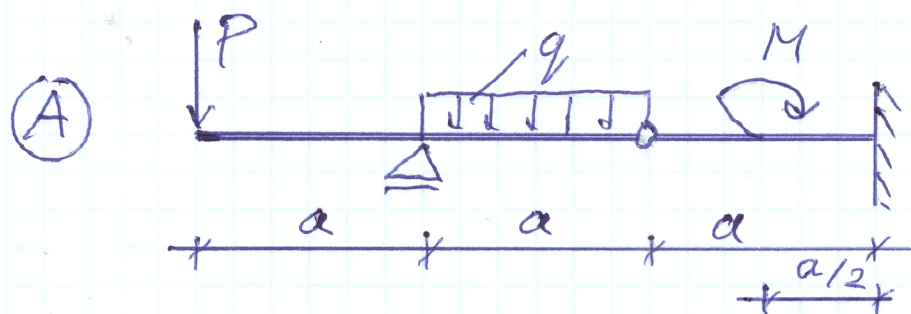


Tematyka Ćwiceń na 17.05

1. Rozwiązać belki o schematach podanych na rysunkach:

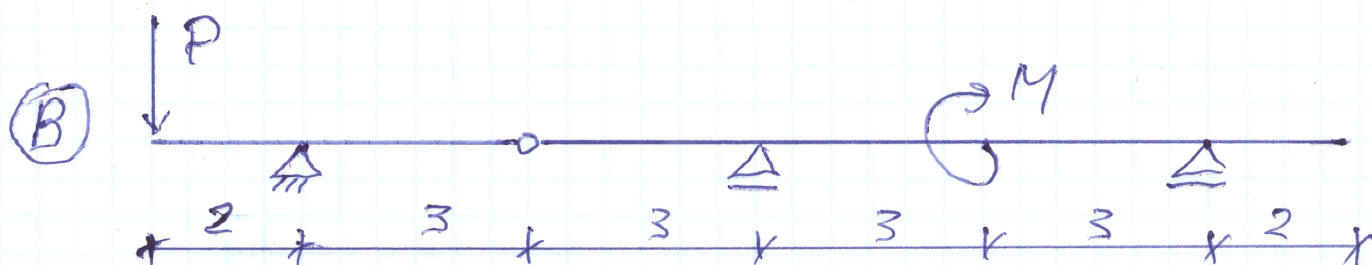


$$P = 40 \text{ kN}$$

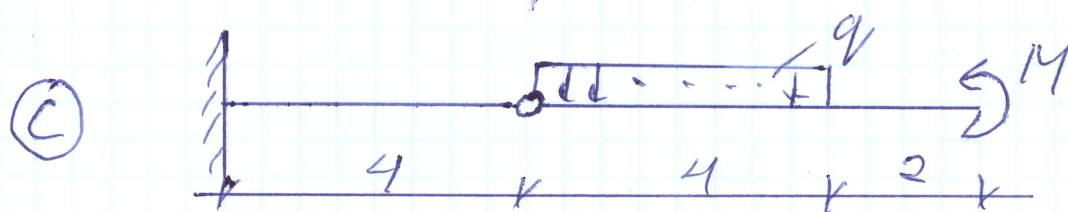
$$q = 10 \text{ kN/m}$$

$$M = 20 \text{ kNm}$$

$$a = 3 \text{ m}$$

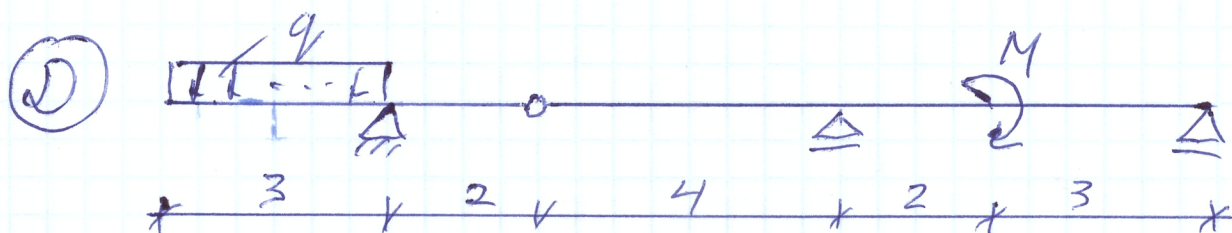


$$P = 300 \text{ kN}, \quad M = 200 \text{ kNm}$$



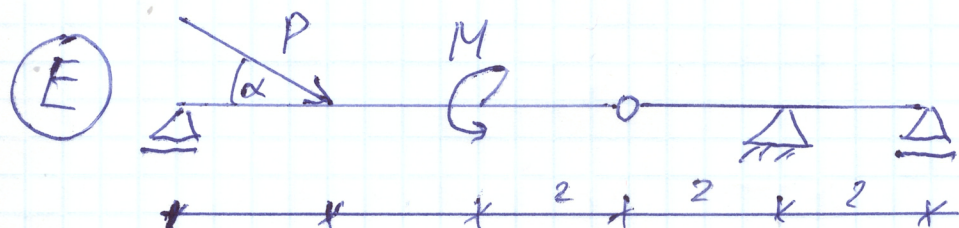
$$M = 60 \text{ kNm}$$

$$q = 20 \text{ kN/m}$$



$$M = 120 \text{ kNm}$$

$$q = 20 \text{ kN/m}$$



$$P = 120 \text{ kN}$$

$$\alpha = 30^\circ$$

$$M = 90 \text{ kNm}$$

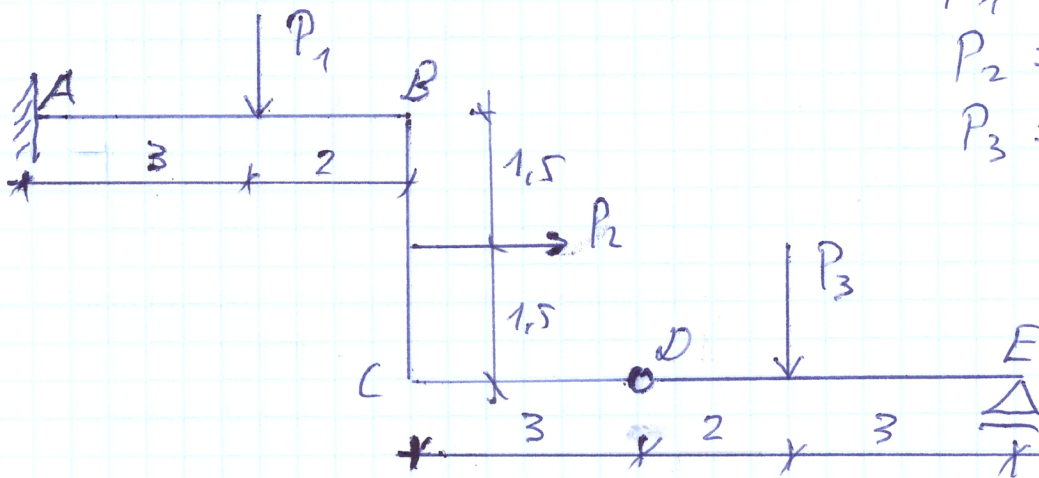
(2)

2. Rozwiązać ramę o schemacie jak na rysunku

$$P_1 = 10 \text{ kN}$$

$$P_2 = 30 \text{ kN}$$

$$P_3 = 50 \text{ kN}$$



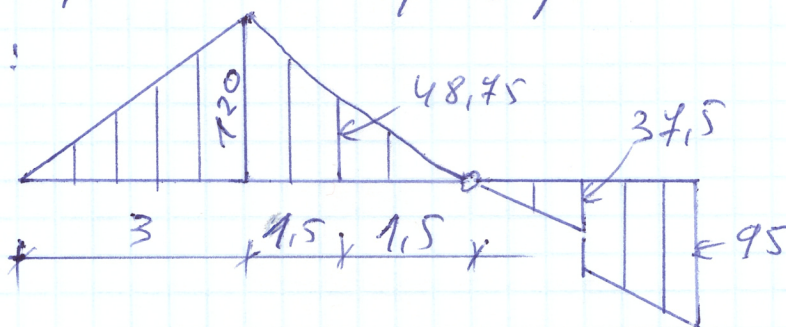
Odpowiedzi:

W celu kontroli podano poniżej ogólny poprawny odpowiedź każdego zadania, Sg to wykresy momentów gięcych. Proszę do nich dojść samodzielnie czyli:

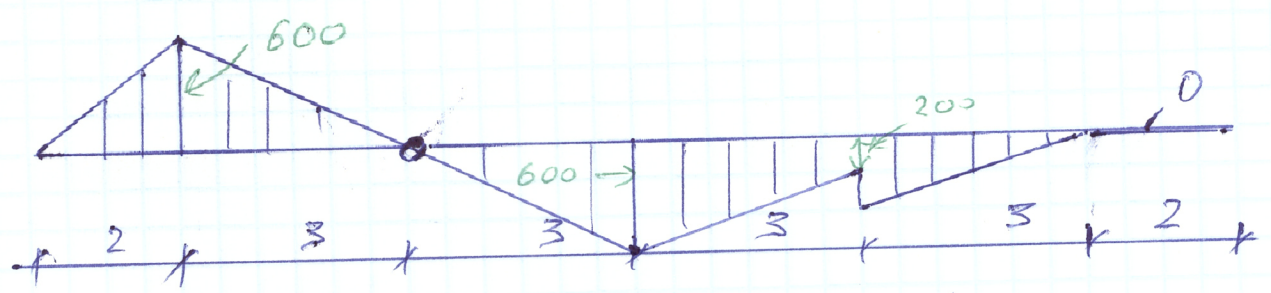
- 1) wyznaczyć reakcje w podporach
- 2) napisać wyrażenia na momenty gięce, ugię tnące i ugię osiowe
- 3) na podstawie tych wyrażeń narysować odpowiednie wykresy.

Bellu:

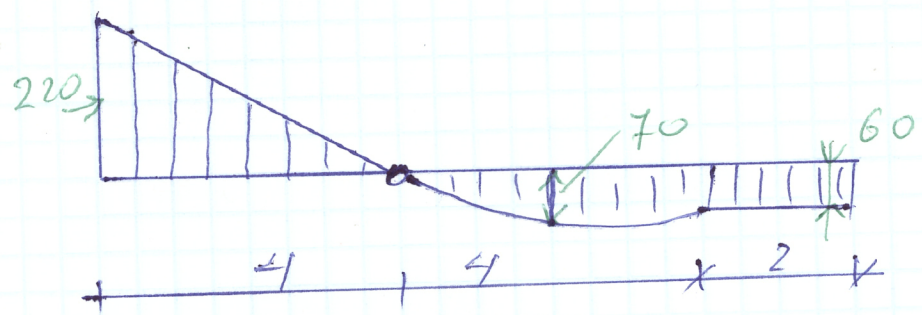
(A)



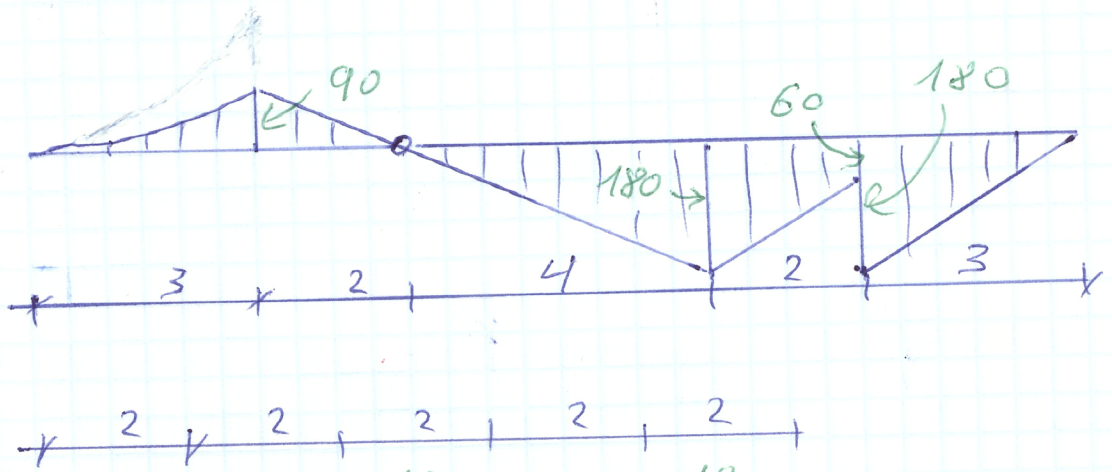
B



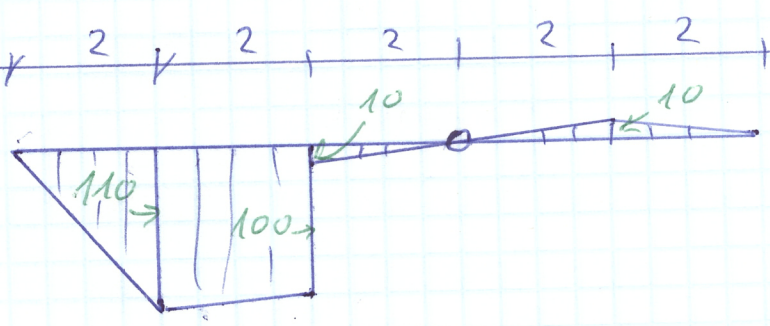
C



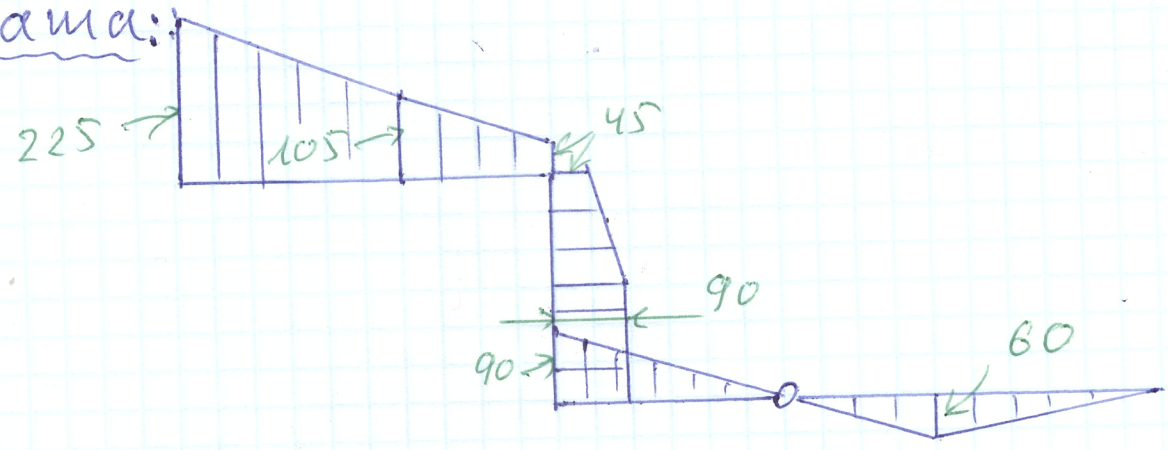
D



E

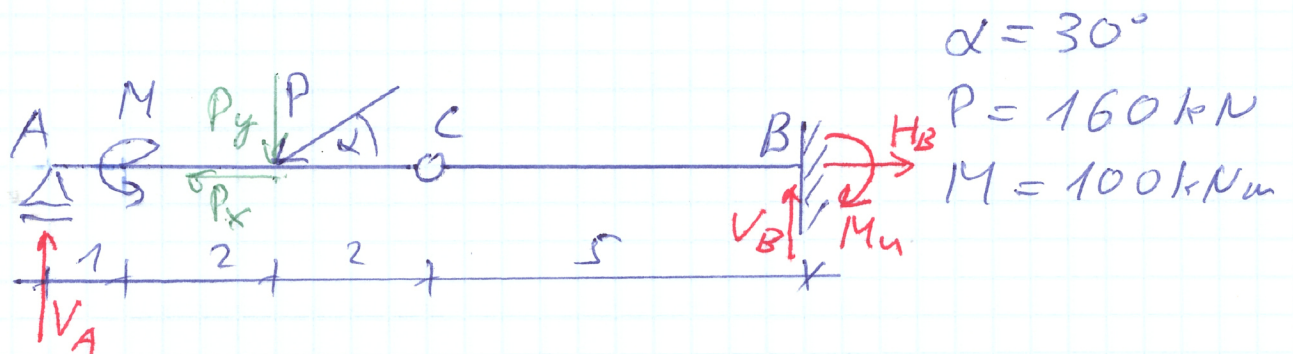


Rama:



(9)

Przykład. Rozwiązać belkę o schemacie
jak na rysunku.



1) Reakcje: Siłę pod kątem (cięż P) rozkładamy na kierunku pionowy i poziomy:

$$P_x = P \cos \alpha = 160 \cdot \cos 30^\circ = 160 \cdot 0,866 = 138,6$$

$$P_y = P \sin \alpha = 160 \cdot \sin 30^\circ = 160 \cdot 0,5 = 80$$

$$\sum M_{Cz} = M + P_y \cdot 2 - V_A \cdot 5 = 0$$

$$5V_A = M + 2P_y = 100 + 2 \cdot 80 = 260$$

$$V_A = \frac{260}{5} = 52 \text{ kN}$$

$$\sum Y = V_A - P_y + V_B = 0 \rightarrow V_B = P_y - V_A = 80 - 52 = 28 \text{ kN}$$

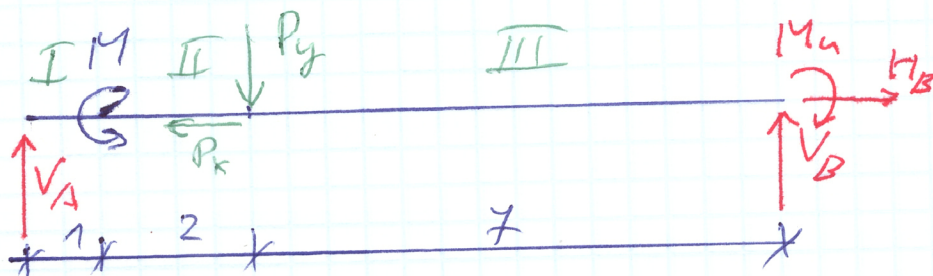
$$\sum X = -P_x + H_B = 0 \rightarrow H_B = P_x = 138,6 \text{ kN}$$

$$\sum M_{C,pr} = -M_C + V_B \cdot 5 = 0 \rightarrow M_C = 5V_B = 5 \cdot 28 = 140 \text{ kNm}$$

sprawdzenie reakcji:

$$\begin{aligned} \sum M_B &= -V_A \cdot 10 + M + P_y \cdot 7 - M_C = \\ &= -520 + 100 + 80 \cdot 7 - 140 = 0! \quad \text{O.K.} \end{aligned}$$

(5)

2) Sily wewnystrze:Przech. I

$0 < x < 1$



$$M(x) = -V_A \cdot x =$$

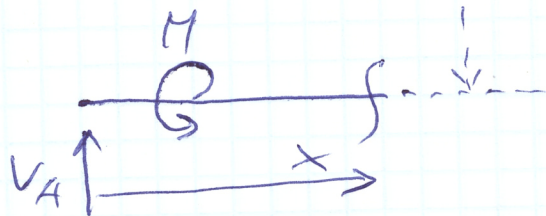
$$= -52 \cdot x$$

$$M(0) = 0, \quad M(1) = -52$$

$$T(x) = -V_A = -52, \quad N(x) = 0$$

Przech. II

$1 < x < 3$



$$M(x) = -V_A \cdot x + M =$$

$$= -52x + 100$$

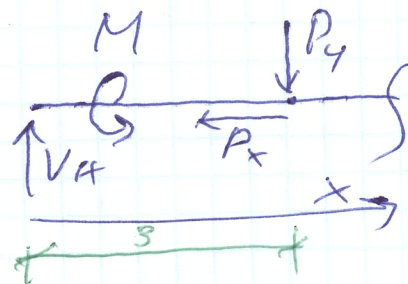
$$M(1) = -52 + 100 = 48$$

$$M(3) = -52 \cdot 3 + 100 = -56$$

$$T(x) = -V_A = -52, \quad N(x) = 0$$

Przech. III

$3 < x < 10$



$$M(x) = -V_A \cdot x + M + P_y \cdot (x - 3) =$$

$$= -52x + 100 + 80x - 240 =$$

$$= 28x - 140$$

$$M(3) = 28 \cdot 3 - 140 = -56$$

$$M(10) = 28 \cdot 10 - 140 = 140$$

6

$$T(x) = -V_A + P_y = -52 + 80 = 28$$

$$N(x) = +P_x = 138,6$$

Wylaczenie:

