_A \bar{q} + h_A \Delta T + \theta = \varphi \end{cases}$$

$$\begin{cases} 10 \frac{EJ}{L} \varphi_B - 6 \frac{EJ}{L^2} h_A + \frac{1}{8} qL^2 - \frac{21}{8} qL^2 = \varphi \\ 6 \frac{EJ}{L^2} \varphi_B - 20 \frac{EJ}{L^3} h_A + \frac{3}{4} qL + \frac{21}{2} qL = \varphi \end{cases}$$

$$\begin{cases} \text{I} \quad 10 \frac{EJ}{L} \varphi_B - 6 \frac{EJ}{L^2} h_A - \frac{1}{4} qL^2 = \varphi \\ \text{II} \quad 6 \frac{EJ}{L^2} \varphi_B - 20 \frac{EJ}{L^3} h_A + \frac{45}{4} qL = \varphi \end{cases}$$

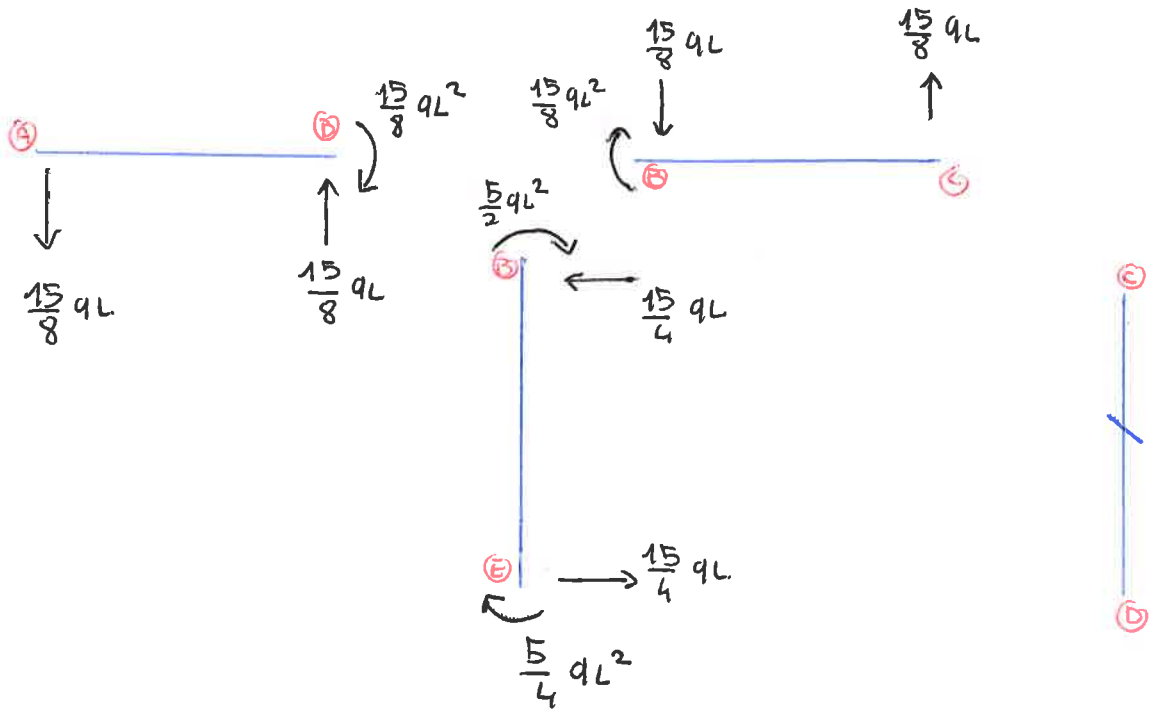
$$\begin{aligned} \text{I} \rightarrow \varphi_B &= \left[6 \frac{EJ}{L^2} h_A + \frac{1}{4} qL^2 \right] \cdot \frac{L}{10 EJ} \\ &= \frac{3}{5} \frac{1}{L} h_A + \frac{1}{40} \frac{qL^3}{EJ} \end{aligned}$$

$$\begin{aligned} \text{II} \rightarrow 6 \frac{EJ}{L^2} \cdot \frac{3}{5} \frac{1}{L} h_A - 20 \frac{EJ}{L^3} h_A + \frac{45}{4} qL + \frac{42}{40} qL &= \varphi \\ -\frac{82}{5} \frac{EJ}{L^3} h_A + \frac{123}{10} qL &= \varphi \rightarrow h_A = \frac{123}{10} \frac{qL^4}{EJ} \frac{5}{82} = \frac{3}{4} \frac{qL^4}{EJ} \end{aligned}$$

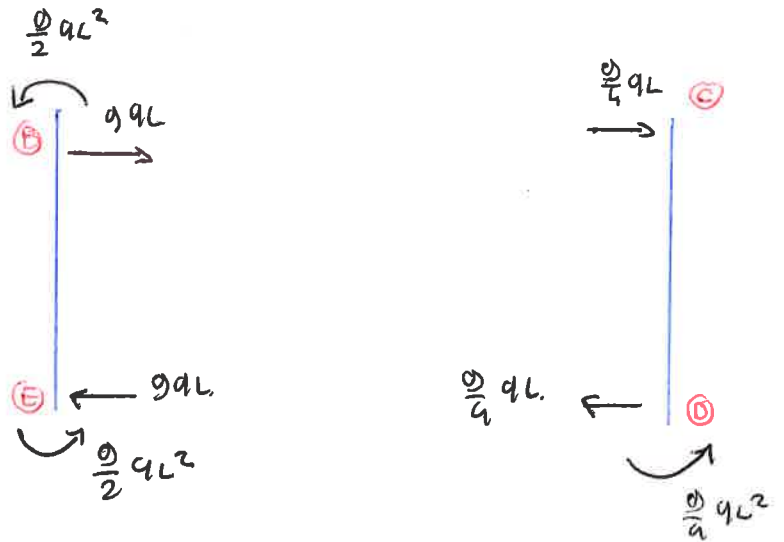
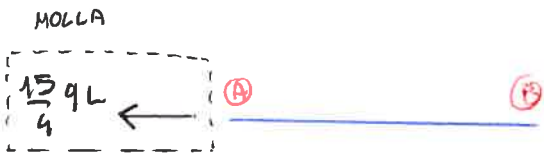
$$\begin{cases} \text{I} \\ h_A \end{cases} \rightarrow \varphi_B = \frac{3}{5} \cdot \frac{1}{L} \frac{3}{4} \frac{qL^4}{EJ} + \frac{1}{40} \frac{qL^3}{EJ} = \frac{5}{8} \frac{qL^3}{EJ}$$

$\varphi_B = \frac{5}{8} \frac{qL^3}{EJ}$
$h_A = \frac{3}{4} \frac{qL^4}{EJ}$

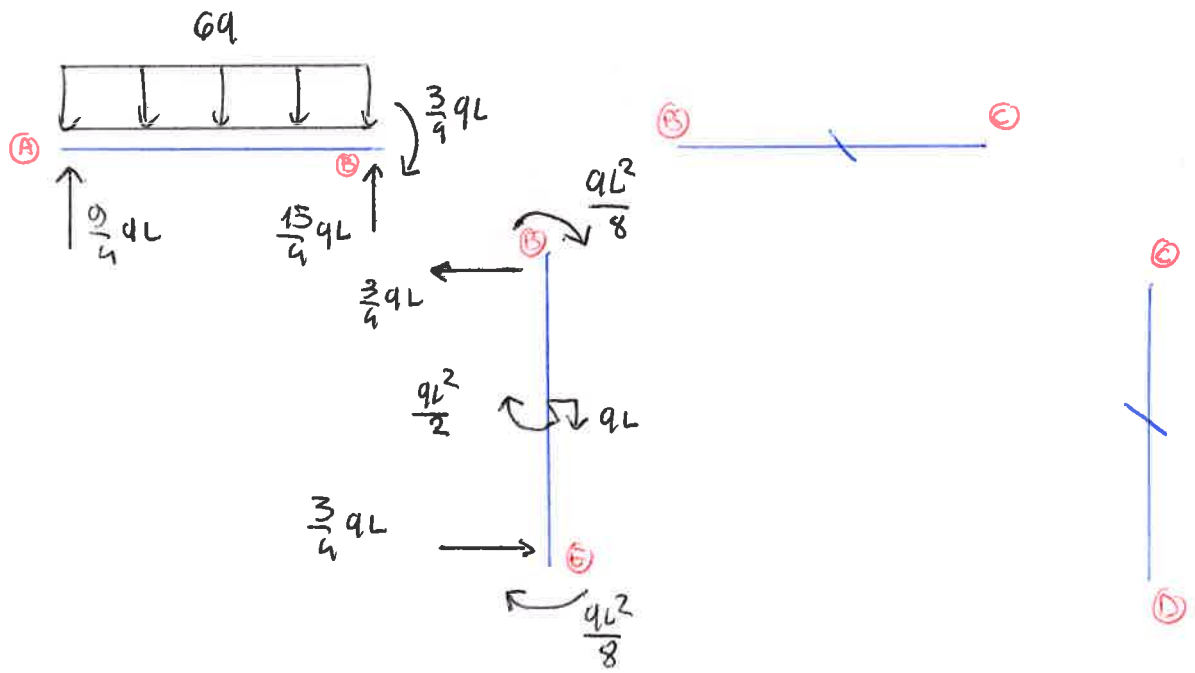
$$\psi_B = \frac{5}{8} \frac{qL^3}{EI}$$



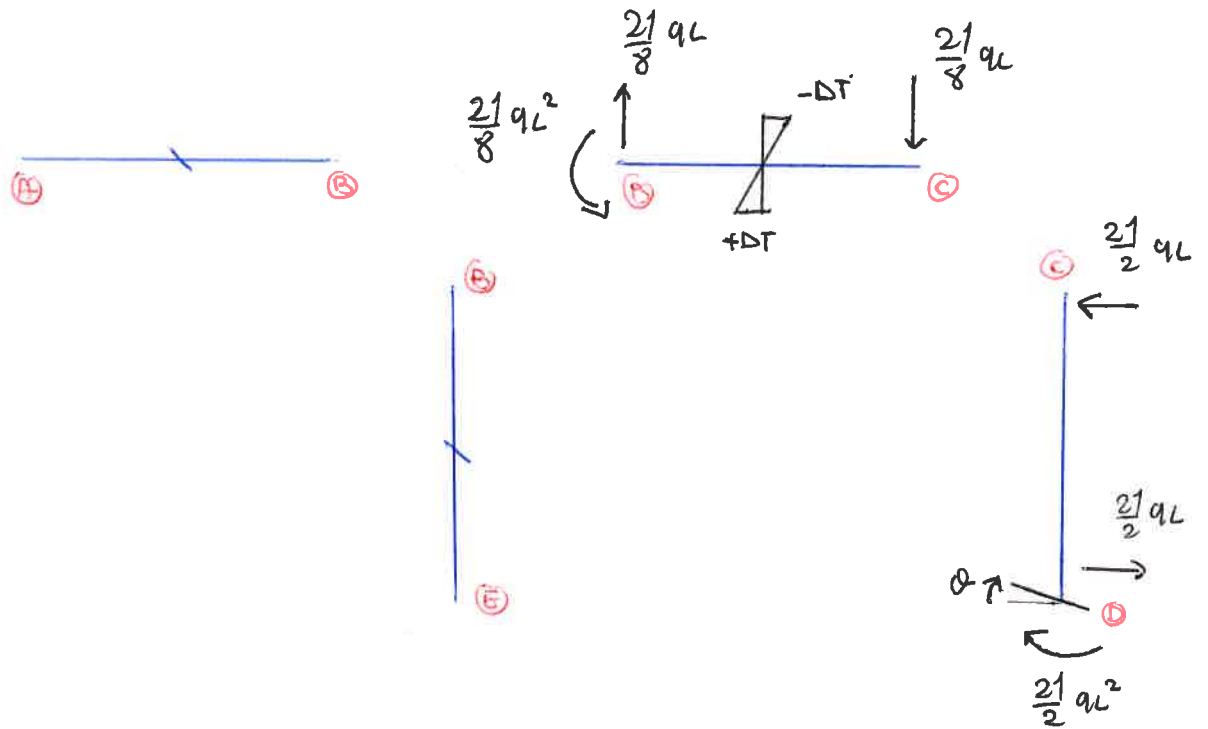
$$h_A = \frac{3}{4} \frac{qL^4}{EI}$$



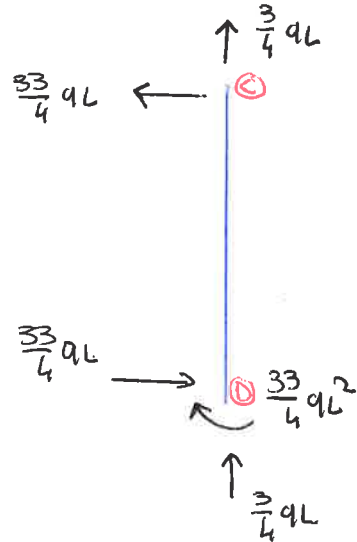
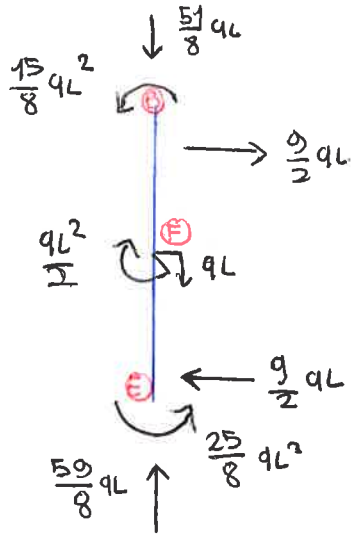
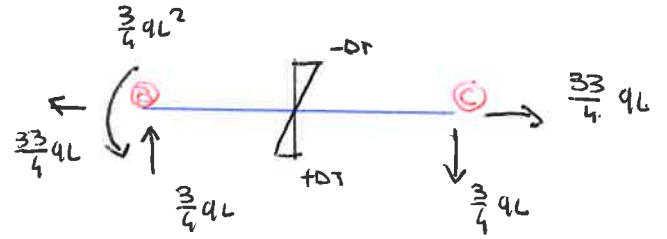
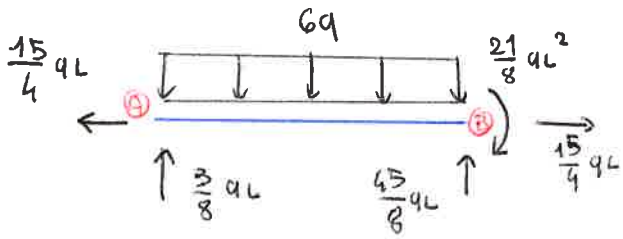
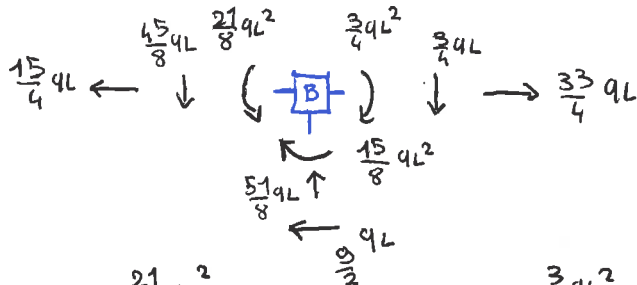
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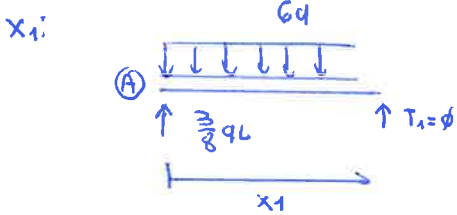
DT
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GALE

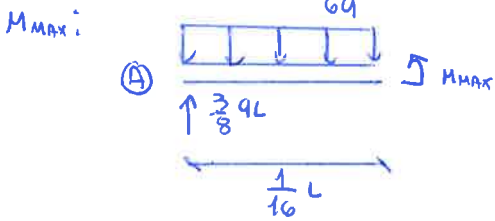


M_{MAX} ASTA AB



$$T_1 = \phi = -\frac{3}{8} qL + 6qx_1$$

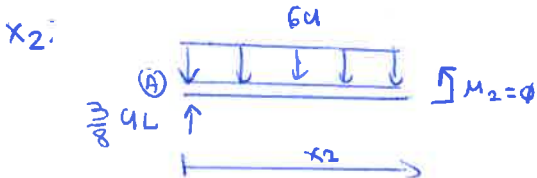
$$\rightarrow x_1 = \frac{1}{16} L$$



$$M_{MAX} = \frac{3}{8} \cdot \frac{1}{16} qL^2 - 6q \frac{1}{16} L \cdot \frac{1}{16} \frac{1}{2}$$

$$\rightarrow M_{MAX} = \frac{3}{256} qL^2$$

PUNTO DI FLESSO ASTA AB



$$M_2 = \phi = \frac{3}{8} qL x_2 - 6q \frac{x_2^2}{2}$$

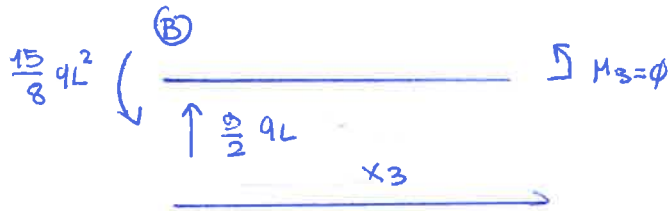
$$x_2 \left(\frac{3}{8} qL - 3qx_2 \right) = \phi$$

$$x_2 = 0 \rightarrow \text{CERNIERA IN A}$$

$$\rightarrow x_{2,2} = \frac{1}{8} L$$

PUNTO DI FLESSO ASTA B-E

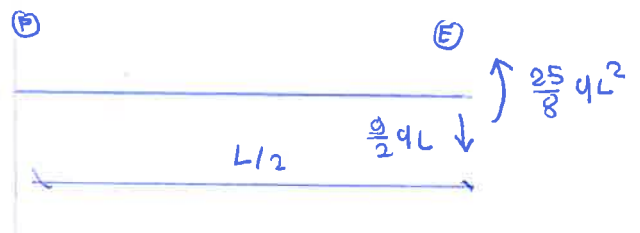
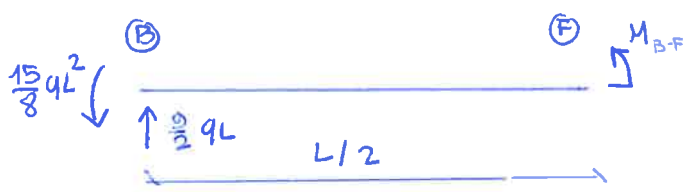
x_3 :



$$M_3 = \phi = \frac{15}{8} qL^2 - \frac{9}{2} qL x_3$$

$$x_3 = \frac{5}{12} L$$

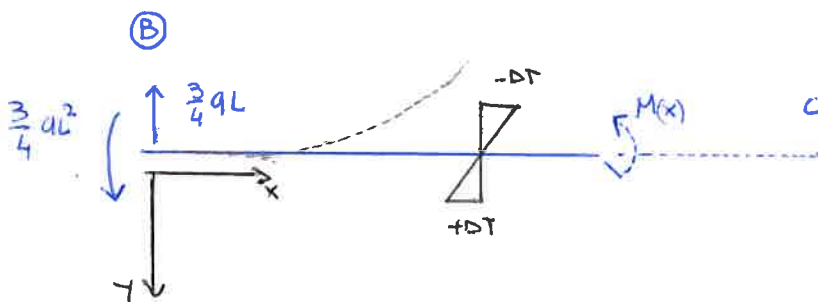
VALORI MOMENTI ASTA B-E IN F



$$M_{BF} = -\frac{15}{8} qL^2 + \frac{9}{2} qL \frac{L}{2} = \frac{3}{8} qL^2$$

$$M_{FE} = \frac{25}{8} qL^2 - \frac{9}{2} qL \frac{L}{2} = \frac{7}{8} qL^2$$

STUDIO DEFORMATA TERMICA ASTA BC



$$y'' = -\frac{M(x)}{ES} - 2 \frac{\alpha DT}{H}$$

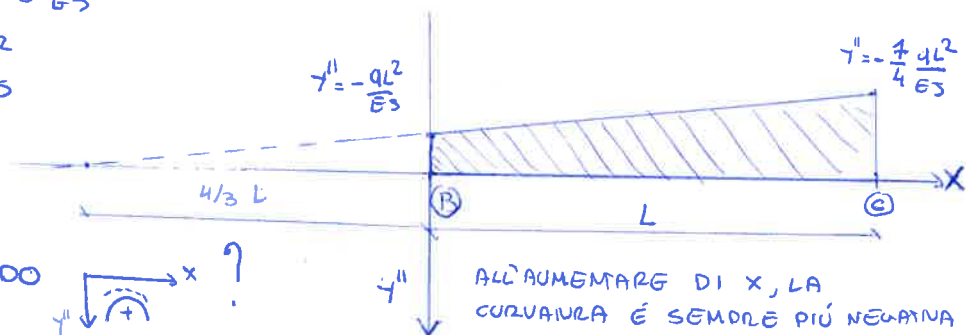
$$M(x) = \frac{3}{4} qLx - \frac{3}{4} qL^2$$

$$\frac{\alpha DT}{H} = \frac{1}{8} \frac{qL^2}{ES}$$

$$= -\frac{1}{ES} \left[\frac{3}{4} qLx - \frac{3}{4} qL^2 \right] - 2 \frac{1}{8} \frac{qL^2}{ES}$$

$$= -\frac{3}{4} \frac{qLx}{ES} + \frac{3}{4} \frac{qL^2}{ES} - \frac{1}{4} \frac{qL^2}{ES}$$

$$y'' = -\frac{3}{4} \frac{qLx}{ES} - \frac{qL^2}{ES}$$

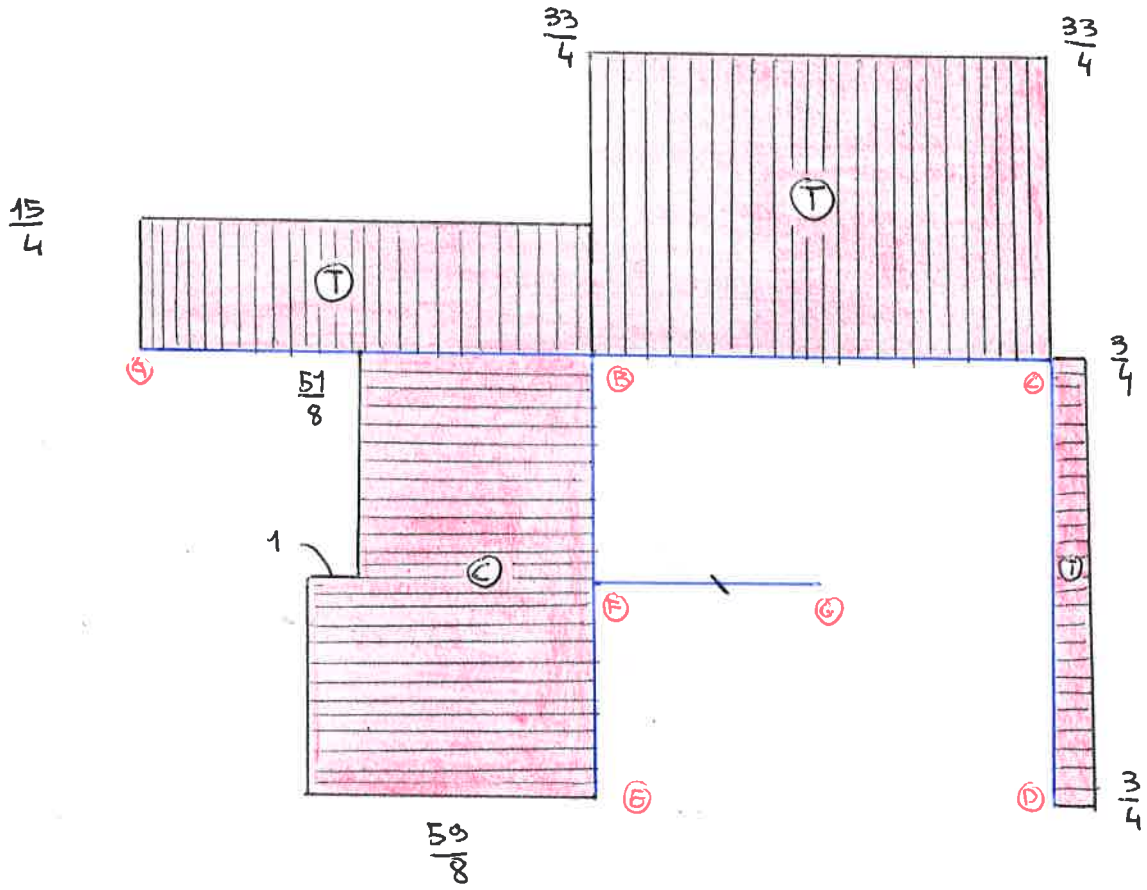


• QUANDO $y''(x) \geq 0$? \Rightarrow QUANDO $x \geq 0$?

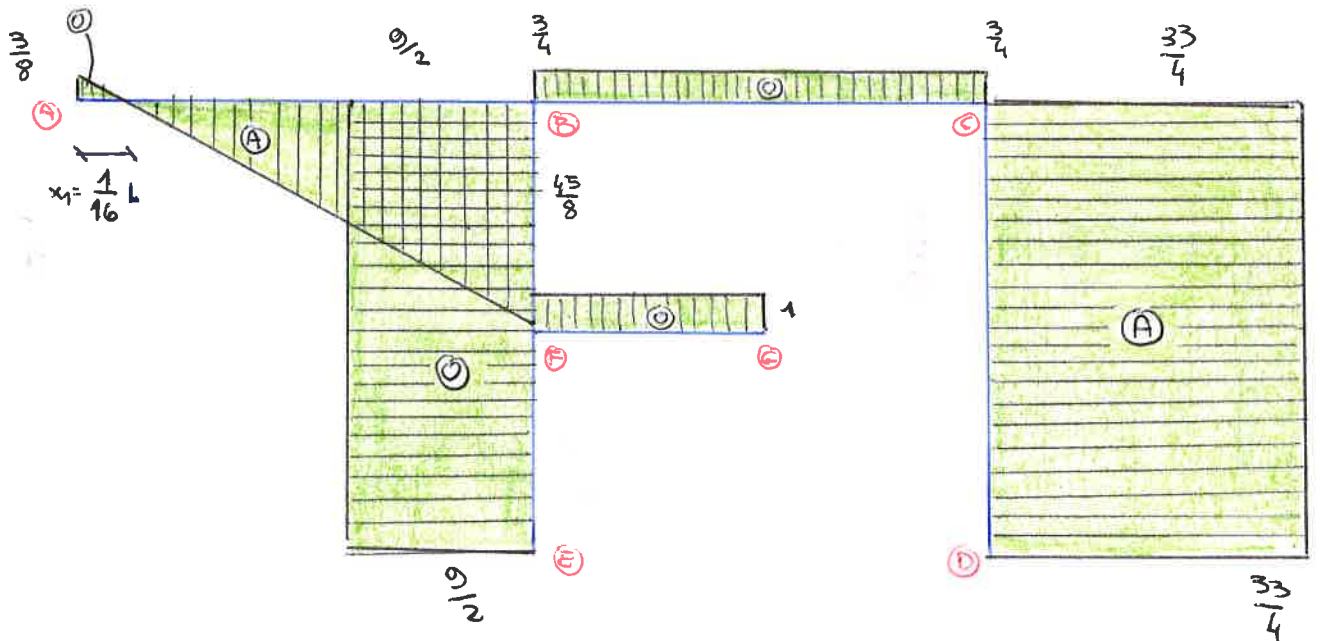
$$y'' = -\frac{3}{4} \frac{qLx}{ES} - \frac{qL^2}{ES} \geq 0? \quad \text{MAI } \forall x \geq 0$$

DIAGRAMMI AZIONI

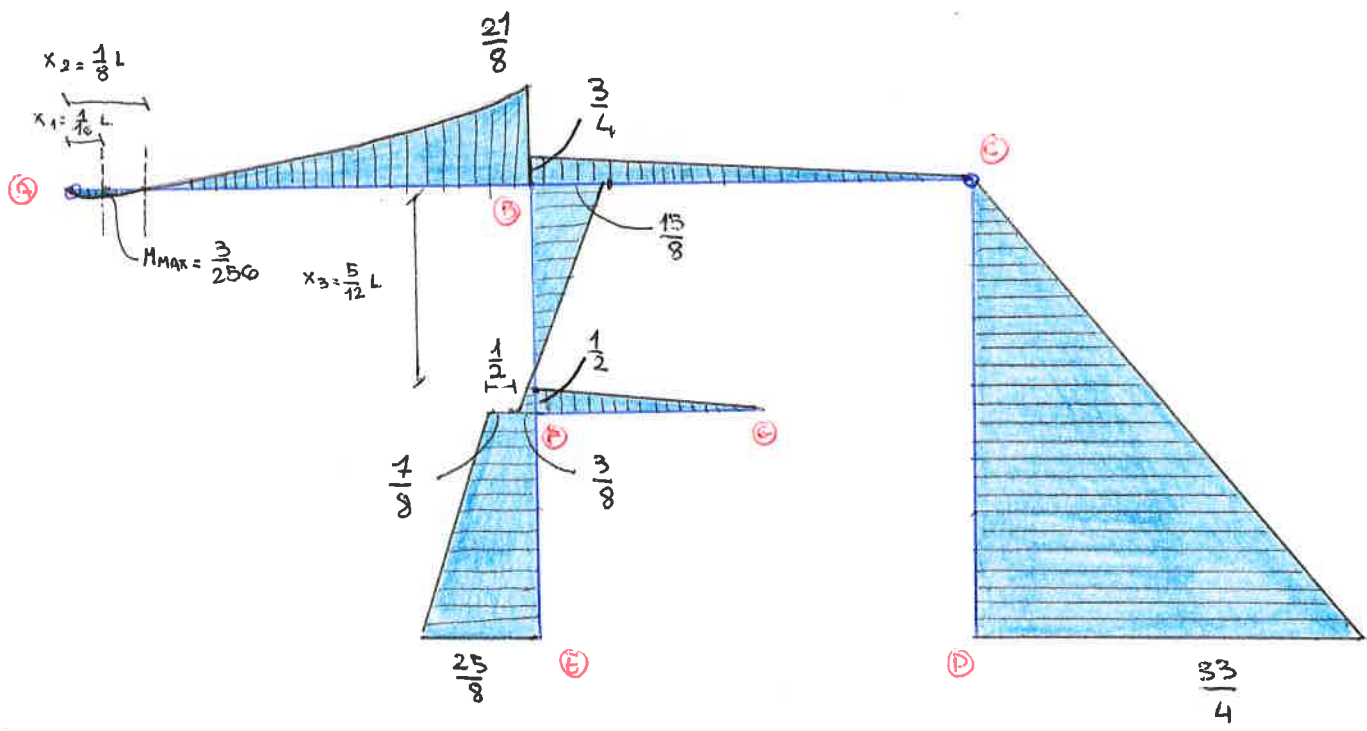
$\frac{N}{qL}$



$\frac{V}{qL}$



$$\frac{M}{ql^2}$$



DEFORMATA QUALITATIVA

