

Oświadczam, że niniejsza praca stanowiąca podstawę do uznania osiągnięcia efektów uczenia się z przedmiotu NK I została wykonana przez mnie samodzielnie

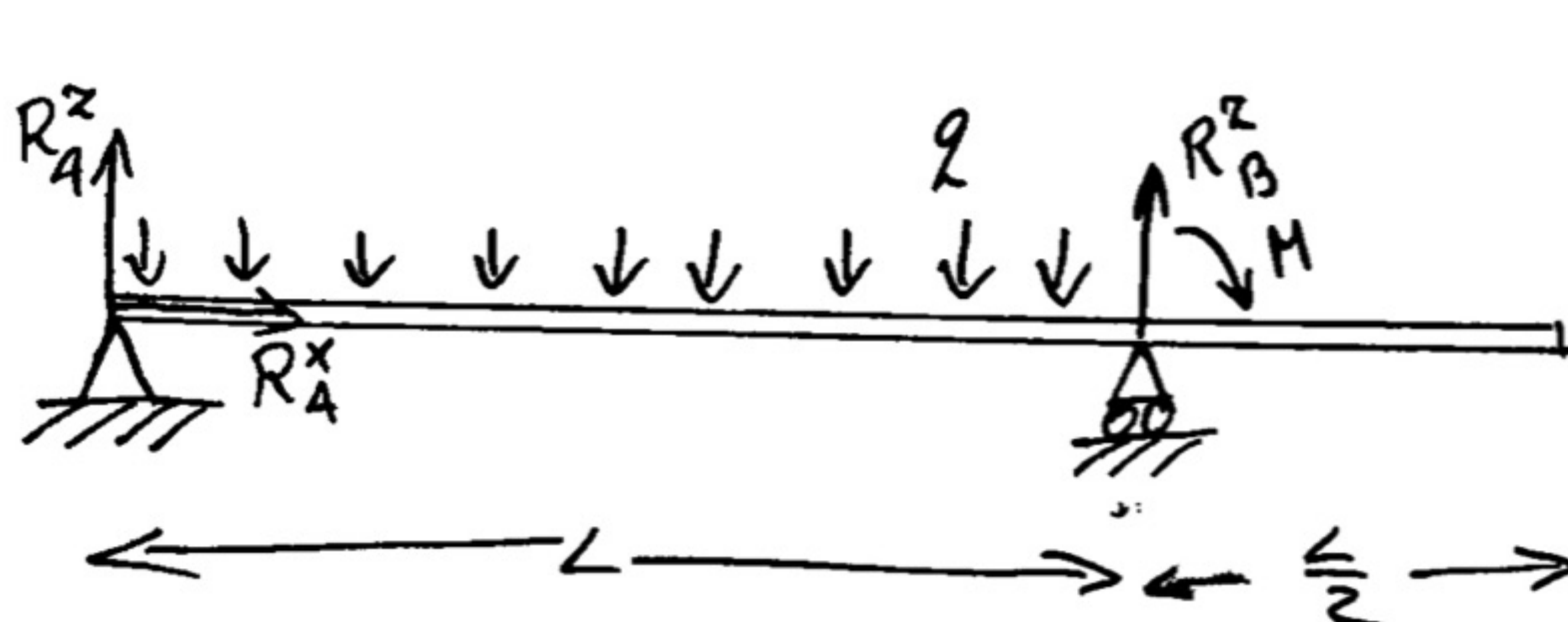
Zad.

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I = 6 N = 7

Zad. $L = 1\text{ m}$ $q = 16,12\text{ kN/m}$ $M = 1,14\text{ kNm}$



$$R_A^x = 0$$

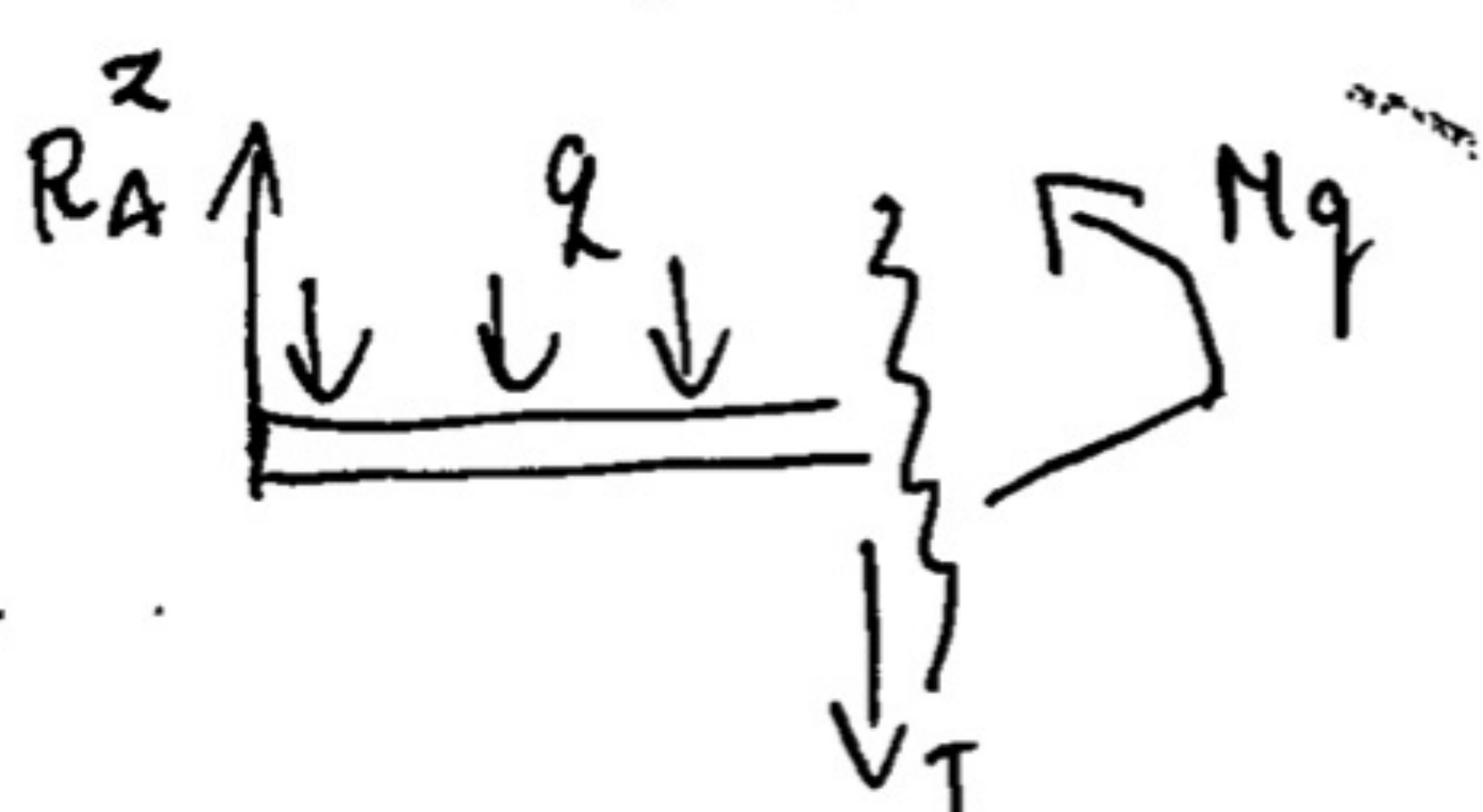
$$R_A^z - qL + R_B^z = 0$$

$$-q \frac{L^2}{2} + LR_B^z - M = 0$$

$$R_B^z = (M + q \frac{L^2}{2}) \frac{1}{L} = 1,14 + 16,12 \cdot \frac{1}{2} = 9,2\text{ kN}$$

$$R_A^z = 16,12 - 9,2 = 6,92$$

$x \in (0, L)$



$$R_A^z - T - qx = 0 \Rightarrow T(x) = R_A^z - qx = 6,92 - 16,12x\text{ kN}$$

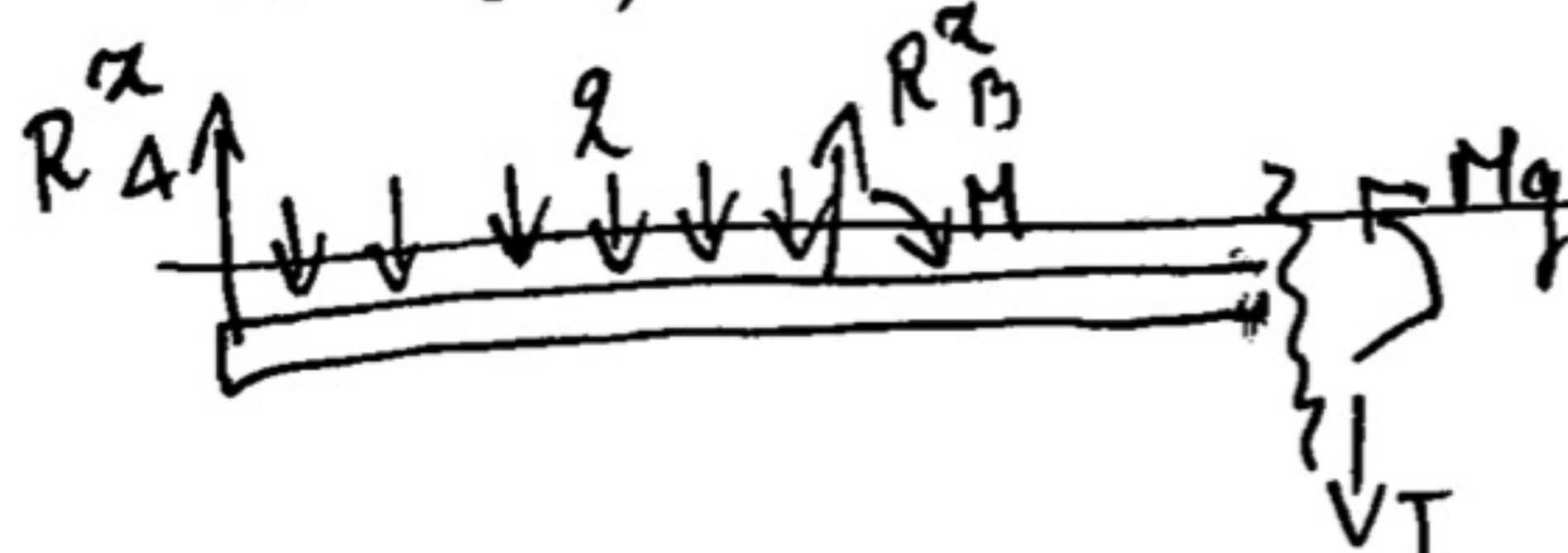
$$M_q(x) + q \frac{x^2}{2} - R_A^z x = 0 \Rightarrow M_q(x) = 6,92x - 8,06x^2$$

$$T(0) = 6,92\text{ kN} \quad T(L) = -9,2\text{ kN} \quad M_q(0) = 0\text{ kNm} \quad M_q(L) = -1,14\text{ kNm}$$

$$T(x_0) = 0 \Rightarrow 0 = 6,92 - 16,12x_0 \Rightarrow x_0 = \frac{6,92}{16,12} \approx 0,429\text{ m}$$

$$M_q(0,429) = 2,96869 - 1,4833704 \approx 1,485\text{ kNm}$$

$x \in (L, \frac{3}{2}L)$

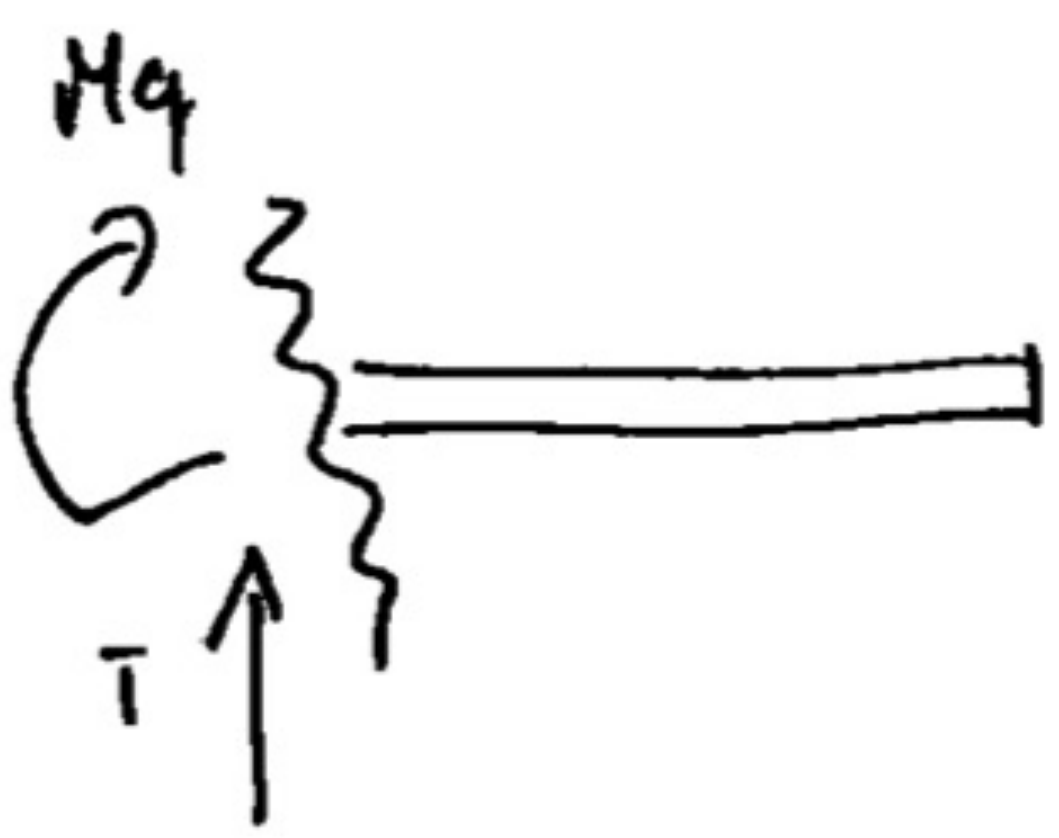


$$R_B^z - qL + R_B^z - T = 0 \Rightarrow T(x) = 0\text{ kN}$$

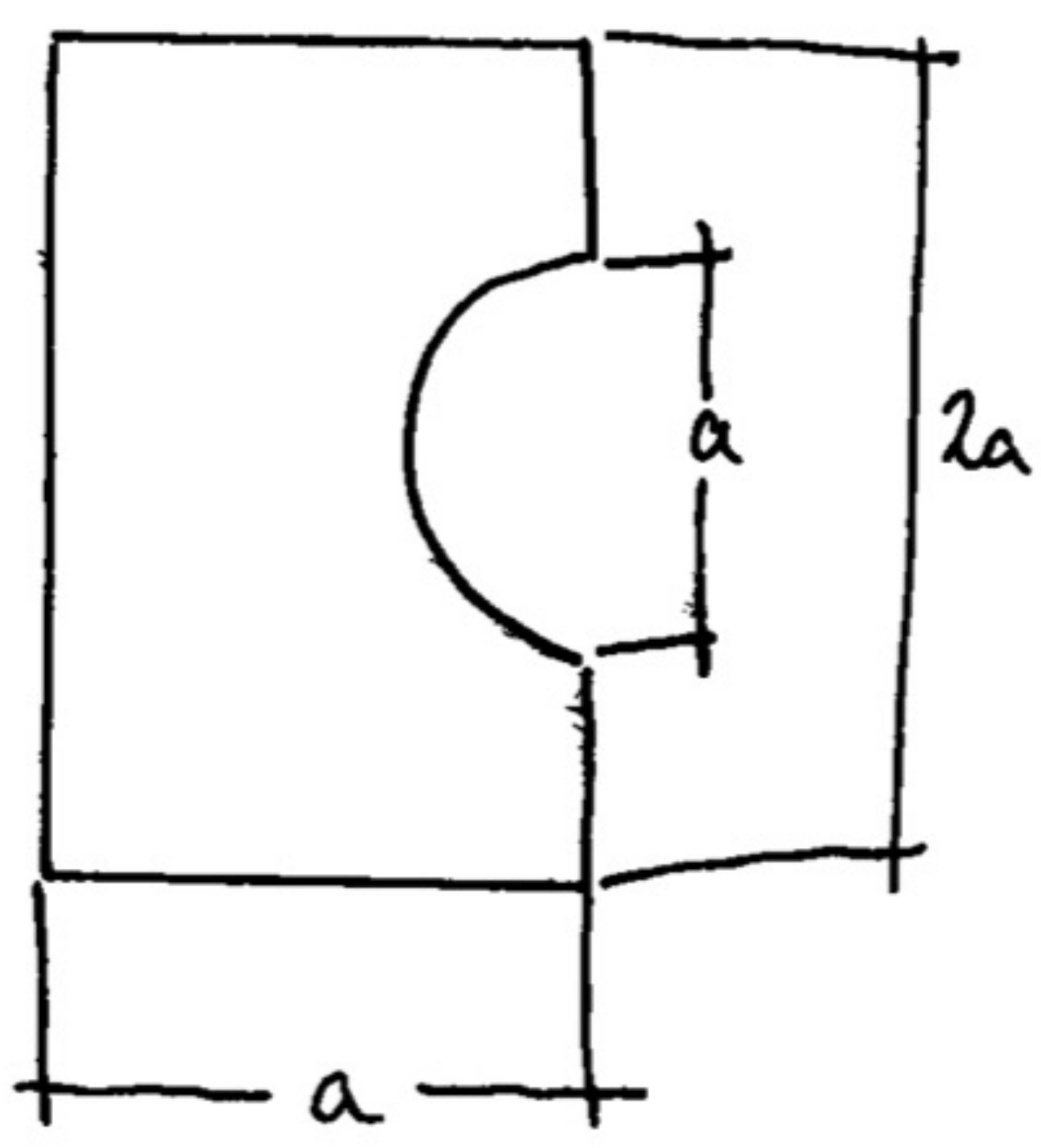
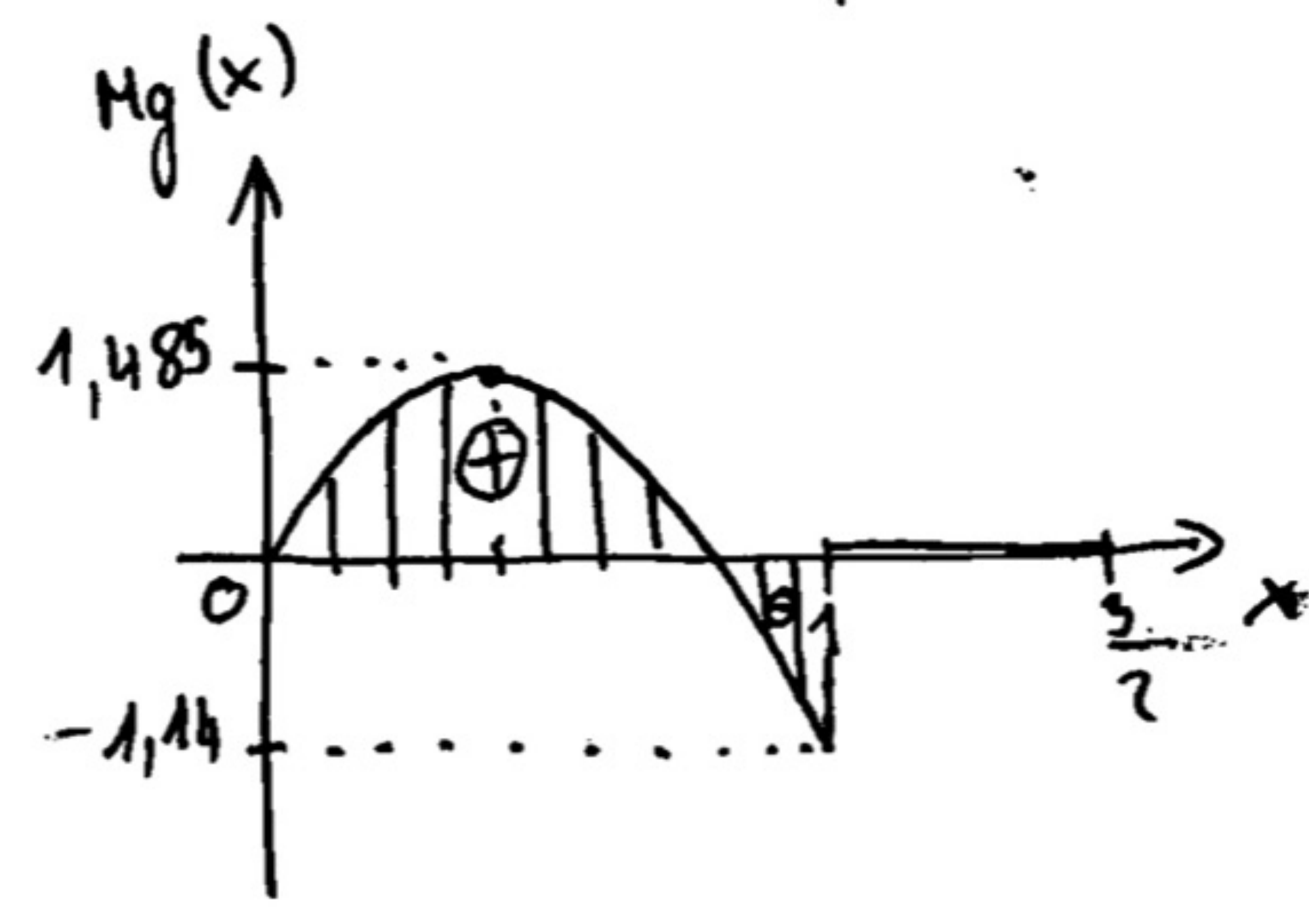
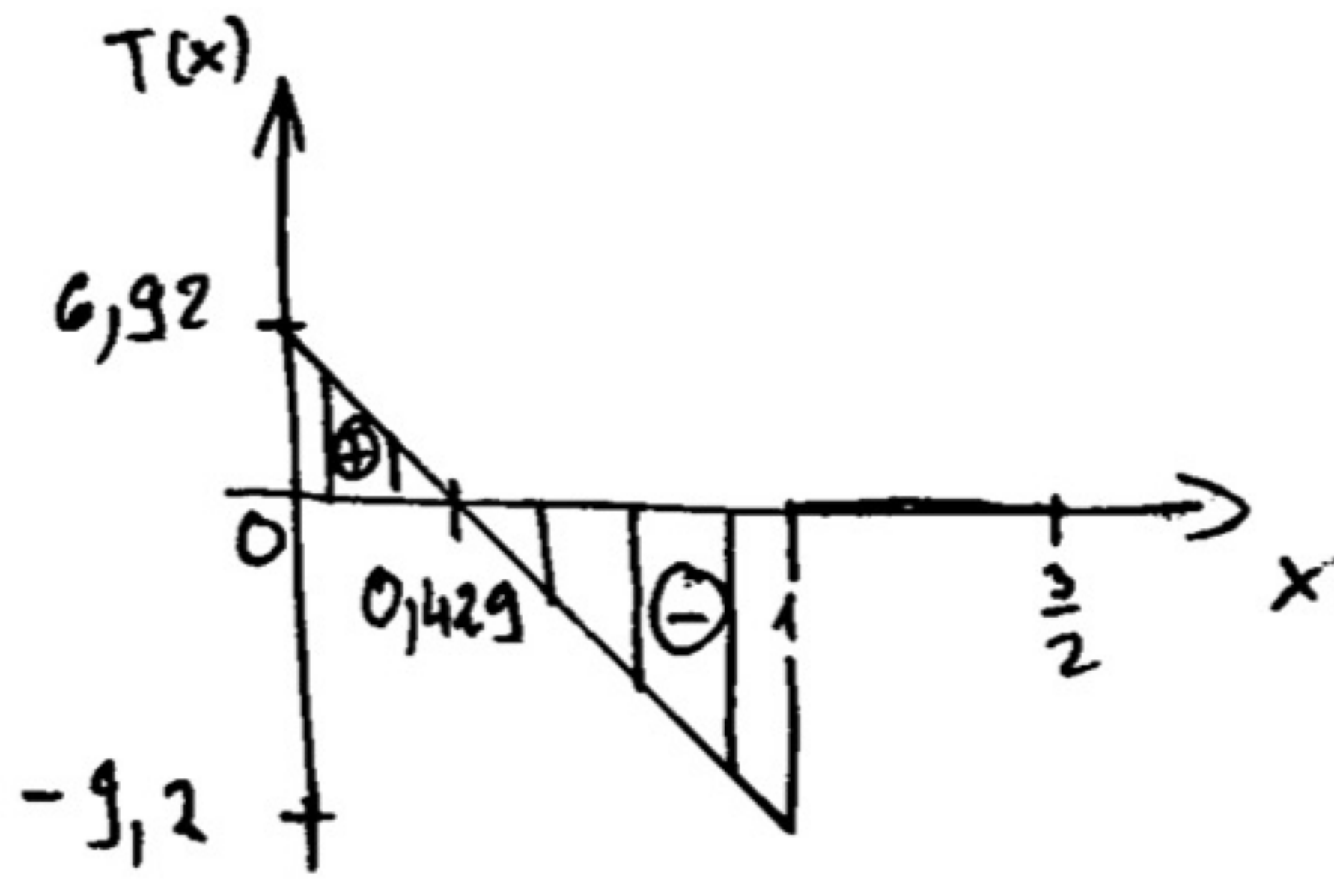
$$M_q - R_A^z x + R_B^z(x-L) - M + q \frac{(x-L)^2}{2} = 0$$

2

$x \in (L, \frac{3}{2}L)$



$T(x) = 0 \text{ kN}$
 $-Mg(x) = 0 \text{ kNm} \Rightarrow Mg(x) = 0 \text{ kNm}$



$$J_y = \frac{a \cdot 8a^3}{12} - \frac{\pi a^4}{128} = a^4 \left(\frac{2}{3} - \frac{\pi}{128} \right)$$

$$= a^4 \left(\frac{96 - \pi}{128} \right)$$

$$\sigma_{extr} = - \frac{1485 \cdot 128}{a^4 \left(\frac{96 - \pi}{128} \right)} \cdot a = - \frac{1485}{a \left(\frac{2}{3} - \frac{\pi}{128} \right)}$$

$k_r = 200 \text{ MPa}$

~~$\sigma_{extr} \leq k_r$~~

~~$$J_y = \frac{a \cdot 8a^3}{12} - 2 \left(\frac{\pi R^4}{16} + \frac{R^4}{9\pi} \right) = \frac{a^4 8}{3} - 2 \left(\frac{\pi a^4}{16} + \frac{a^4}{9\pi} \right)$$~~

~~$$= a^4 \left(\frac{2}{3} - \frac{\pi}{8} + \frac{2}{9\pi} \right) = a^4 \left(\frac{2}{3} - \frac{\pi}{16} + \frac{1}{72\pi} \right)$$~~

~~$$\sigma_{extr} = - \frac{1485}{a^4 \left(\frac{2}{3} - \frac{\pi}{128} - \frac{1}{72\pi} \right)} \cdot a = - 148$$~~

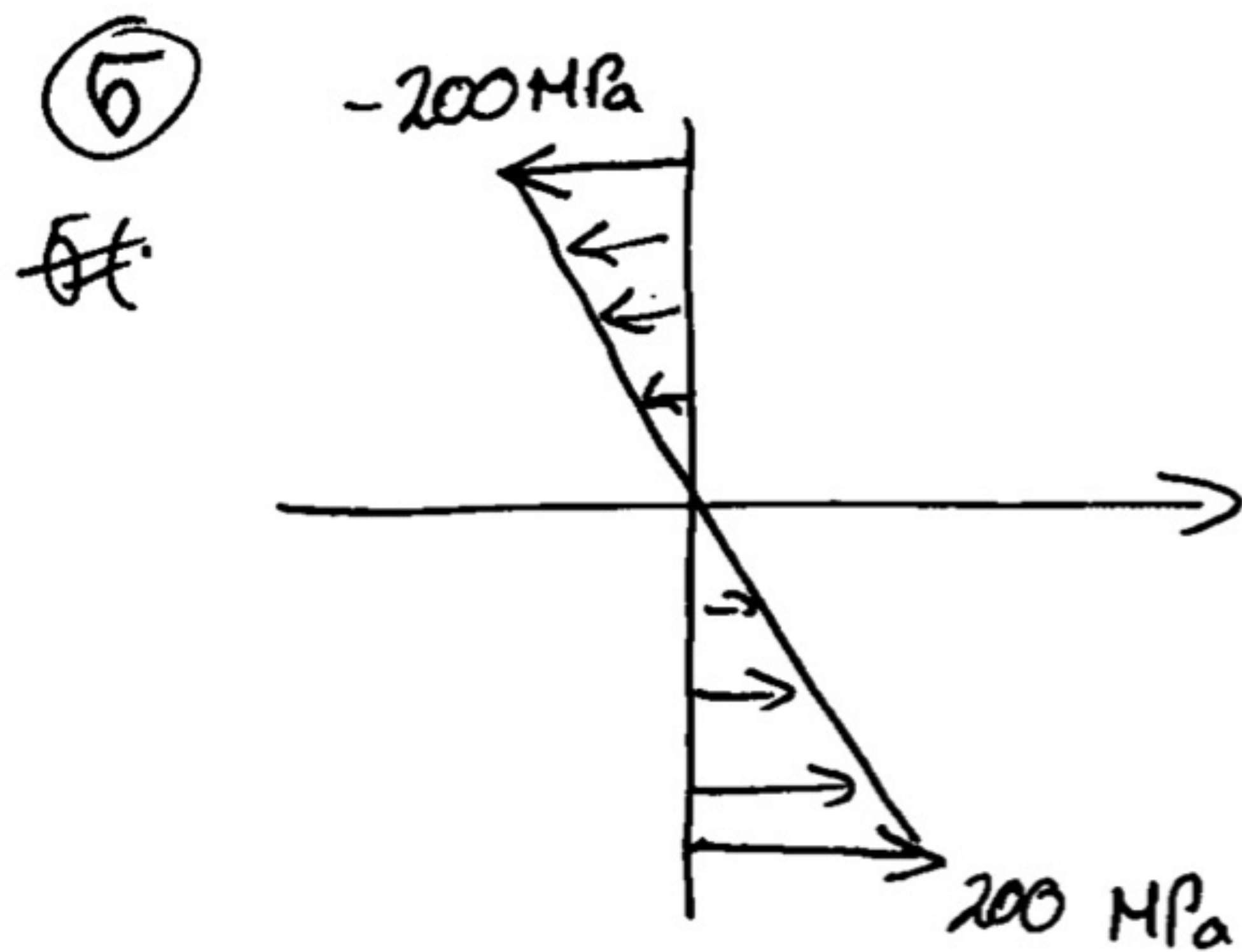
$$J_y = \frac{8a^4}{12} - \frac{\pi a^4}{128} = a^4 \left(\frac{2}{3} - \frac{\pi}{128} \right)$$

(3)

$$\sigma^{extr} = -\frac{1485}{a^4 \left(\frac{2}{3} - \frac{\pi}{128} \right)} \cdot a = -\frac{1485}{a^3 \left(\frac{2}{3} - \frac{\pi}{128} \right)}$$

$$k_r = 200 \text{ MPa} \quad |\sigma^{extr}| \leq k_r$$

$$\frac{1485}{a^3 \left(\frac{2}{3} - \frac{\pi}{128} \right)} \leq 200 \Rightarrow a^3 = \frac{1485}{200 \left(\frac{2}{3} - \frac{\pi}{128} \right)} \Rightarrow a = 2,261 \text{ cm}$$



Naprężenia tnące są pomijalne w stosunku do naprężeń normalnych

(I) $x \in (0, L)$ LINIA UGIĘCIA
przejmowa $E = 2 \cdot 10^5 \text{ MPa}$

$$J_y = (2,261)^4 \left(\frac{256 - 3\pi}{384} \right) = 16,78 \text{ cm}^4$$

$$W_I'' = \frac{Mq}{E J_y} = \frac{(6,92x - 8,06x^2) \cdot 10^3}{2 \cdot 10^{11} \cdot 16,78 \cdot 10^{-8}} = 0,206x - 0,24x^2$$

$$W_I' = 0,206 \frac{x^2}{2} - 0,24 \frac{x^3}{3} + C_I = 0,103x^2 - 0,08x^3 + C_I$$

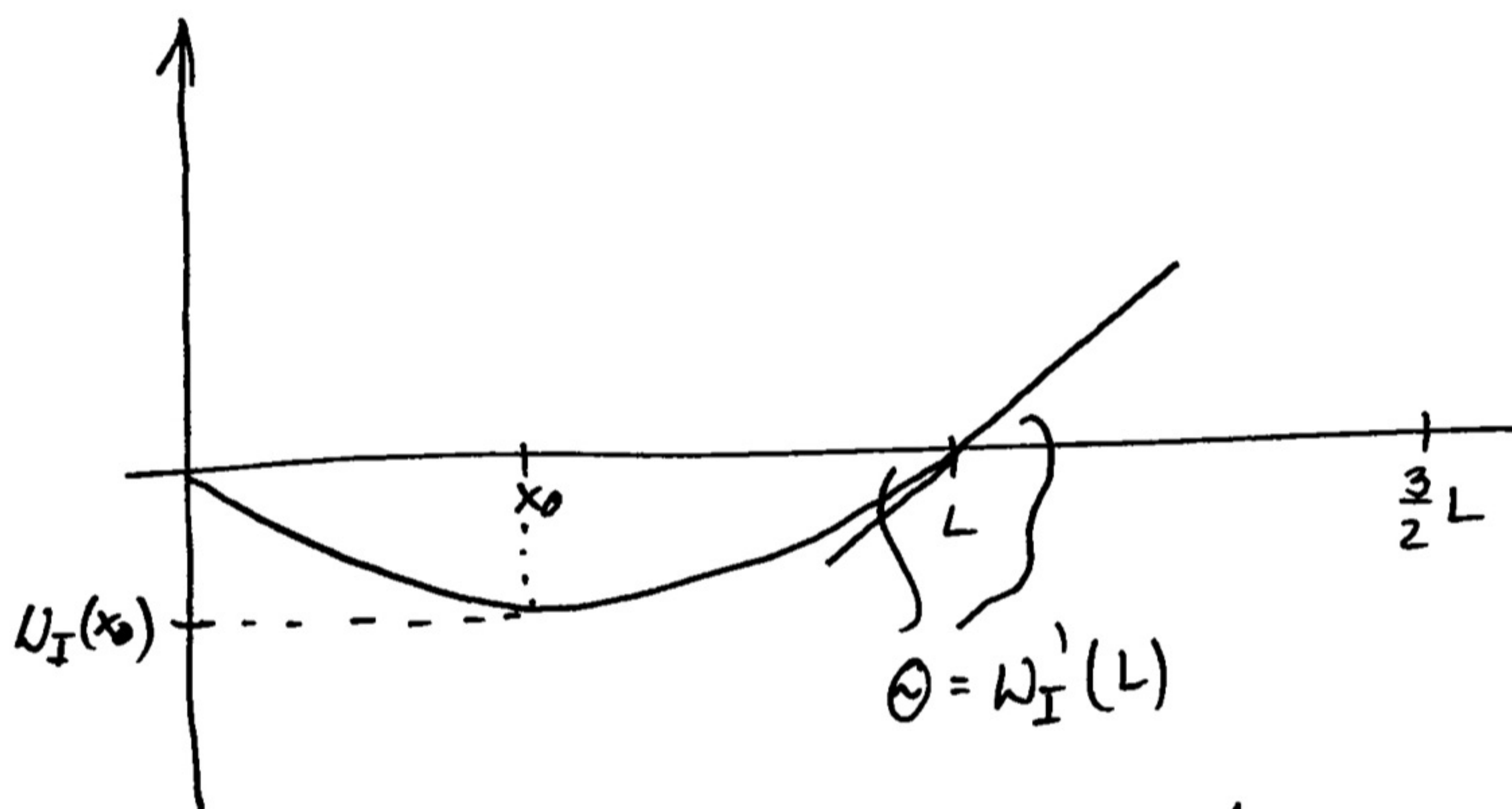
$$W_I = 0,0515x^3 - 0,02x^4 + C_I x + D_I$$

$$W_I(0) = 0 \quad W_I(L) = 0$$

$$D_I = 0 \quad 0 = 0,0343 - 0,02 + C_I \Rightarrow C_I = -0,0143$$

$$W_I = -0,02x^4 + 0,0343x^3 - 0,0143x$$

$$W_I'(0) = -0,0143 \text{ [rad]} \quad W_I'(1) = 0,0087 \text{ [rad]}$$



$$W_I\left(\frac{3}{2}\right) = W\left(\frac{3}{2}L\right) = W_I'(L) \cdot \frac{1}{2}L = 0,00435 \text{ [m]}$$