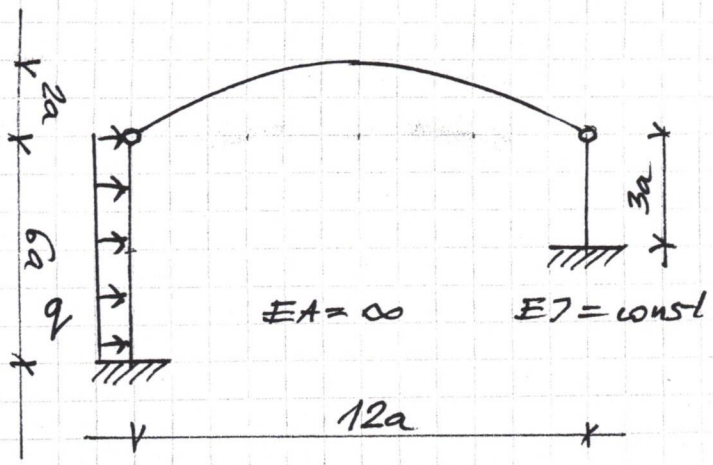
Egzamin pisemny z Mechaniki Konstrukcji I, 4 II 2026 r.

Imię i NAZWISKO				
Prowadzący ćwiczenia, nr grupy, nr indeksu				
ocena zadania 1	ocena zadania 2	ocena zadania 3	ocena egz. pis.	Ocena ostateczna z egzaminu
				Ocena łączna

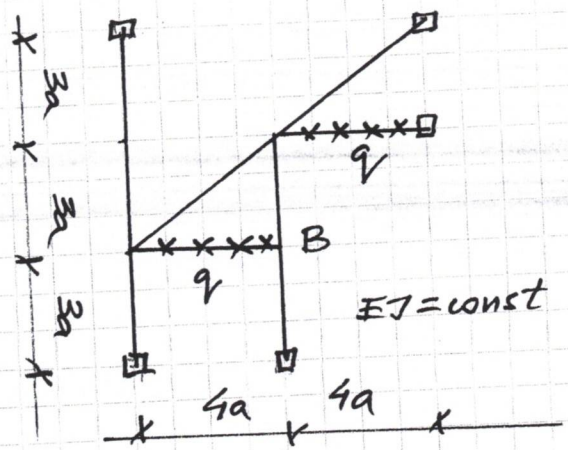
Zadanie 1.
Znaleźć rozkład momentów zginających w danym ramołuku obciążonym jak na rysunku; łuk jest paraboliczny i małowyniosły, EJ=const.

(Construct the diagram of the bending moment in the given frame loaded as in the figure; the arch is parabolic and low-rise, EJ=const)



Zadanie 2.
Znaleźć
a) rozkład momentów zginających w danym ruszcie przegubowym, EJ=const.
b) ugięcie węzła B

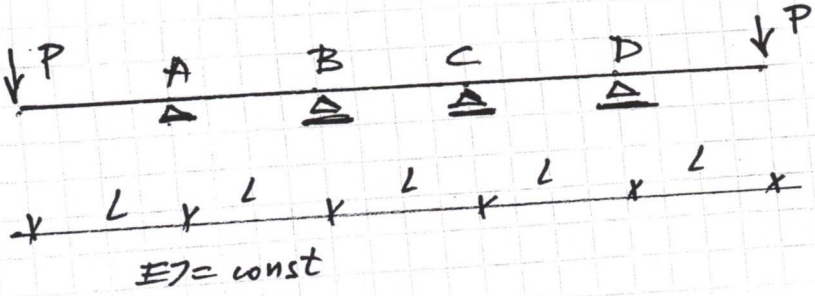
(Find a)the diagram of the bending moments in the grillage with EJ=const b) deflection of the node B.)



Zadanie 3

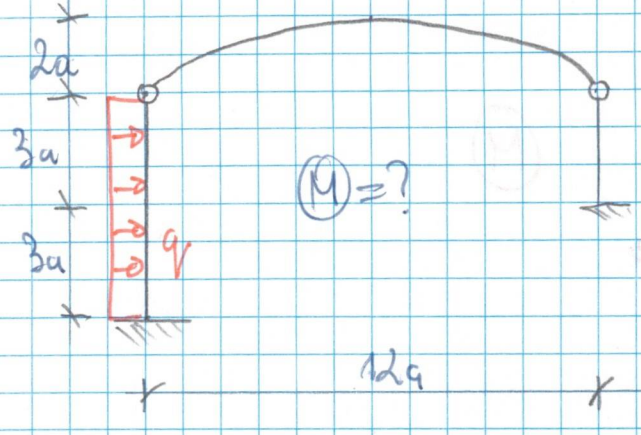
Znajdź funkcję opisująca ugięcie od B do C

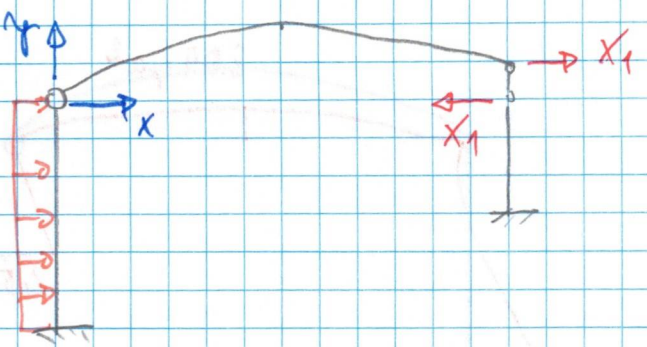
(Find the deflection function from B to C)



ZADANIE 1

$EJ = const.$ $EA \to \infty$ USW



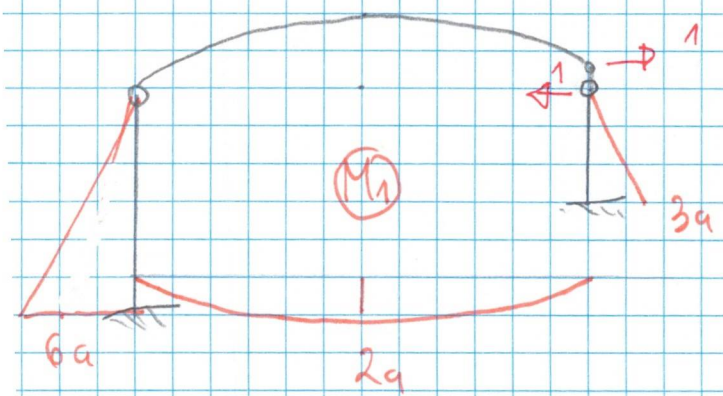


$$\delta_{11} X_1 + \delta_{10} = 0$$

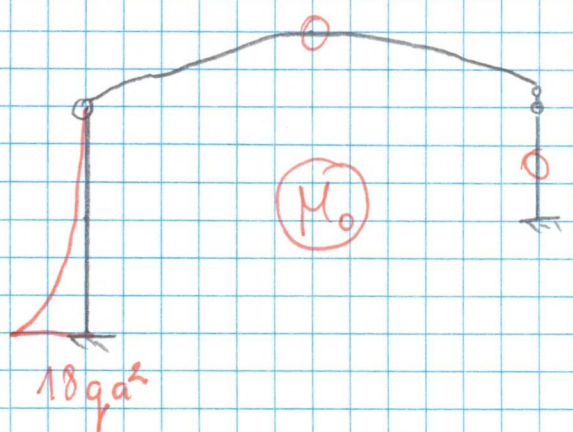
x-wie osi belki

$$y(x) = \frac{4f}{L^2} x(L-x) = \frac{4 \cdot 2a}{(12a)^2} x(12a-x) = \frac{8}{144a} x(12a-x) = \frac{1}{18a} x(12a-x)$$

Stan $X_1 = 1$



Stan „0"

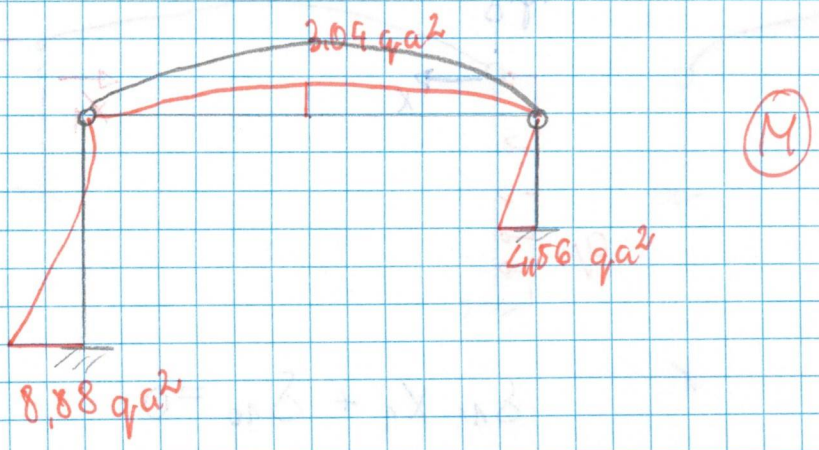


$$M_1(x) = y(x)$$

$$\delta_{11} = \frac{1}{EJ}\left[\frac{1}{2} 6a \cdot 6a \cdot \frac{2}{3} 6a + \frac{1}{2} 3a \cdot 3a \cdot \frac{2}{3} 3a + \int_0^{12a} y(x)\, y(x)\, dx\right] = 106.6 \frac{a^3}{EJ}$$

$$\delta_{10} = \frac{1}{EJ}\left[\frac{1}{2} 18qa^2 \cdot 6a \cdot \frac{2}{3} 6a + \frac{2}{3} q \frac{(6a)^2}{8} 6a \left(-\frac{1}{2} 6a\right)\right] = 162 \frac{qa^4}{EJ}$$

$$X_1 = -\frac{\delta_{10}}{\delta_{11}} = -1{,}520\ q\,a$$



(M)

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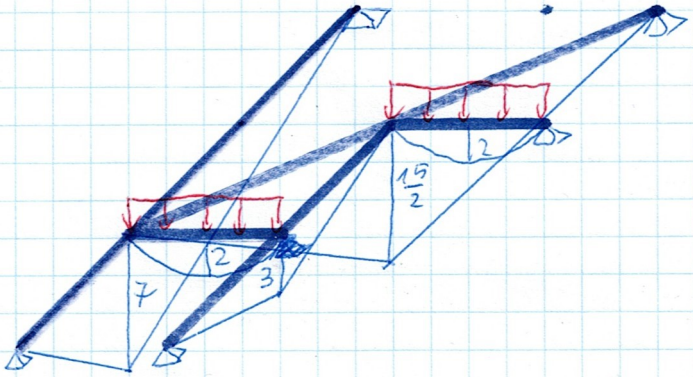
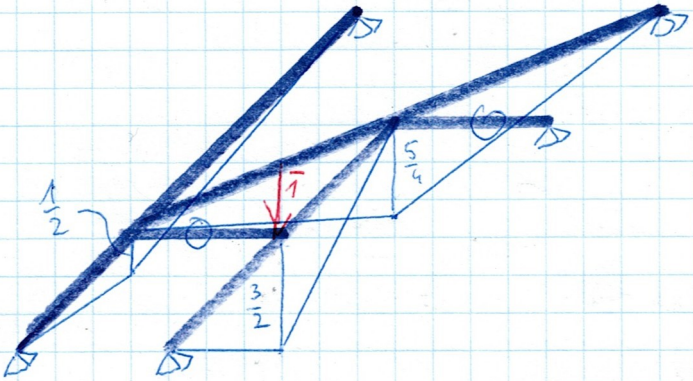
Zad. 2

$M\,[qa^2]$



$\overline{M}\,[1 \cdot a]$



$$w_B = \frac{203}{4}\,\frac{qa^4}{EJ} = 50{,}75\,\frac{qa^4}{EJ}$$

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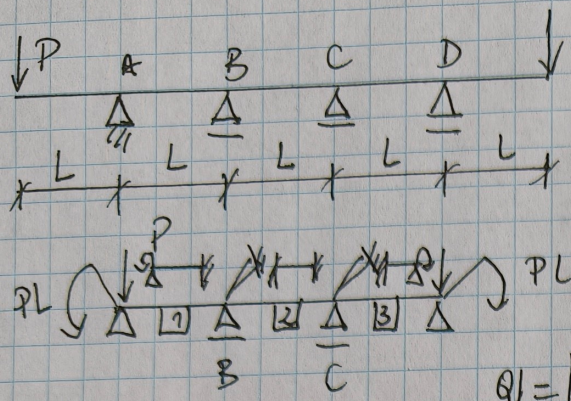
ZAD. 3.

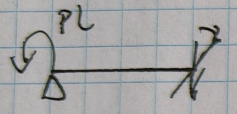
Wyznaczyć ugięcie odcinka B-C



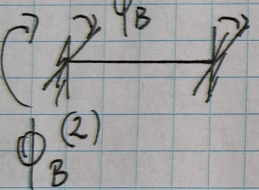
$$Q = [\varphi_B]$$

$$\varphi_B = -\varphi_C$$

Równanie równowagi $\sum M_B = 0 \Rightarrow \phi_B^{(1)} + \phi_B^{(2)} = 0$



$$\phi_B^{(1)} = \frac{3EJ}{L}\varphi_B - \frac{PL}{2}$$

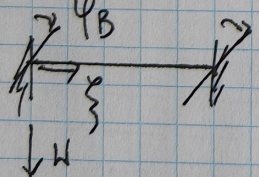


$$\phi_B^{(2)} = \frac{2EJ}{L}\left[2\varphi_B + (-\varphi_B)\right] = \frac{EJ}{L} 2\varphi_B$$

$$\frac{EJ}{L} 5\varphi_B = \frac{PL}{2} \Rightarrow \varphi_B = \frac{PL^2}{10EJ}$$

$$\varphi_C = -\frac{PL^2}{10EJ}$$

Ugięcie belki B-C



$$w(\xi) = C_0 + C_1\xi + C_2\xi^2 + C_3\xi^3$$

$$\varphi(\xi) = \frac{1}{L}\frac{dw}{d\xi} = \frac{1}{L}\left(C_1 + 2C_2\xi + 3C_3\xi^2\right)$$

war. brzegowe

$$w(0) = 0 \Rightarrow C_0 = 0$$

$$\varphi(0) = \varphi_B \Rightarrow \frac{1}{L}C_1 = \frac{PL^2}{10EJ} \Rightarrow C_1 = \frac{PL^3}{10EJ}$$

$$w(1) = 0 \Rightarrow \frac{PL^3}{EJ} + C_2 + C_3 = 0$$

$$\varphi(1) = -\varphi_B \Rightarrow \frac{1}{L}\left[\frac{PL^3}{EJ} + 2C_2 + 3C_3\right] = -\frac{PL^2}{10EJ}$$

$$C_3 = 0 \qquad C_2 = -\frac{1}{10}\frac{PL^3}{EJ} \Rightarrow w(\xi) = \frac{PL^3}{EJ}\left[\frac{1}{10}\xi - \frac{1}{10}\xi^2\right]$$