



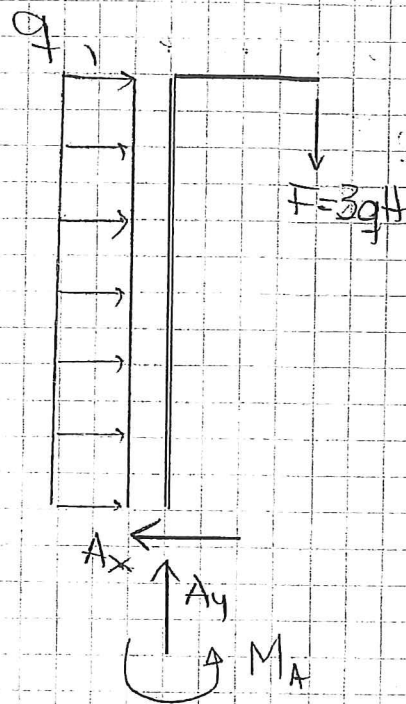
OPPGAVE 1

- a) Tar utgangspunkt i FLD
til høyre. Global likevekt

$$\sum F_x = 0 \Rightarrow \underline{A_x = qH}$$

$$\sum F_y = 0 \Rightarrow \underline{A_y = 3qH}$$

$$\begin{aligned}\sum M_A = 0 &\Rightarrow qH \cdot \frac{H}{2} + 3qH \cdot \frac{H}{3} - M_A = 0 \\ &\Rightarrow \underline{M_A = \frac{3}{2}qH^2}\end{aligned}$$



- b) Trenger to snitt:

I: Bjelke BC

II: Søyel AB

SNITT I:

{FLD nederst til høyre}

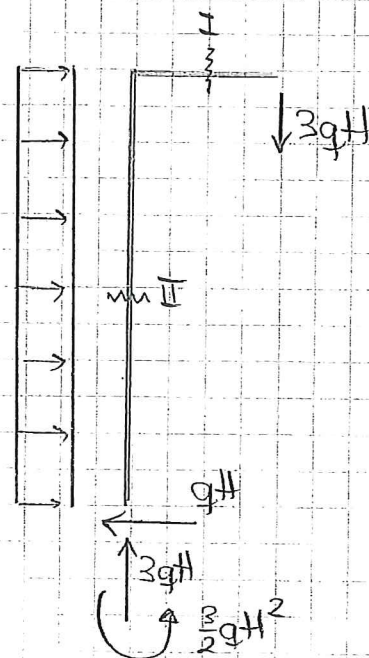
Åpenbart: $N = 0$

$$\sum F_y = 0 \Rightarrow \underline{V = 3qH} \quad \uparrow \downarrow$$

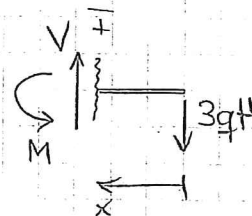
$$\sum M = 0 \Rightarrow \underline{M = 3qHx}$$

$$M(0) = 0$$

$$M\left(\frac{H}{3}\right) = qH^2 = M_B$$



SNITT I:



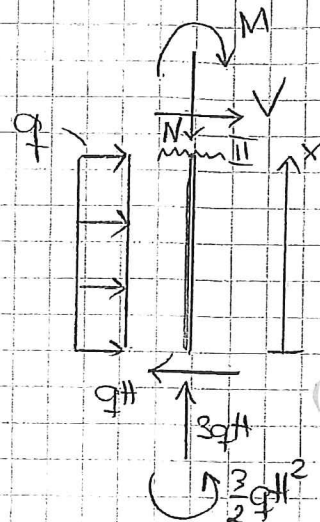


	Dato	Side
		2
	Sign	

SNITT II:

Velger å la x løpe nedover

NB: Benytter ofte x som langs-
etter - variabel også for
vertikale komponenter



$$\sum F_{\text{horis}} = 0 \Rightarrow V + qx - qH = 0 \Rightarrow \underline{V = qH - qx}$$

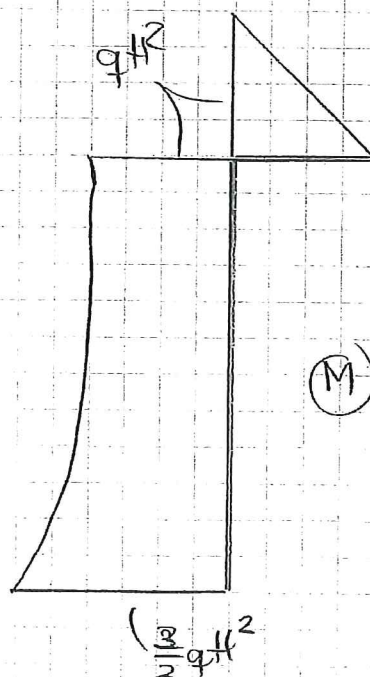
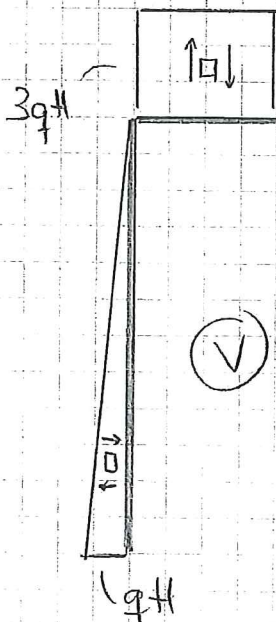
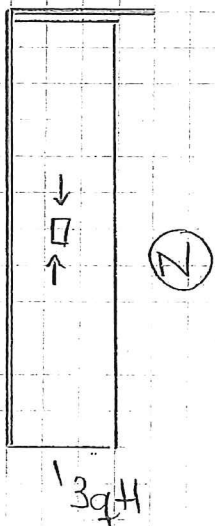
$$V(0) = qH = A_x \quad V(H) = 0$$

$$\sum F_{\text{vert}} = 0 \Rightarrow \underline{N = 3qH}$$

$$\sum M = 0 \Rightarrow M - qx \cdot \frac{x}{2} + \underbrace{qH \cdot x}_{A_x} - \underbrace{\frac{3}{2}qH^2}_{M_A} = 0 \Rightarrow \underline{M = \frac{1}{2}qx^2 - qHx + \frac{3}{2}qH^2}$$

$$M(0) = \frac{3}{2}qH^2 = M_A \quad M(H) = qH^2 = M_B \quad M\left(\frac{H}{2}\right) = \frac{9}{8}qH^2$$

Diagram:

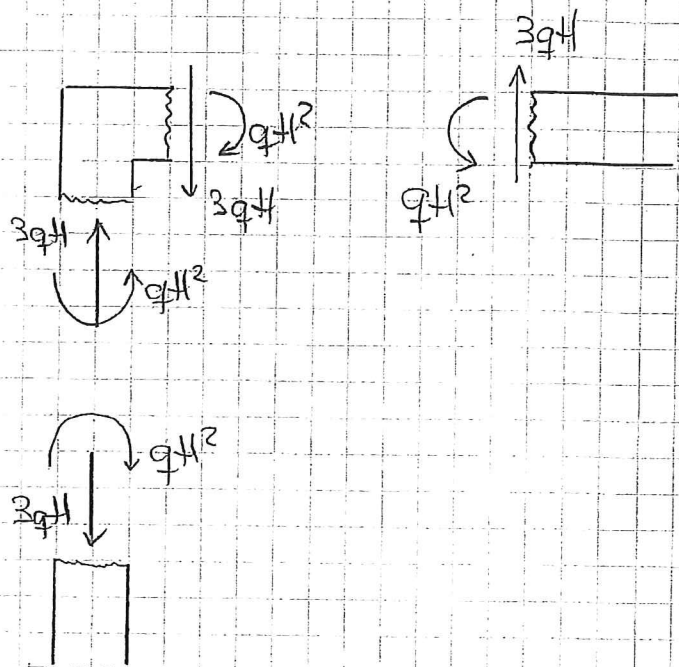




	Dato	Side 3
	Sign	

c) Hjørne B

Figuren til høyre viser kreftene og momentene på enden av hver komponent, samt motkreftene (Newton 3.!) på hjørnet



Åpenbart for hjørnet:

$$\sum F_{\text{vert}} = 0$$

$$\sum M = 0$$

} LIKEVEKT
OK



	Dato	Side 4
	Sign	

OPPGAVE 2

Global likevekt gir ytre
lægerreaksjoner A_x , A_y og D_x :

$$\sum F_y = 0 \Rightarrow \underline{A_y = 150 \text{ kN}}$$

$$\sum M_A = 0 \Rightarrow 150 \cdot 4 - D_x \cdot 6 = 0 \Rightarrow \underline{D_x = 100 \text{ kN}}$$

$$\sum F_x = 0 \Rightarrow \underline{A_x = 100 \text{ kN}}$$

$$\text{KONTROLL: } \sum M_B = 150 \cdot 4 - \underbrace{100 \cdot 2}_{D_x} - \underbrace{100 \cdot 4}_{A_x} = 0 \quad \text{OK}$$

Betrakter stolpe ABD for å
bestemme leddekrefter i B og
kraften i støt CD (støt!)

$$\sum M_B = 0 \Rightarrow N_{CD} \cdot \underbrace{\frac{4}{\sqrt{4^2+2^2}}}_{x\text{-komp.}} \cdot 2 - 100 \cdot 2 - 100 \cdot 4 = 0$$
$$\Rightarrow \underline{N_{CD} = 335 \text{ kN}}$$

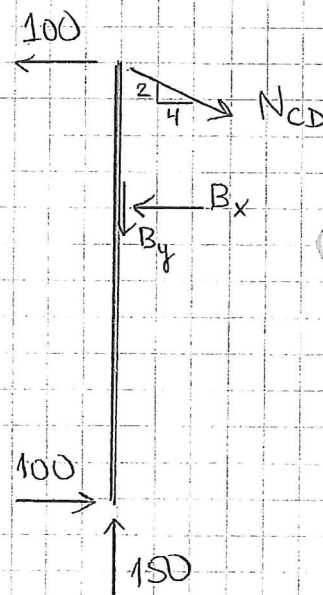
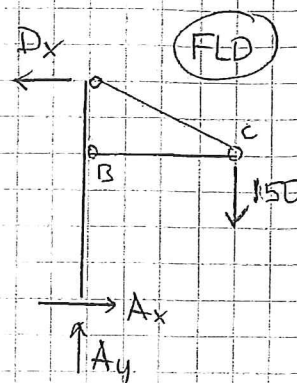
$$\sum F_x = 0 \Rightarrow \underbrace{335 \cdot \frac{4}{\sqrt{20}}}_{N_{CD}} - B_x + 100 - 100 = 0$$
$$\Rightarrow \underline{B_x = 300 \text{ kN}}$$

$$\sum F_y = 0 \Rightarrow 150 - B_y - 335 \cdot \frac{2}{\sqrt{20}} = 0$$

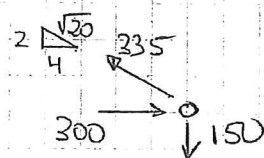
$$\Rightarrow \underline{B_y = 0}$$

KONTROLL: Likevekt i C

$$\left. \begin{aligned} \sum F_x &= 300 - \frac{4}{\sqrt{20}} \cdot 335 = 0 \\ \sum F_y &= \frac{2}{\sqrt{20}} \cdot 335 - 150 = 0 \end{aligned} \right\} \text{OK}$$



ÅPENBART!
BC er en støt





	Dato	Side
		5
	Sign	

Både CD og BC er staver $\Rightarrow$ Kun N ($V=M=0$)

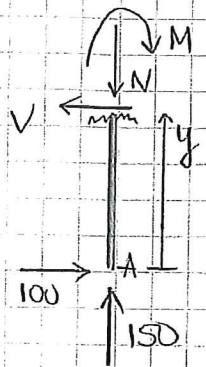
Stolpe ABD: Trenger to snitt — ett på hver side av B

SNITT MELLOM A OG B:

$$\Sigma F_x = 0 \Rightarrow \underline{V = 100}$$

$$\Sigma F_y = 0 \Rightarrow \underline{N = 150}$$

$$\Sigma M = 0 \Rightarrow \underline{M = 100 \cdot y_-} \quad \{M(4) = M_B = 400\}$$

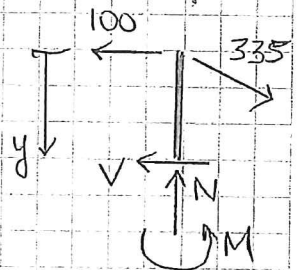


SNITT MELLOM C OG B:

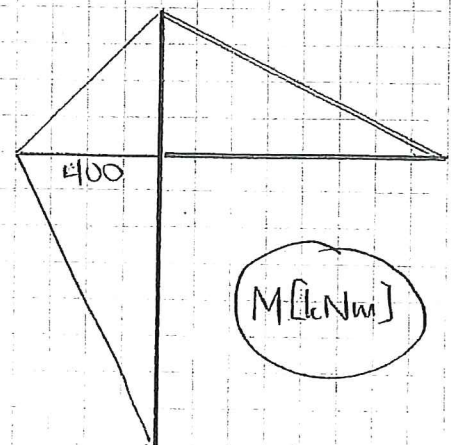
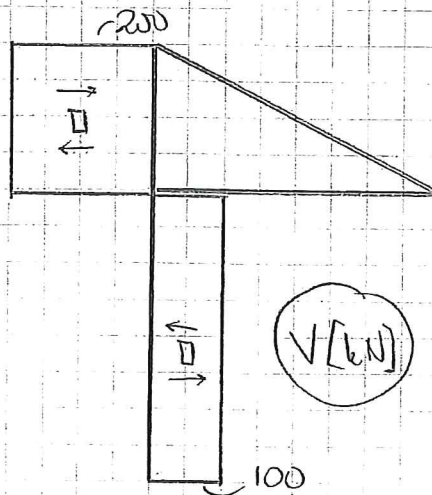
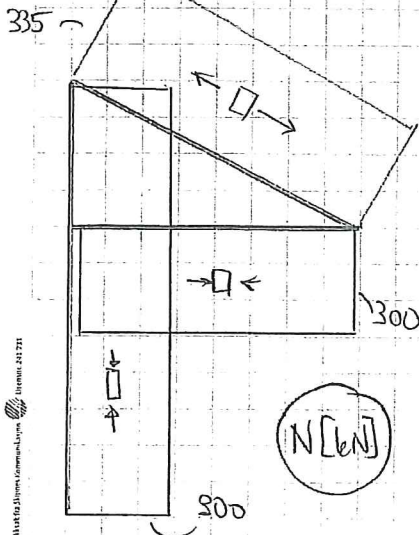
$$\Sigma F_x = 0 \Rightarrow -100 - V + 335 \cdot \frac{4}{\sqrt{20}} = 0$$

$$\Rightarrow \underline{V = 200}$$

$$\Sigma F_y = 0 \Rightarrow N - 335 \cdot \frac{2}{\sqrt{20}} = 0 \Rightarrow \underline{N = 150}$$

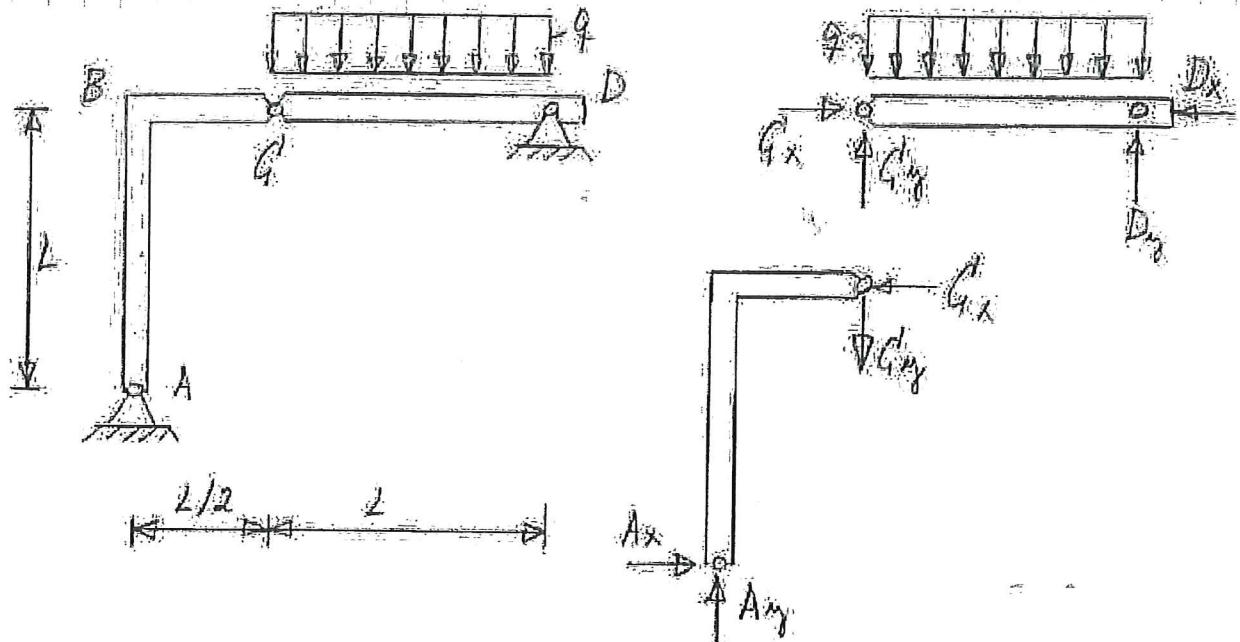


$$\Sigma M = 0 \Rightarrow 335 \cdot \frac{4}{\sqrt{20}} \cdot y - 100 \cdot y - M = 0 \Rightarrow \underline{M = 200 y_-} \quad \{M(2) = M_B = 400\}$$





OPPGAVE 3



Lagerneskrifter, biddkraft i C og diagram for skjærkraft og bøyemoment.

Likewekt krever for

bjelke CD: $G_y = D = \frac{1}{2} \cdot (q \cdot L)$ (symmetri)

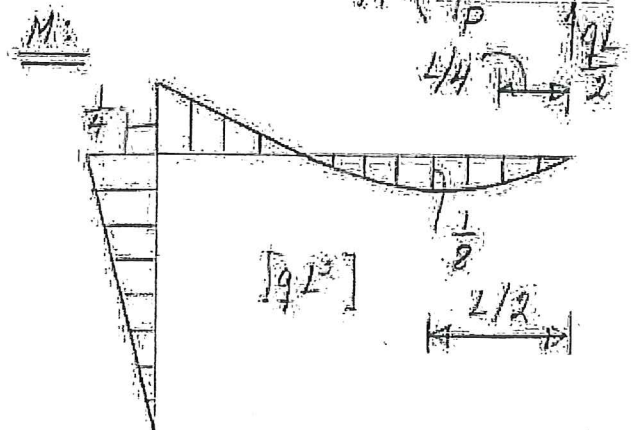
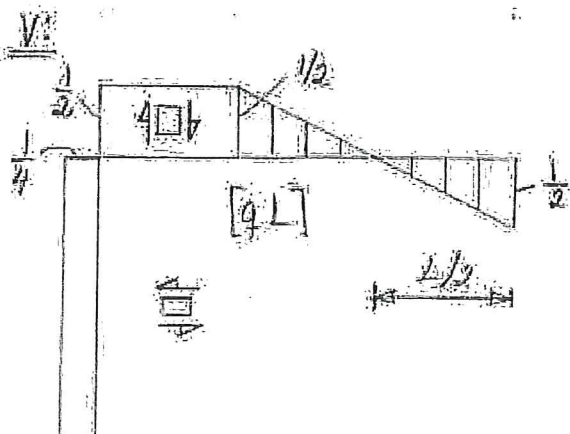
del ABC: $\sum M_A = 0 \Rightarrow G_x \cdot L - G_y \cdot L/2 = 0 \Rightarrow G_x = qL/4$

$\sum F_x = 0, \sum F_y = 0 \Rightarrow A_x = G_x = qL/4, A_y = G_y = qL/2$

bjelke CD: $D_x = G_x = qL/4$

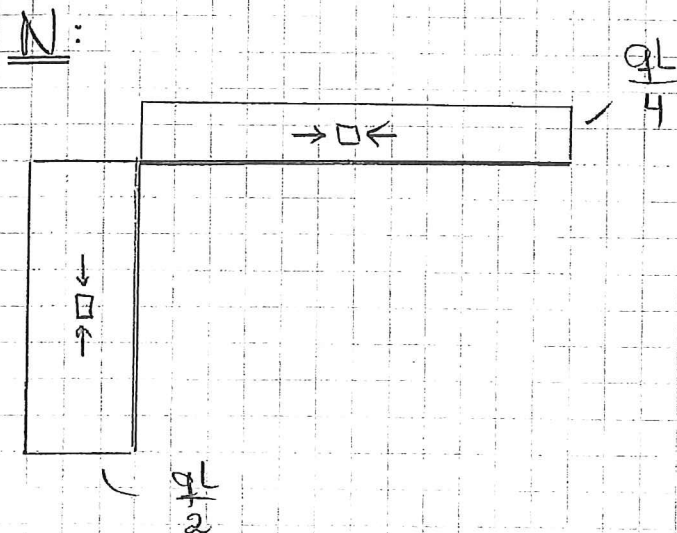
$\Rightarrow A_x = G_x = D_x = \underline{qL/4}, A_y = G_y = D_y = \underline{qL/2}$

Likewekt av del PD $\Rightarrow M = (qL/2) \cdot L/4 = qL^2/8$





	Dato	Side
	Sign	7



Kontroll:

- $M=0$ i pkt C
- Identifiserer A_x og D_y i V-diagram
- Identifiserer A_y og D_x i N-diagram
- Lineær M i AB og BC. Konstant V
- Parabelformet M i CD. Lineær V

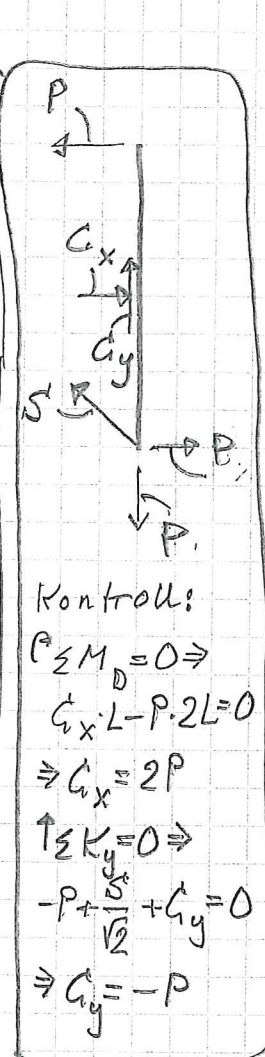
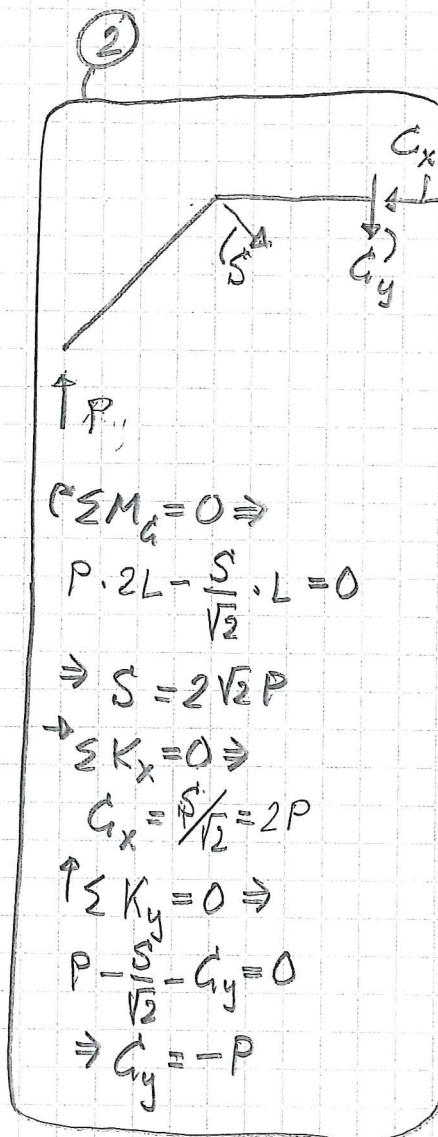
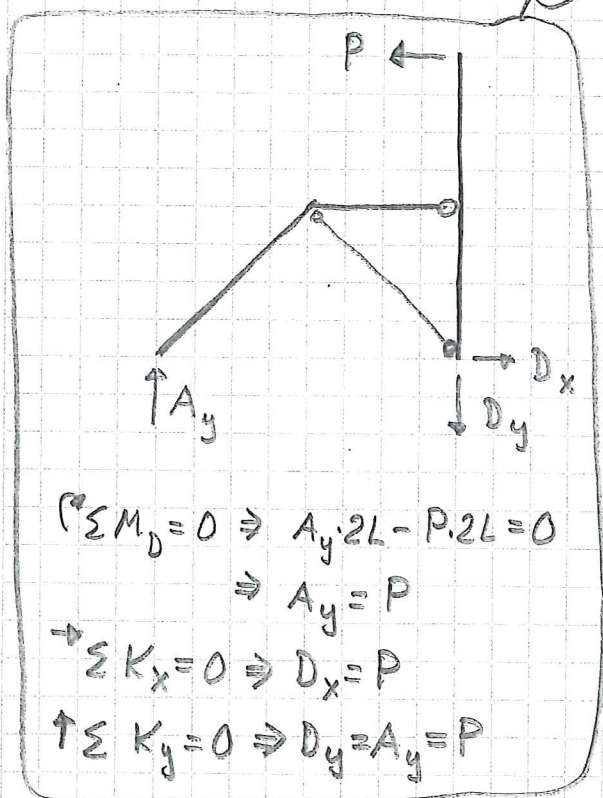
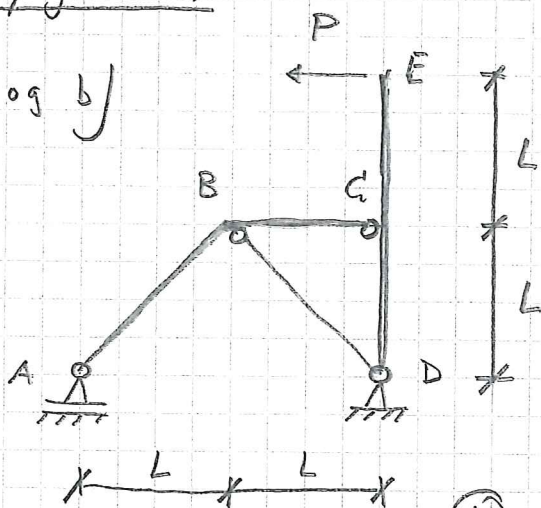
MERK:

Utrekningen av funksjonene $N(x)$, $V(x)$ og $M(x)$ mangler i denne løsningen !

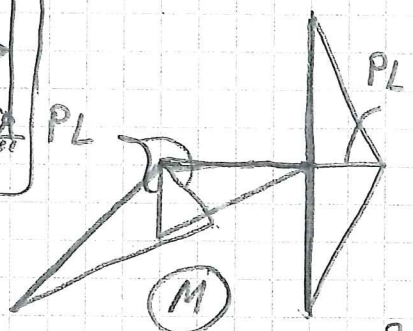
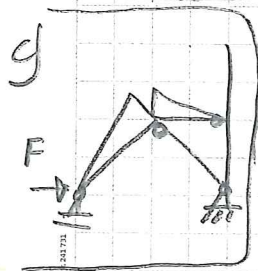


Oppgave 4

a) og b)



Diagrammene kan nå legges opp.



$\frac{P}{\sqrt{2}}$

