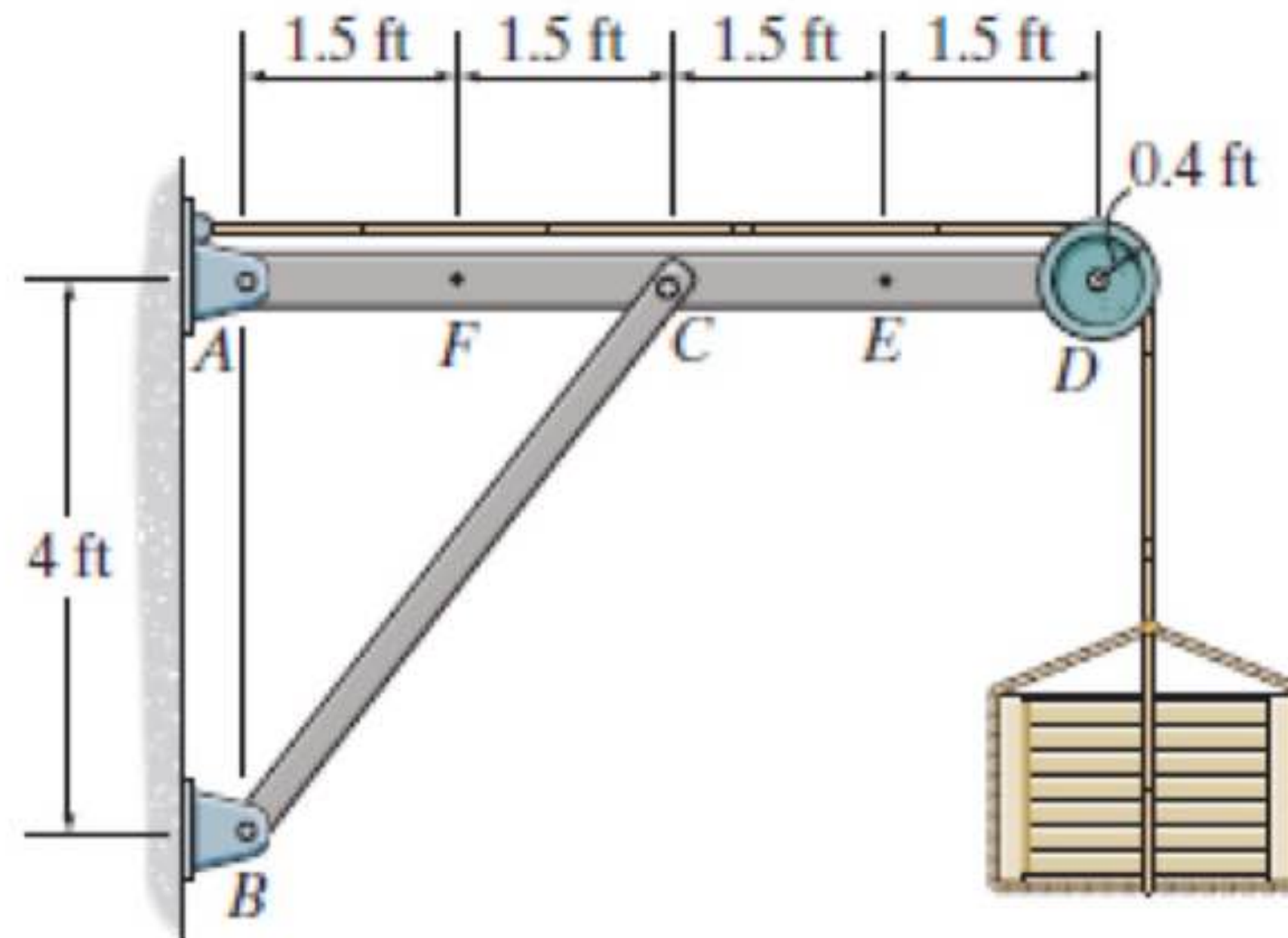
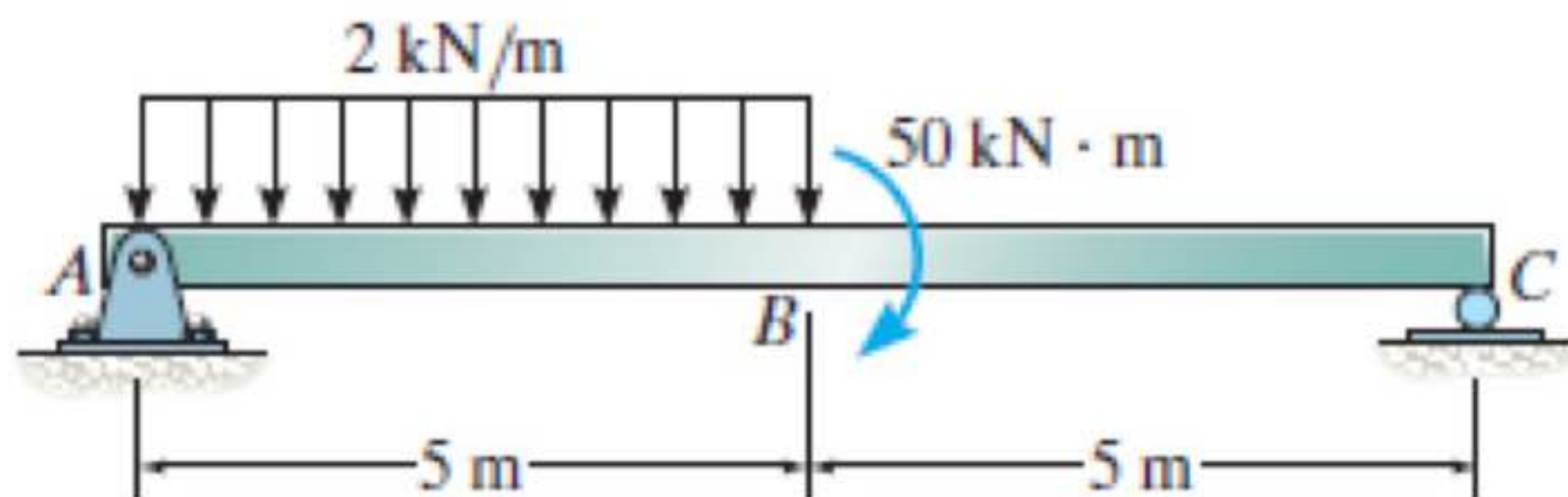


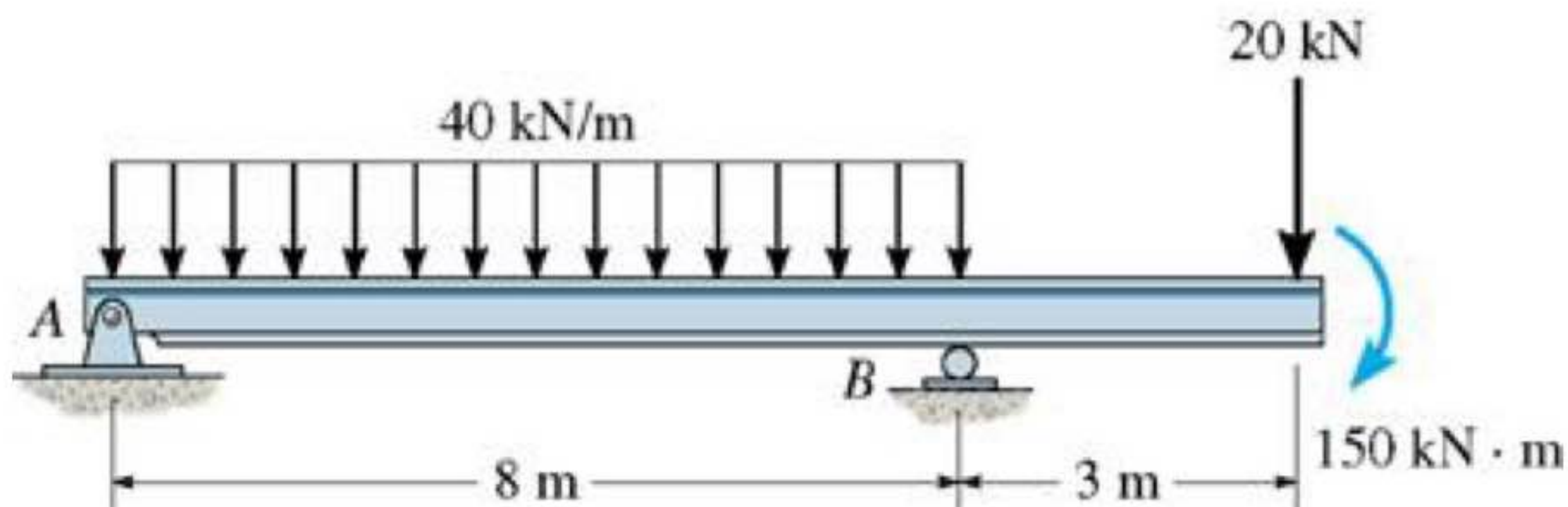
(7.24) Determine a força normal interna, o esforço cortante e o momento nos pontos F e E da estrutura. A caixa pesa 300 lbf.



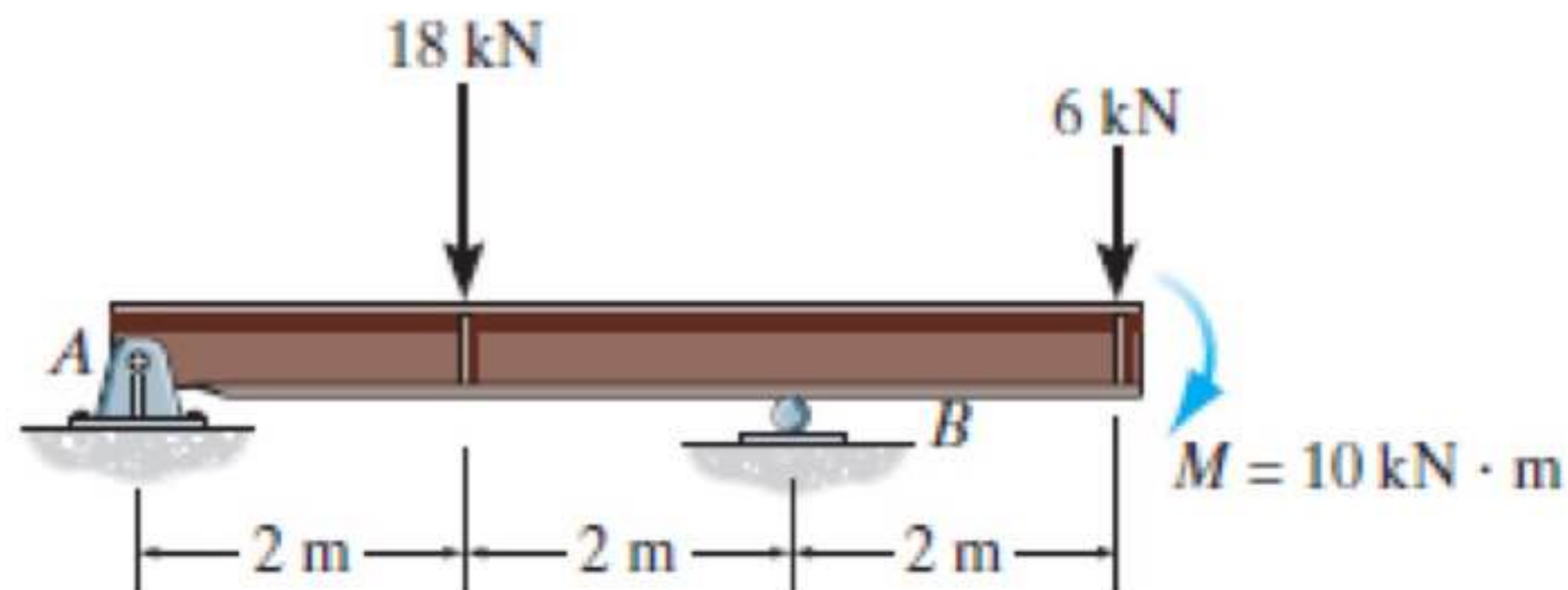
(7.49) Determine os diagramas de esforço cortante e de momento fletor para a viga.



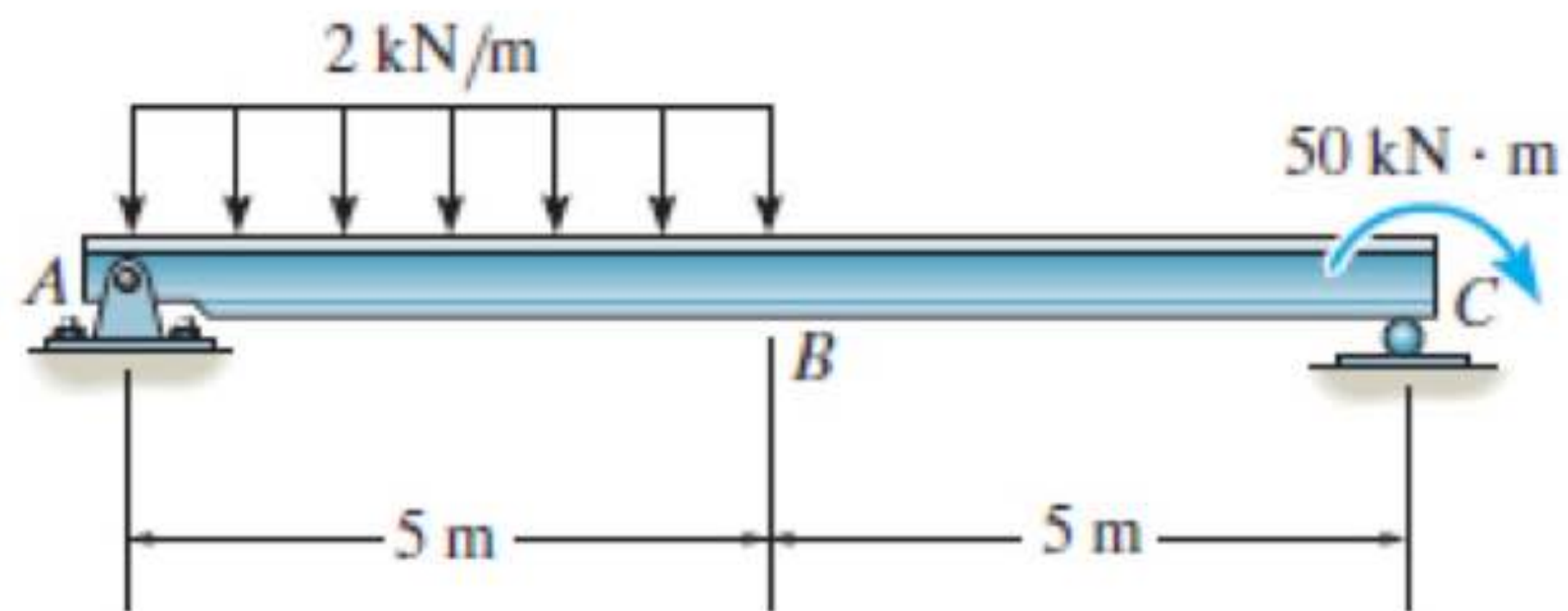
(7.71_10°ed) Desenhe os diagramas de forças de cisalhamento e de momentos fletores para a viga.

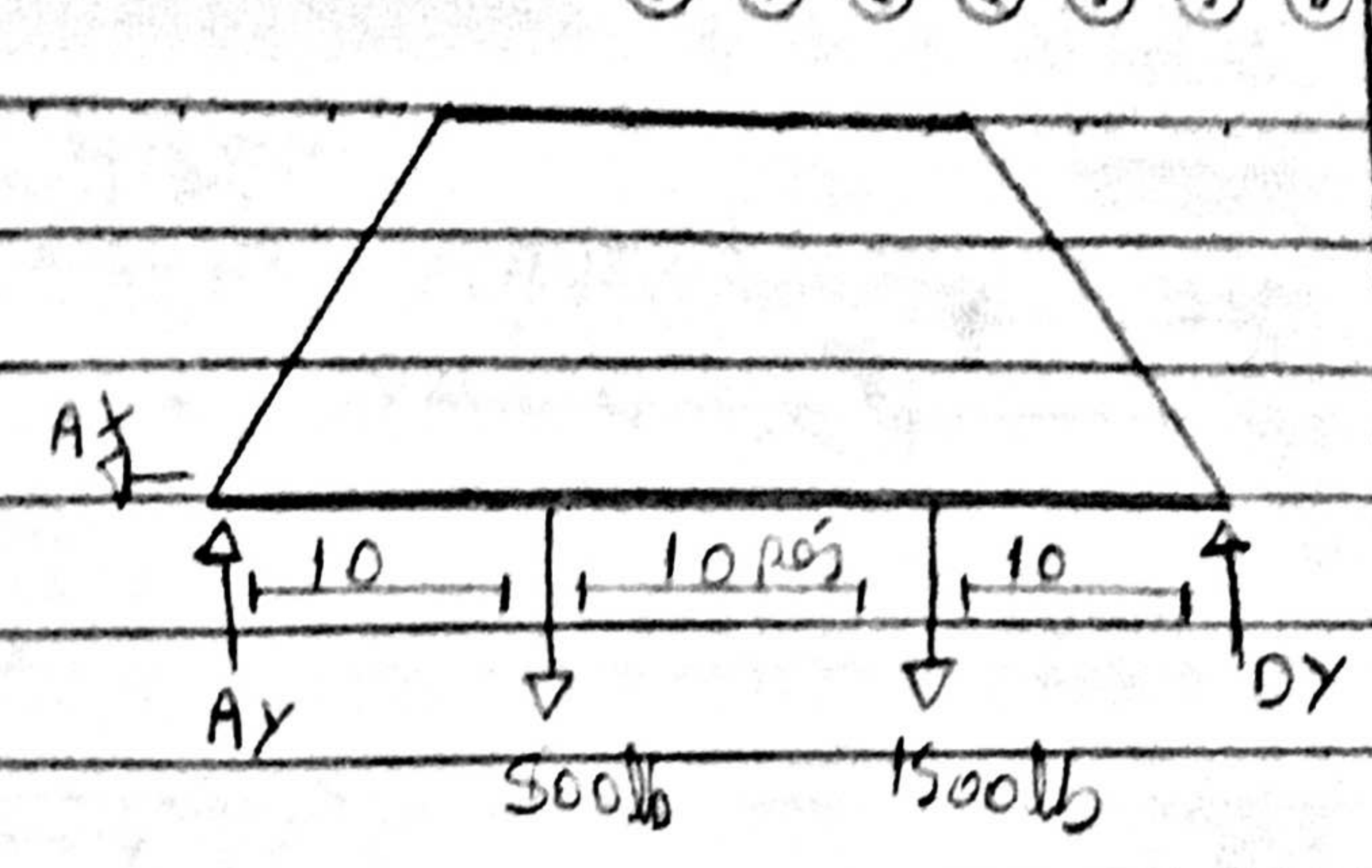
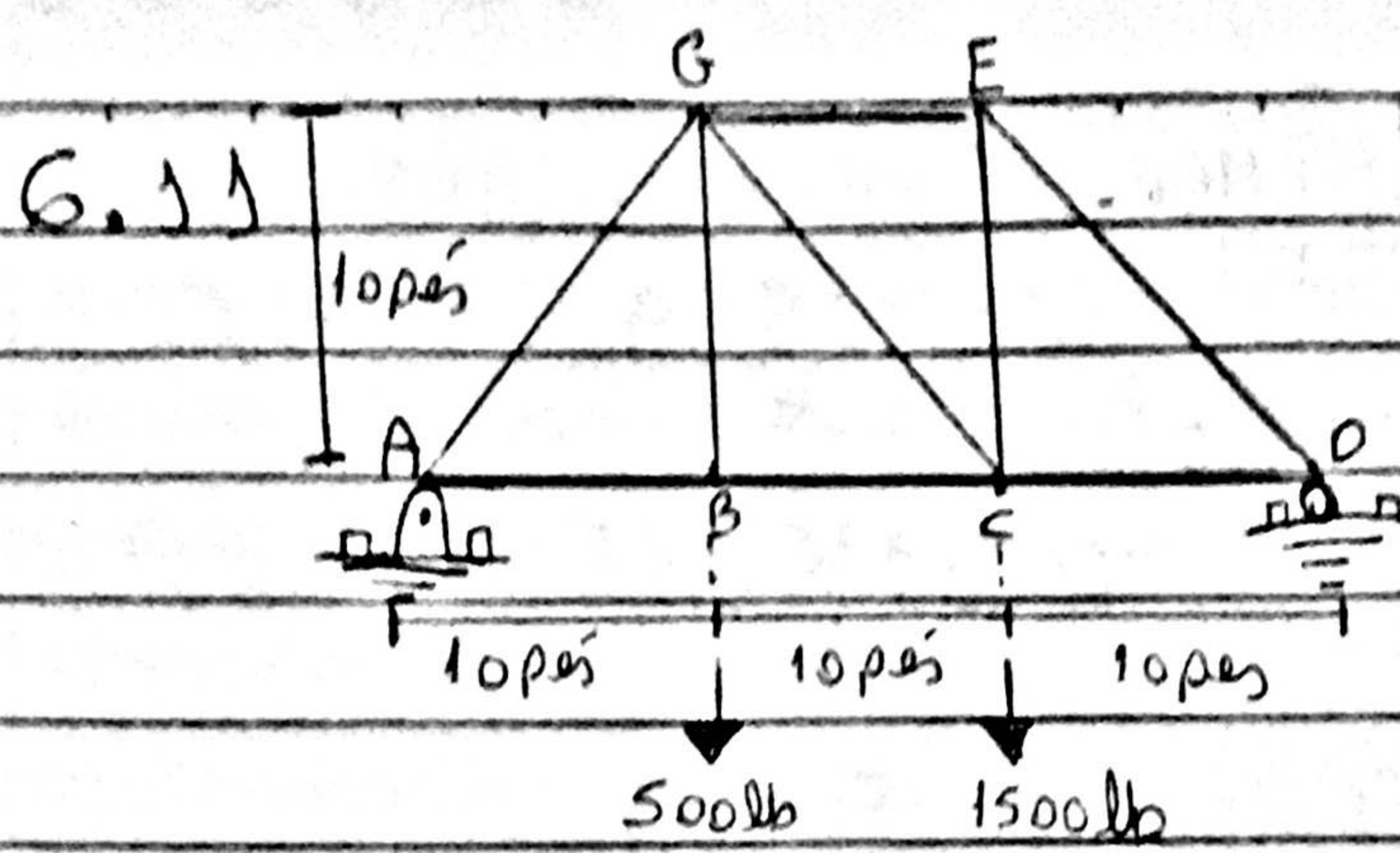


(7.67) Determine os diagramas de esforço cortante e de momento fletor para a viga com extremidade em balanço.



(7.120) Determine os diagramas de esforço cortante e de momento fletor para a viga.





$A_x = 0$

$\sum M_D = 0; -A_y(30) + 500(20) + 1500(10) = 0$

$A_y = 833,33 \text{ lb. pes}$

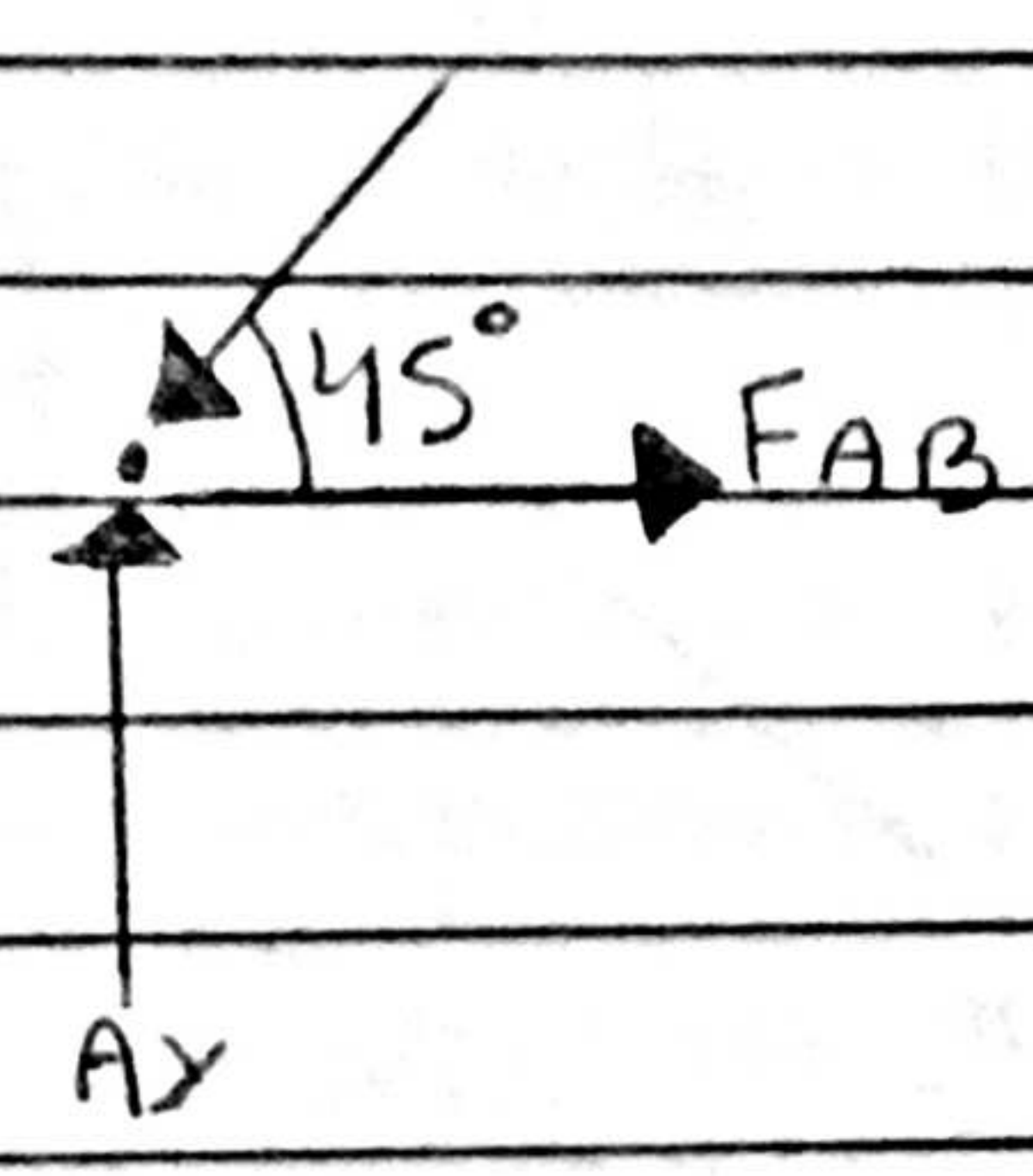
$\sum F_y = 0; 833,33 - 500 - 1500 + D_y = 0$

$D_y = 1166,67 \text{ lb}$

Nó A

$\sum F_y = 0; 833,33 - F_{AG}(\sin 45) = 0$

$F_{AG} = 1178,5 \text{ lb C}$



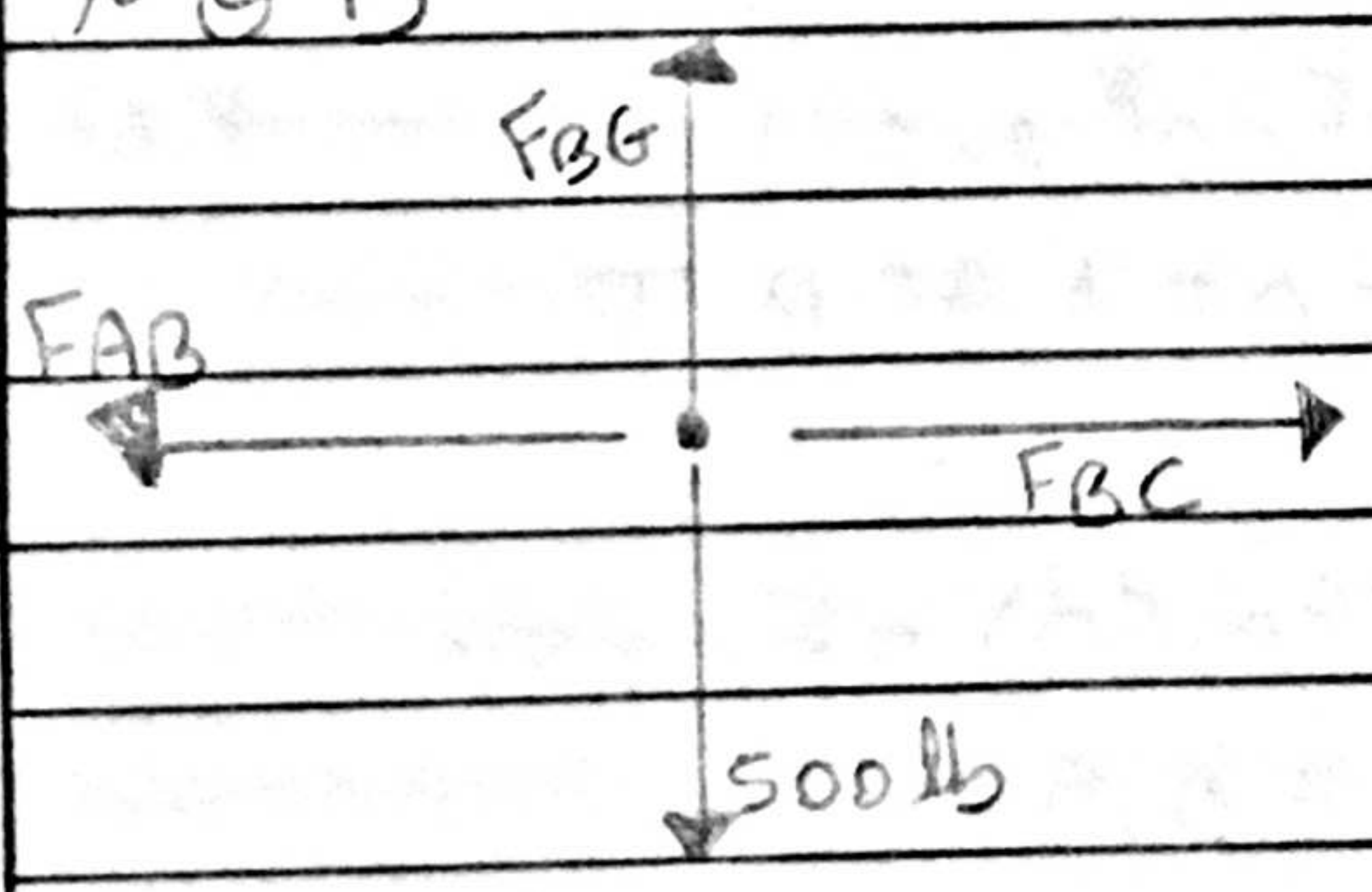
$\sum F_x = 0; -F_{AG}(\cos 45) + F_{AB} = 0$

$F_{AB} = 833,3 \text{ lb T}$

Nó B

$\sum F_y = 0; -500 + F_{BG} = 0$

$F_{BG} = 500 \text{ lb T}$



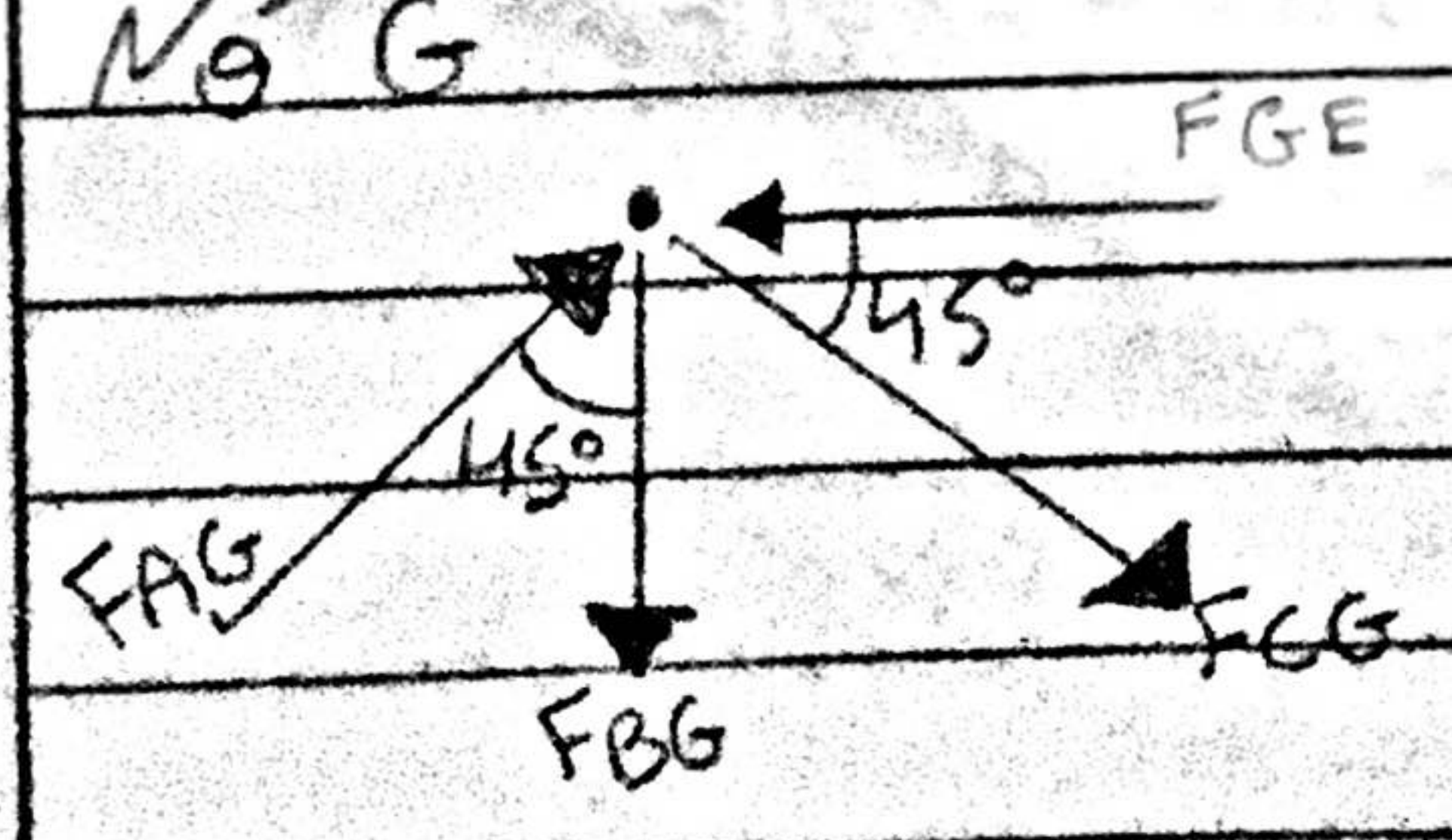
$\sum F_x = 0; -833,3 + F_{BC} = 0$

$F_{BC} = 833,3 \text{ lb T}$

Nó G

$\sum F_y = 0; F_{AG}(\sin 45) - F_{BG} - F_{CG}(\sin 45) = 0$

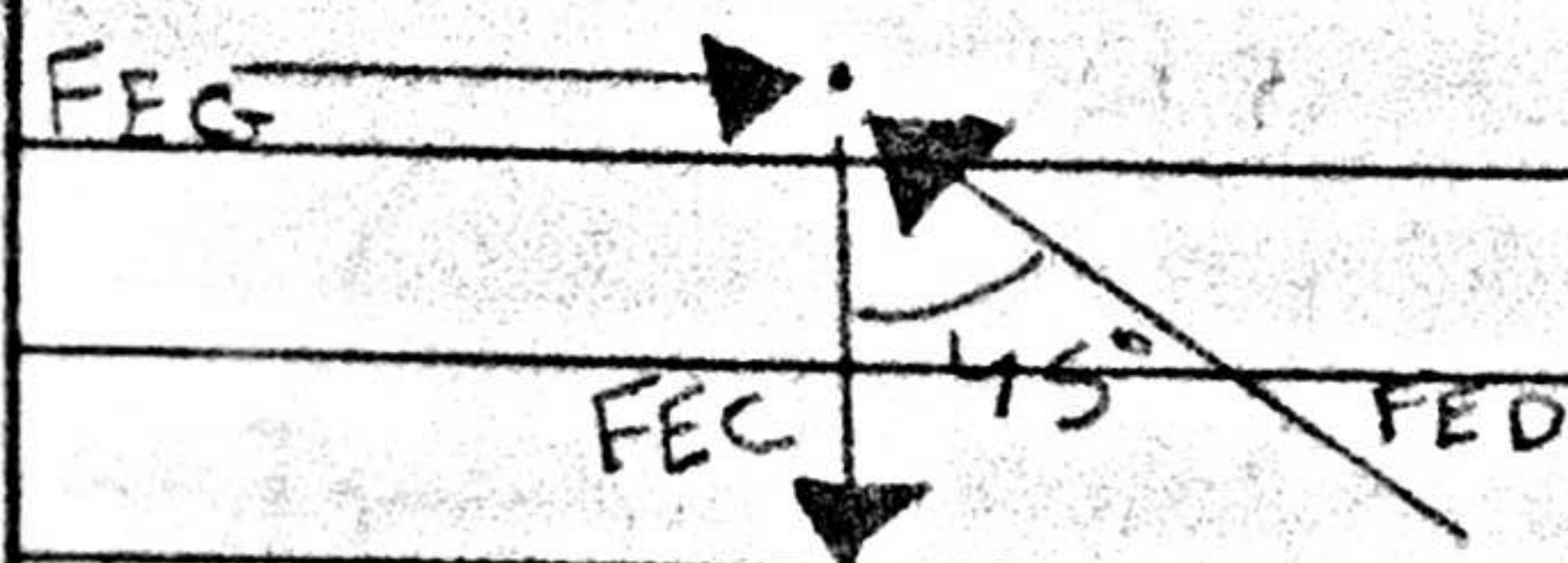
$F_{CG} = 471,39 \text{ lb T}$



$\sum F_x = 0; F_{AG}(\cos 45) + F_{CG}(\cos 45) - F_{GE} = 0$

$F_{GE} = 1166,64 \text{ lb C}$

Nó E



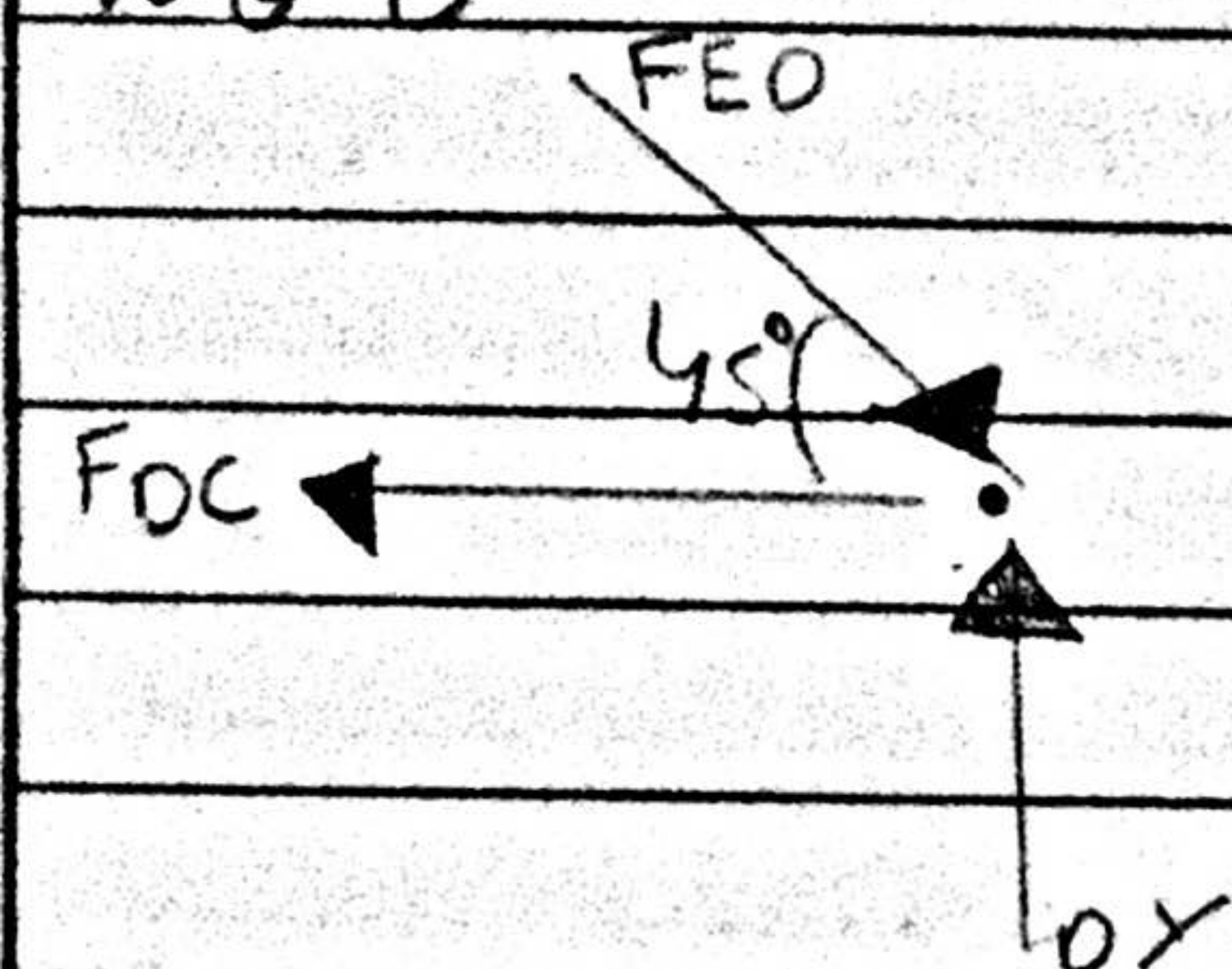
$$\sum F_x = 0; 1166,64 - F_{ED}(\cos 45) = 0$$

$$F_{ED} = 1649,87 \text{ lb C}$$

$$\sum F_y = 0; F_{ED}(\sin 45) - F_{EC} = 0$$

$$F_{EC} = 1166,63 \text{ T}$$

Nó D



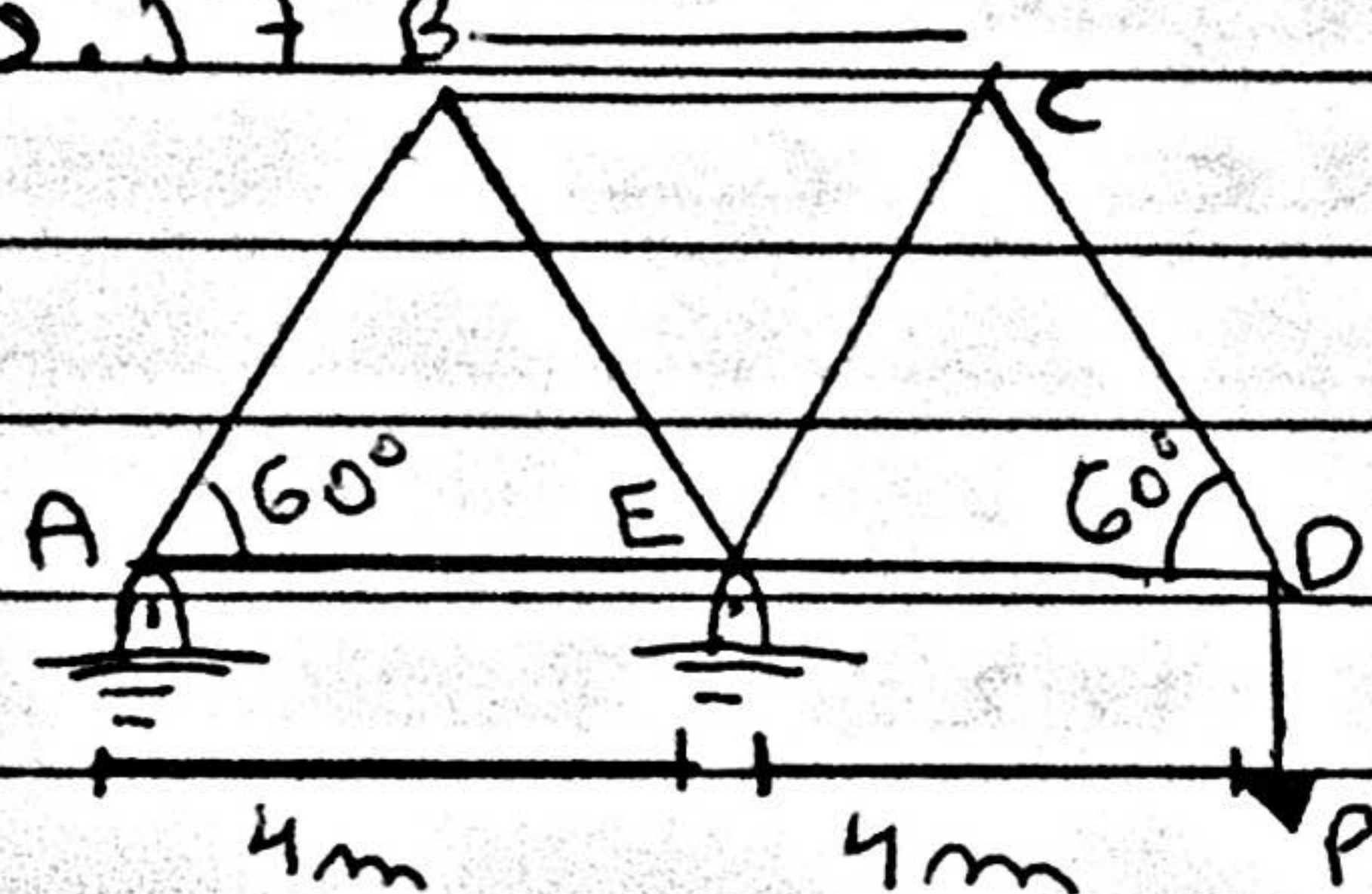
$$\sum F_x = 0; F_{ED}(\cos 45) - F_{DC} = 0$$

$$F_{DC} = 1166,63 \text{ T}$$

$$\sum F_y = 0; -F_{ED}(\sin 45) + D_y = 0$$

$$D_y = 1166,63 \text{ lb}$$

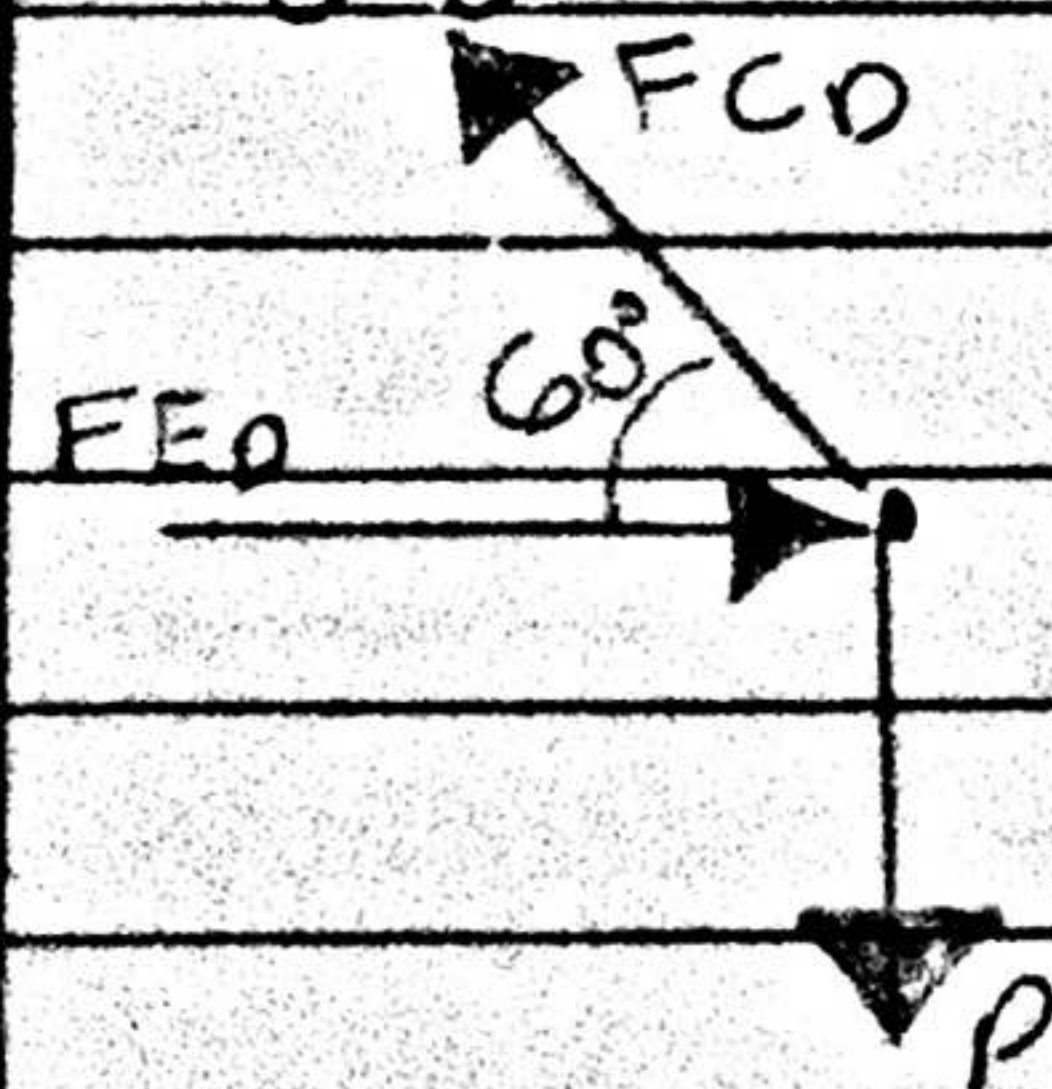
6.17



$$T \leq 8 \text{ kN}$$

$$C \leq 6 \text{ kN}$$

Nó D



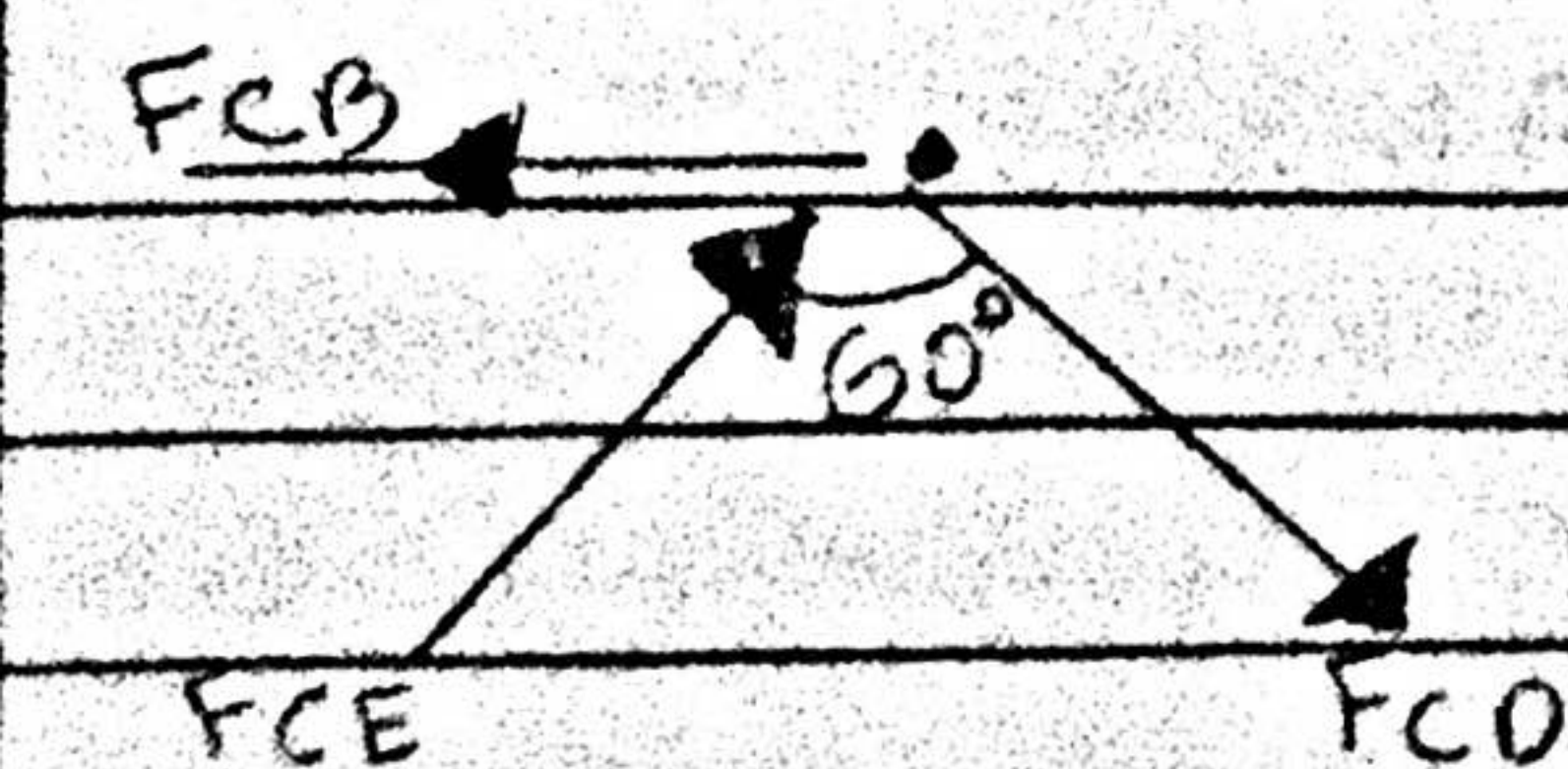
$$\sum F_y = 0; -P + F_{CD}(\sin 60) = 0$$

$$F_{CD} = 1,15P \text{ T}$$

$$\sum F_x = 0; -1,15P(\cos 60) + F_{ED} = 0$$

$$F_{ED} = 0,575P \text{ C}$$

Nó C



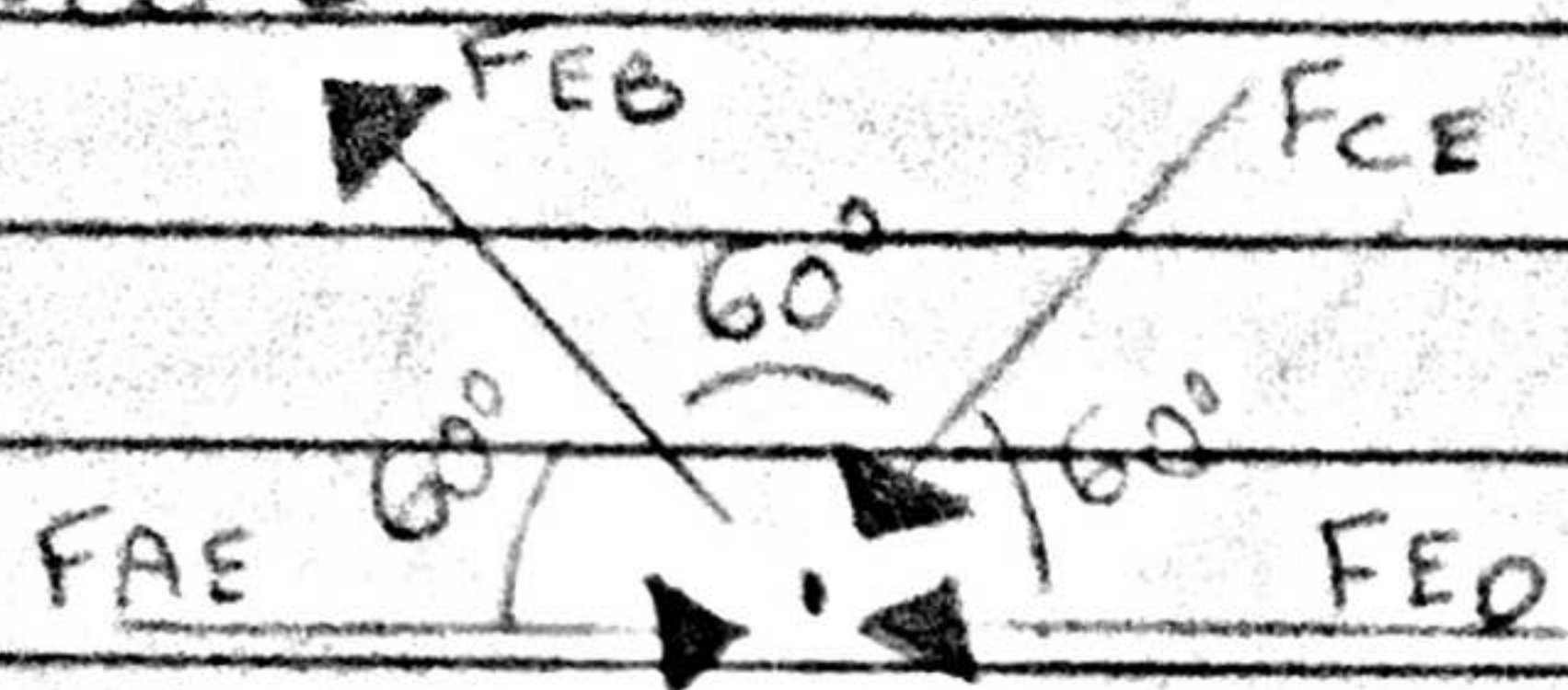
$$\sum F_y = 0; -1,15P(\cos 30) + F_{CE}(\cos 30) = 0$$

$$F_{CE} = 1,15P \text{ C}$$

$$\sum F_x = 0; 1,15P(\sin 30) + 1,15P(\sin 30) - F_{CB} = 0$$

$$F_{CB} = 1,15 \text{ T}$$

MAE



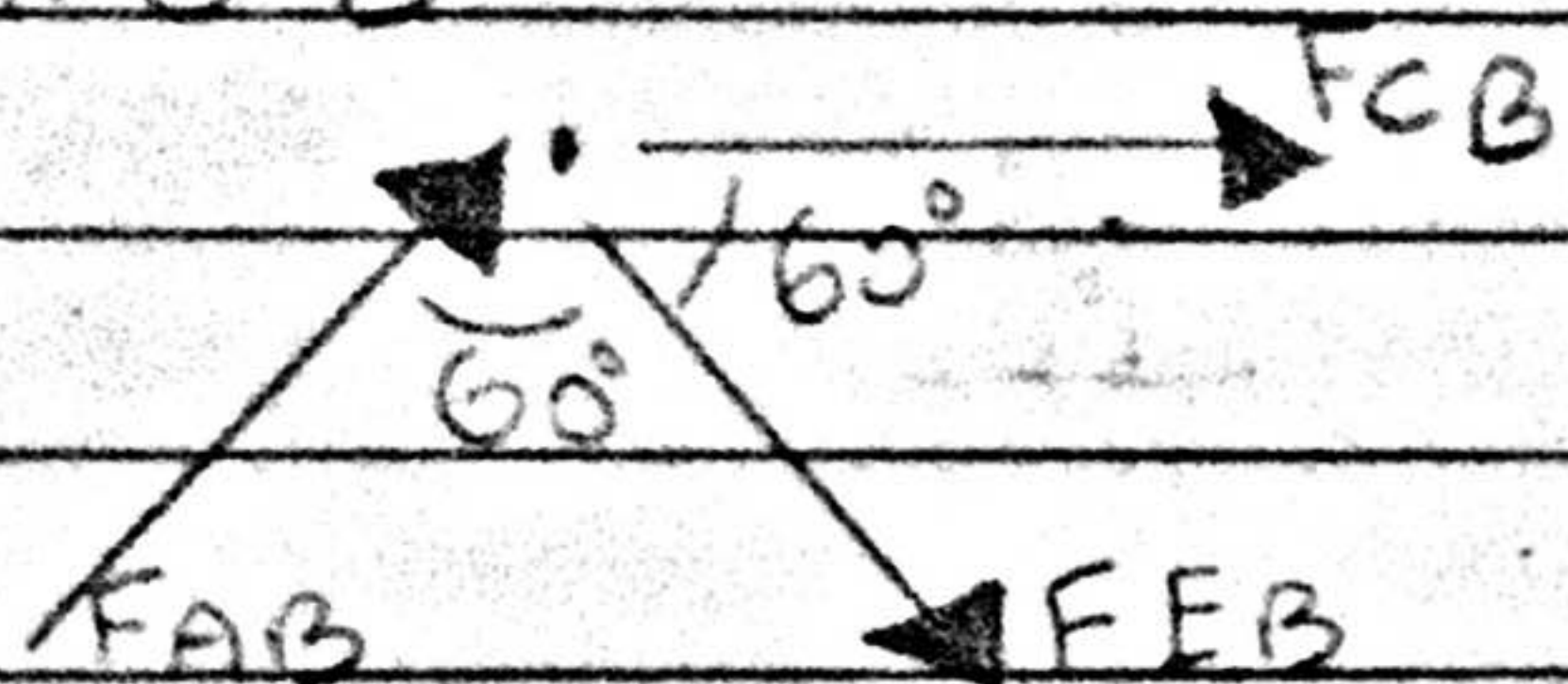
$$\sum F_y = 0; -1,15P(\sin 60) + F_{EB}(\sin 60) = 0$$

$$F_{EB} = 1,15P \text{ T}$$

$$\sum F_x = 0; -0,575 + F_{AE} - 1,15P(\cos 60) - 1,15P(\cos 60) = 0$$

$$F_{AE} = 1,725 \text{ C}$$

NB



$$\sum F_y = 0; -1,15P(\sin 60) + F_{AB}(\cos 30) = 0$$

$$F_{AB} = 1,15P \text{ C}$$

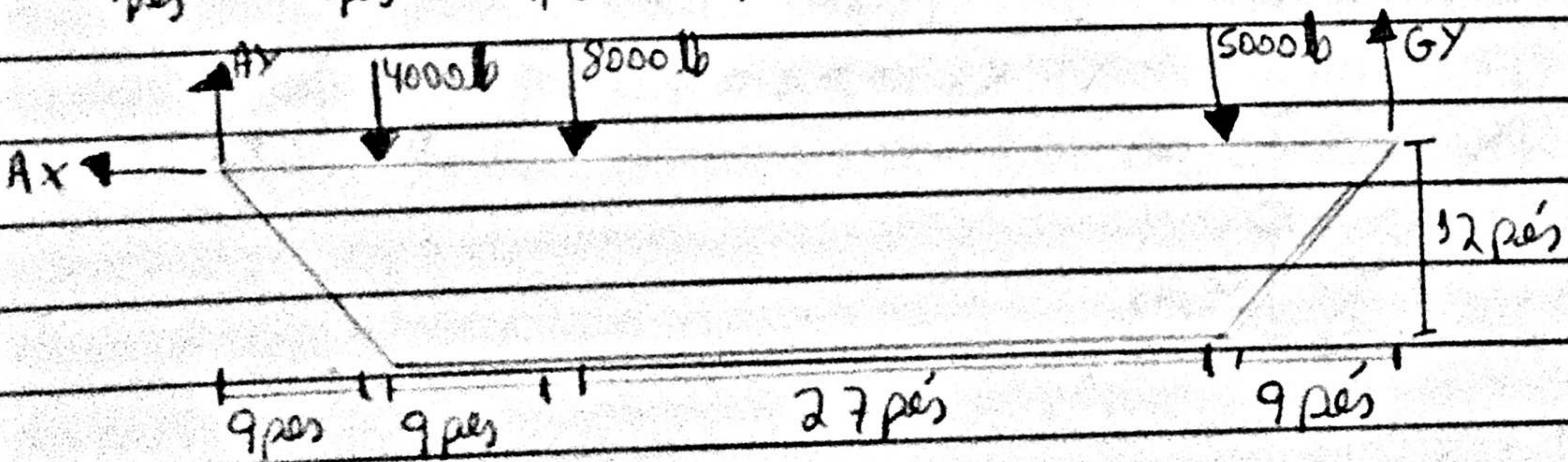
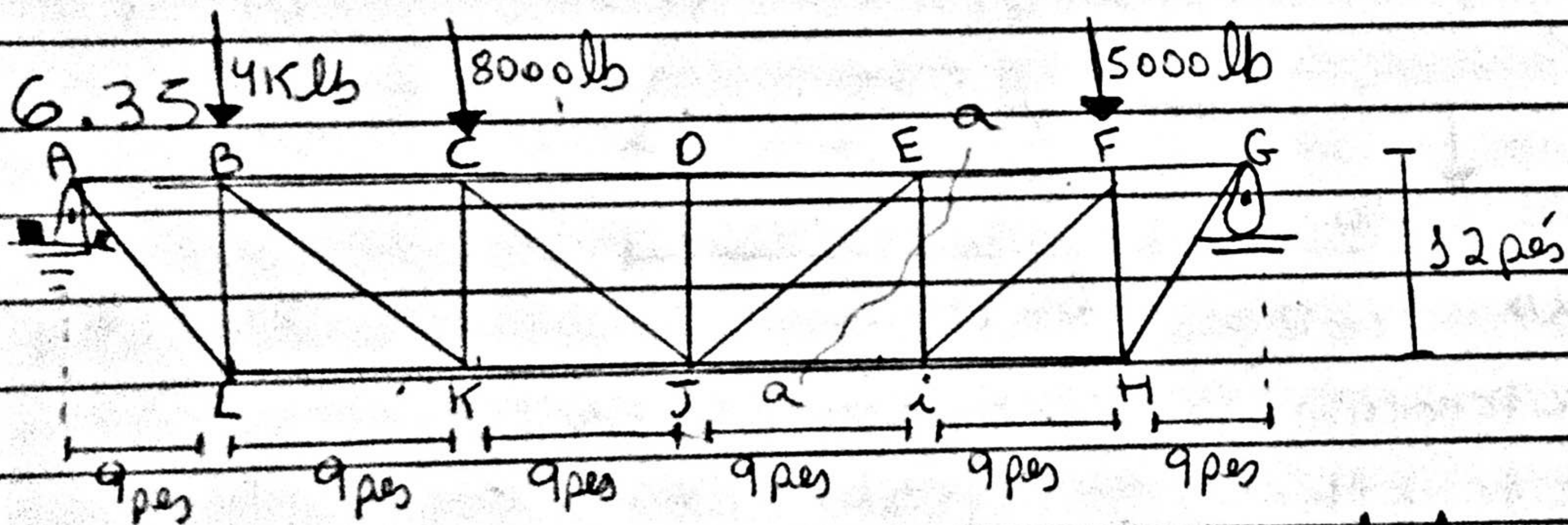
$$1,15P = 8$$

$$1,15P = 6$$

$$P_{\max} = 5,20 \text{ KN}$$

$$P = 6,95 \text{ KN}$$

$$P = 5,20 \text{ KN}$$



$$\sum M_A = 0; -4000(9) - 8000(18) - 5000(45) + G_y(54) = 0$$

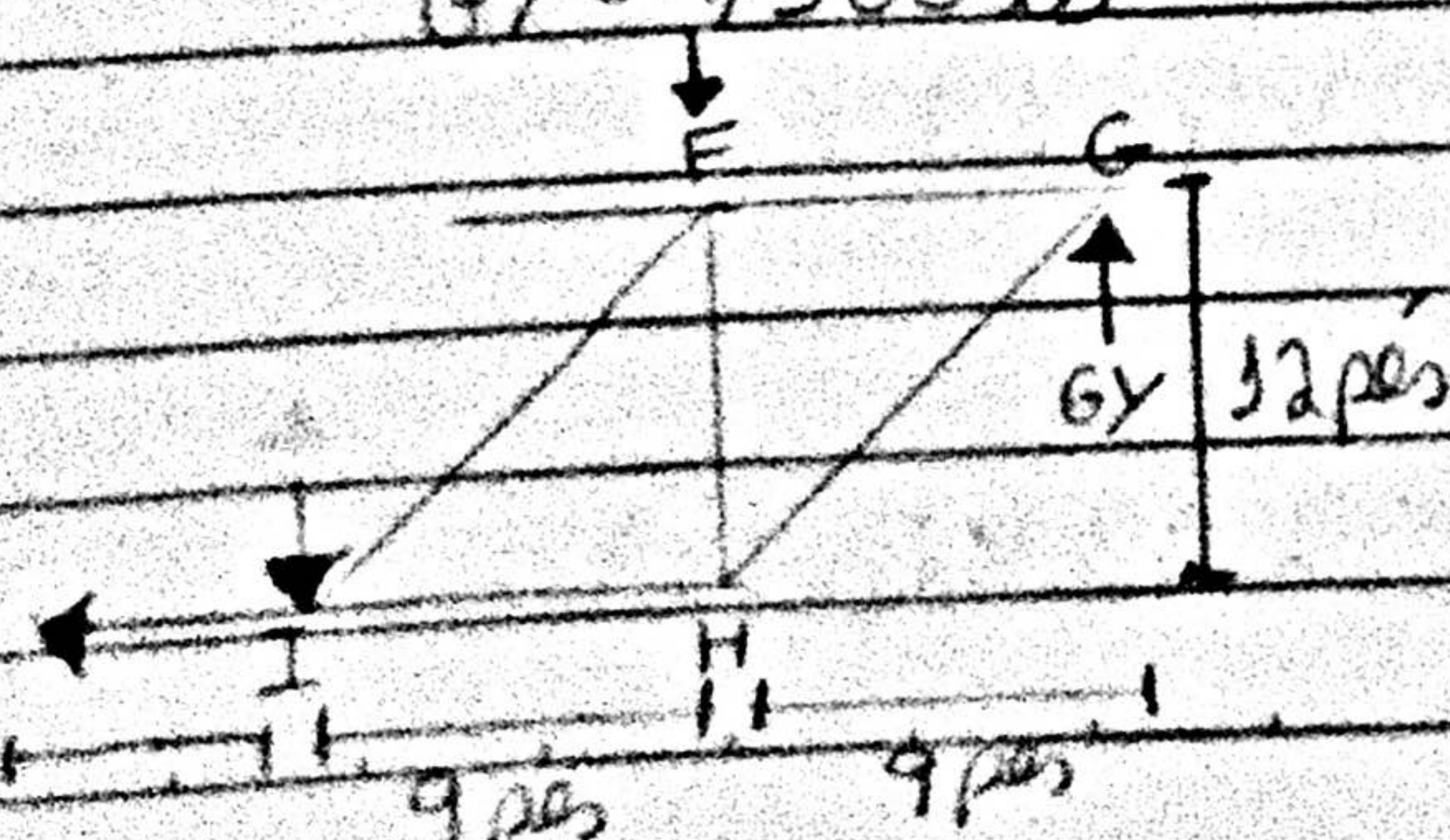
$$G_y = 7500 \text{ lb}$$

$$\sum F_y = 0; -5000 + 7500 - EI = 0$$

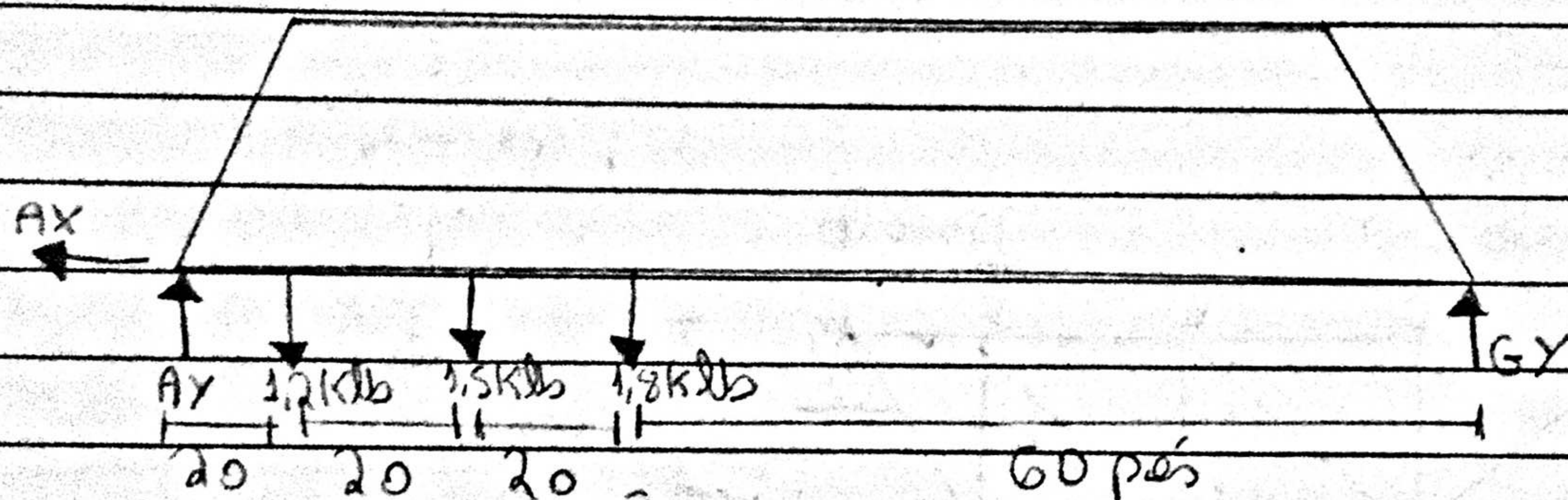
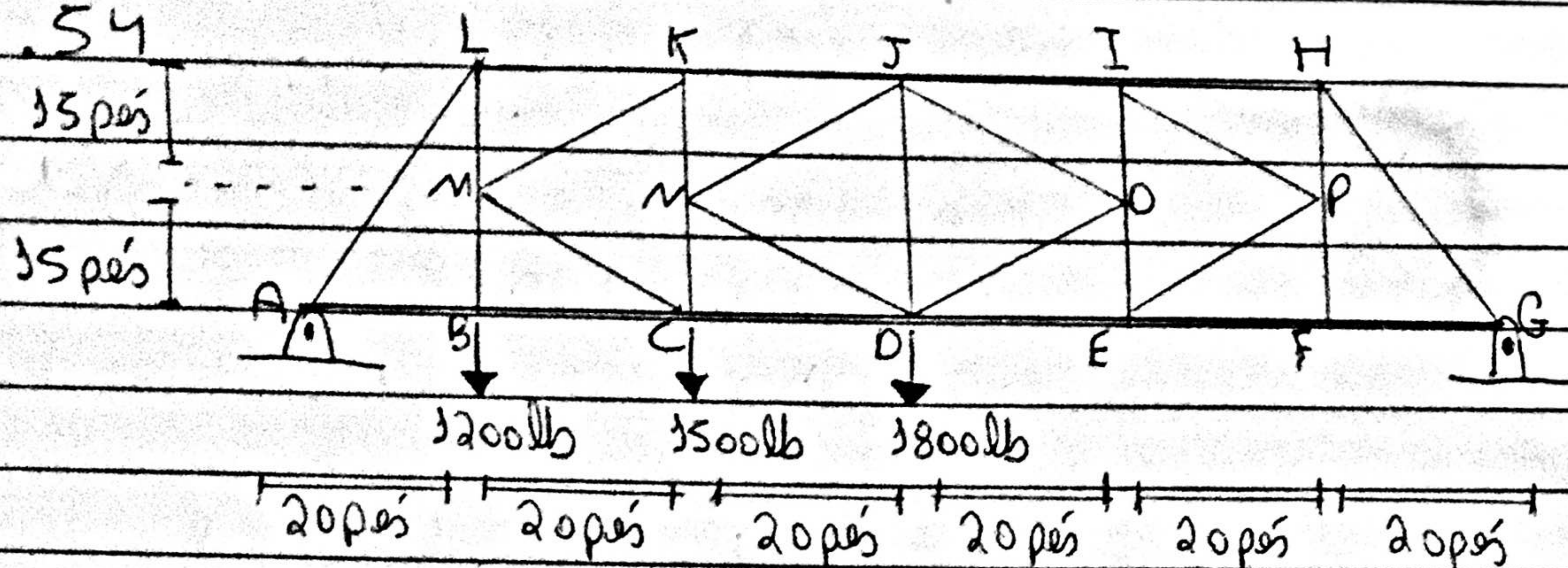
$$EI = 2500 \text{ lb} = 2,5 \text{ kip (C)}$$

$$\sum M_G = 0; 5000(9) + 2500(18) - JI(12) = 0$$

$$JI = 7500 \text{ lb} = 7,5 \text{ kip (T)}$$

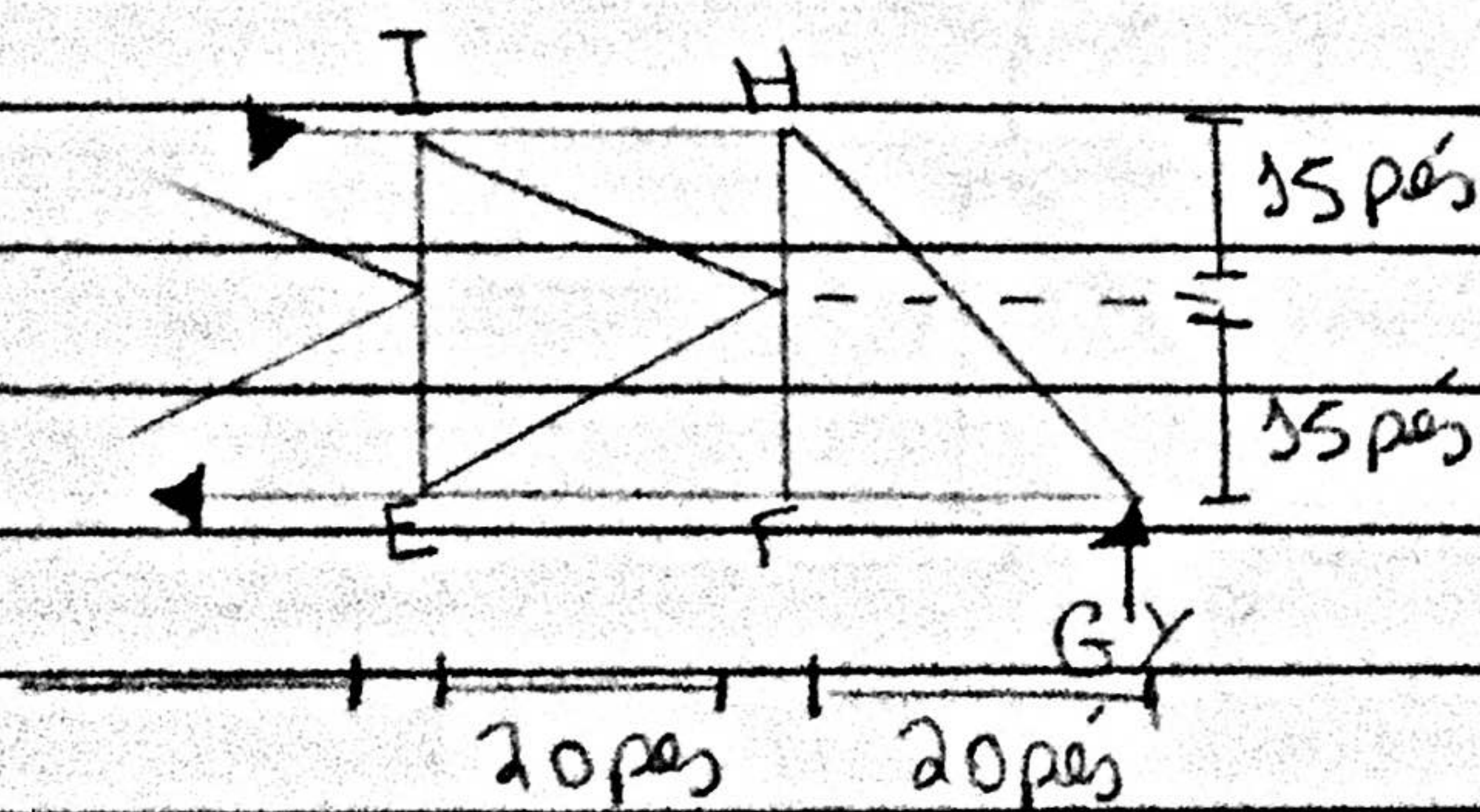


6.54



$$\sum M_A = 0; -1200(20) - 1500(40) - 1800(60) + G_y(120) = 0$$

$$G_y = 1600 \text{ lb}$$



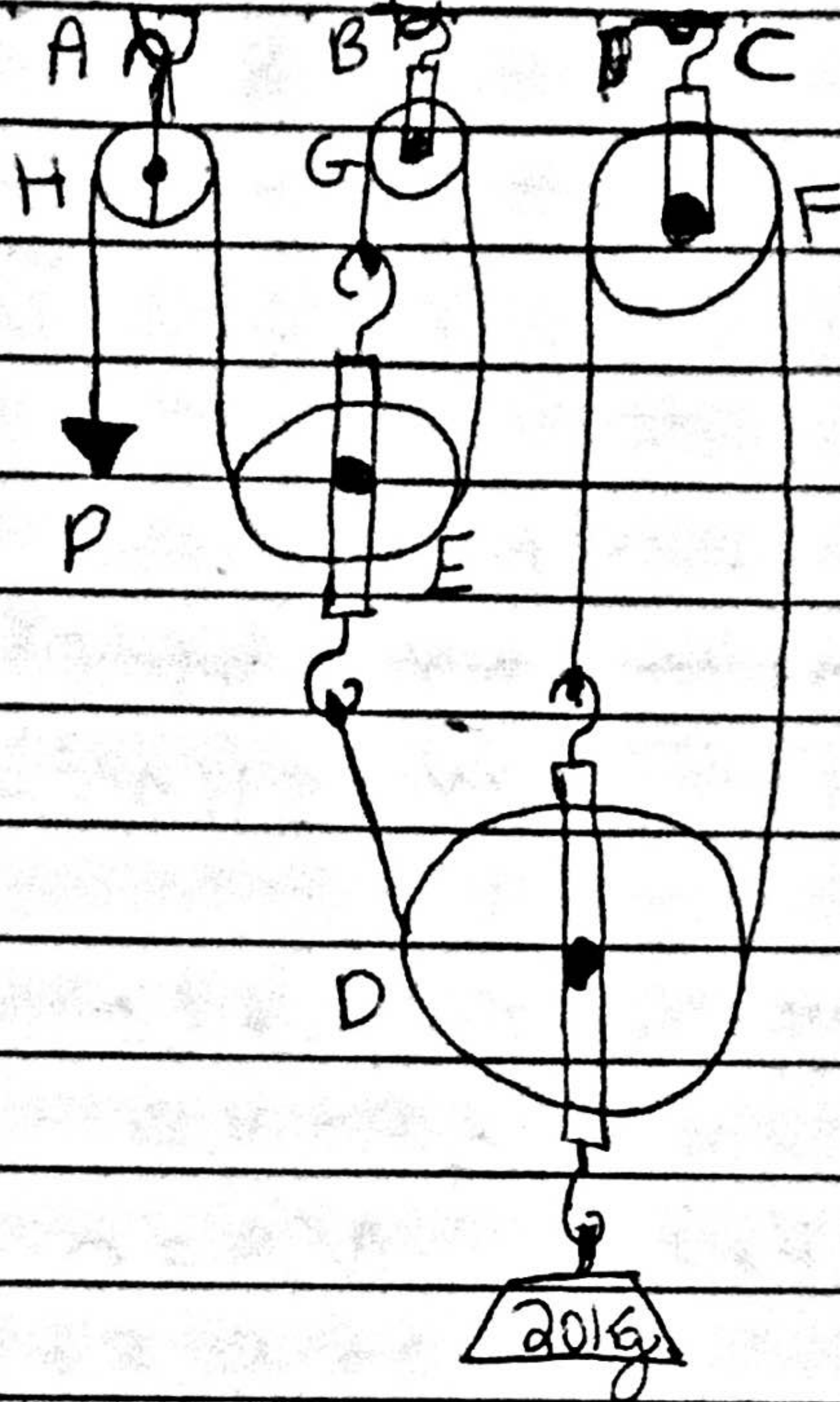
$$\sum M_E = 0; -15(30) + 1600(40) = 0$$

$$IJ = 2133.33 \text{ lb} = 2.13 \text{ kip (C)}$$

$$\sum M_I = 0; -ED(30) + 1600(40) = 0$$

$$ED = 2133.33 \text{ lb T} = 2.13 \text{ kip (T)}$$

6.71

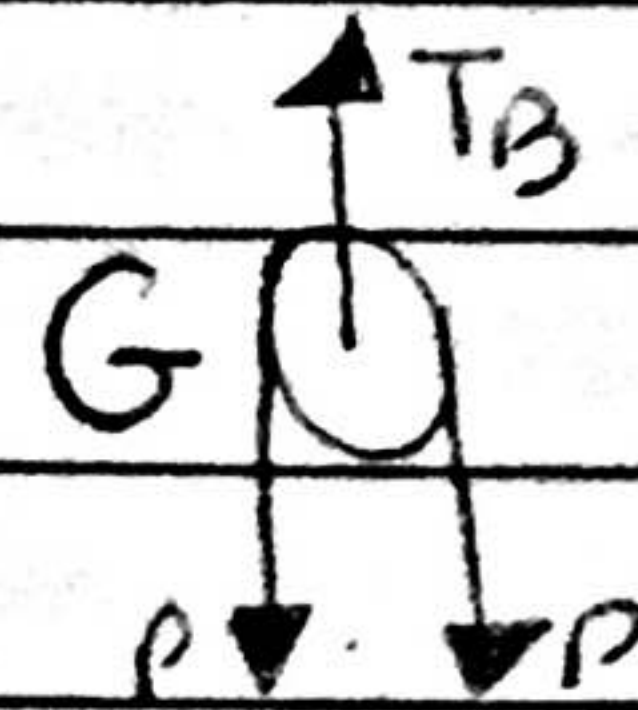


$$\sum F_y = 0; T_A - 2P = 0$$

$$T_A = 2P = 43,6 \text{ N}$$

$$20(9,81)$$

$$196,2 \text{ N}$$

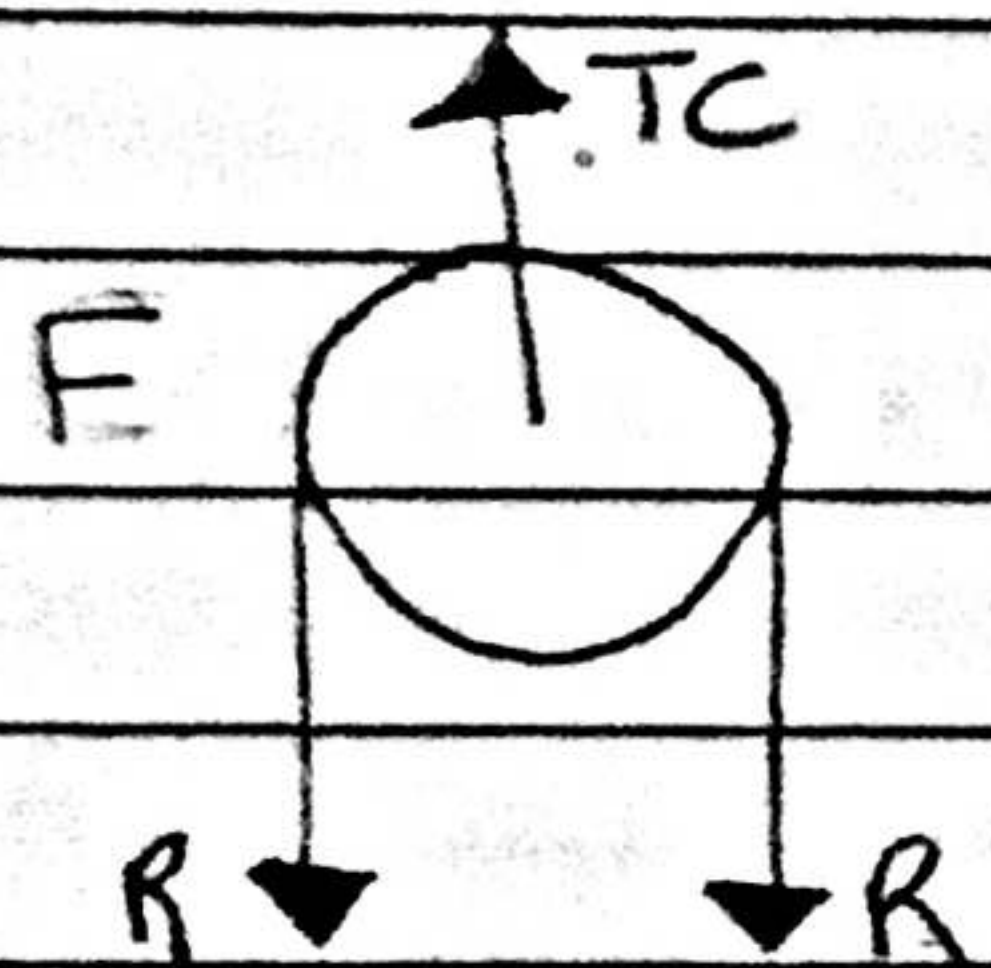


$$\sum F_y = 0;$$

$$T_B - 2P = 0$$

$$T_B = 2P = 43,6 \text{ N}$$

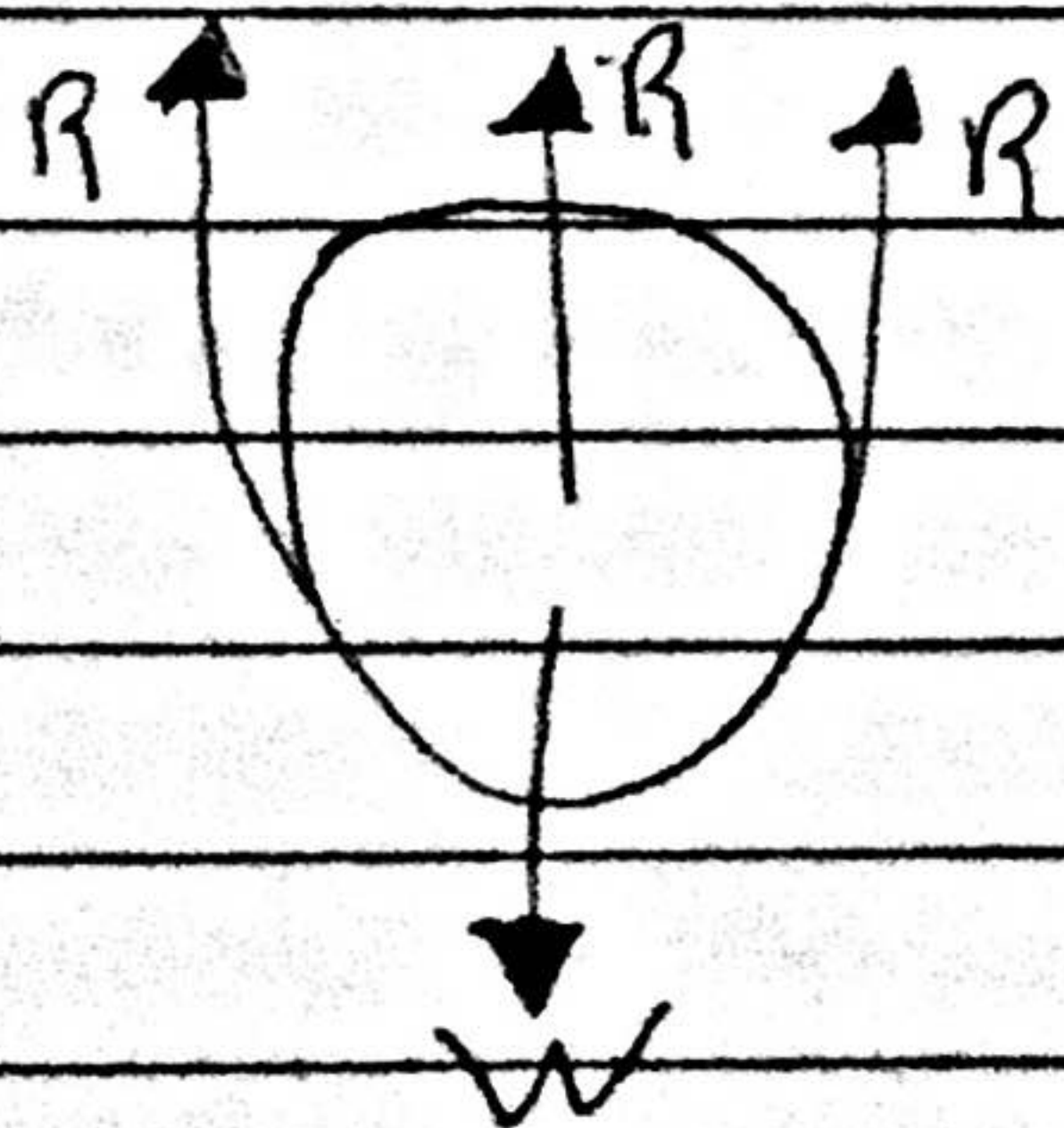
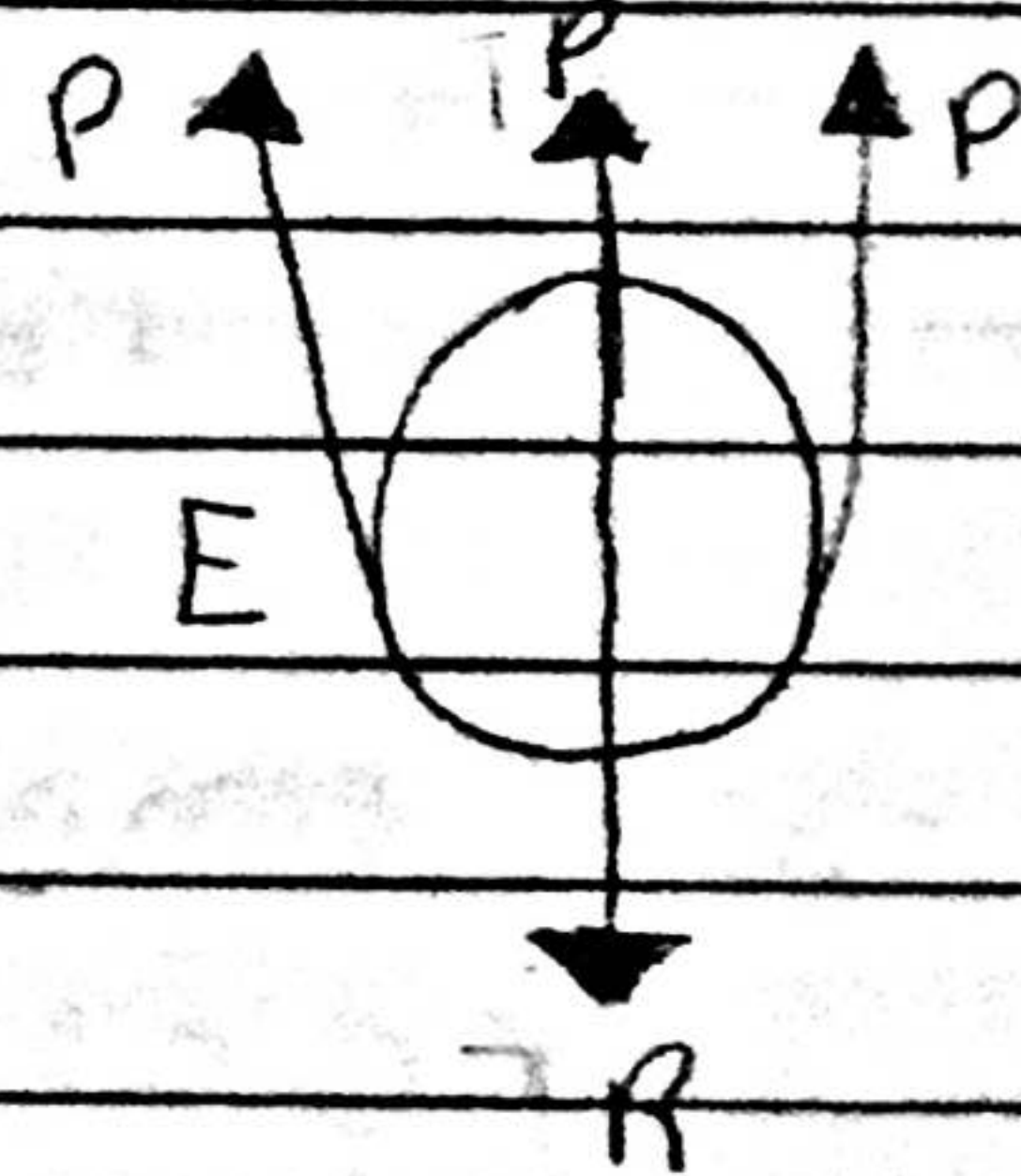
$$T_A = T_B$$



$$\sum F_y = 0; T_C - 2R = 0$$

$$T_C = 2R$$

$$T_C = 130,8 \text{ N}$$



$$\sum F_y = 0; 3R - W = 0$$

$$3R = 196,2$$

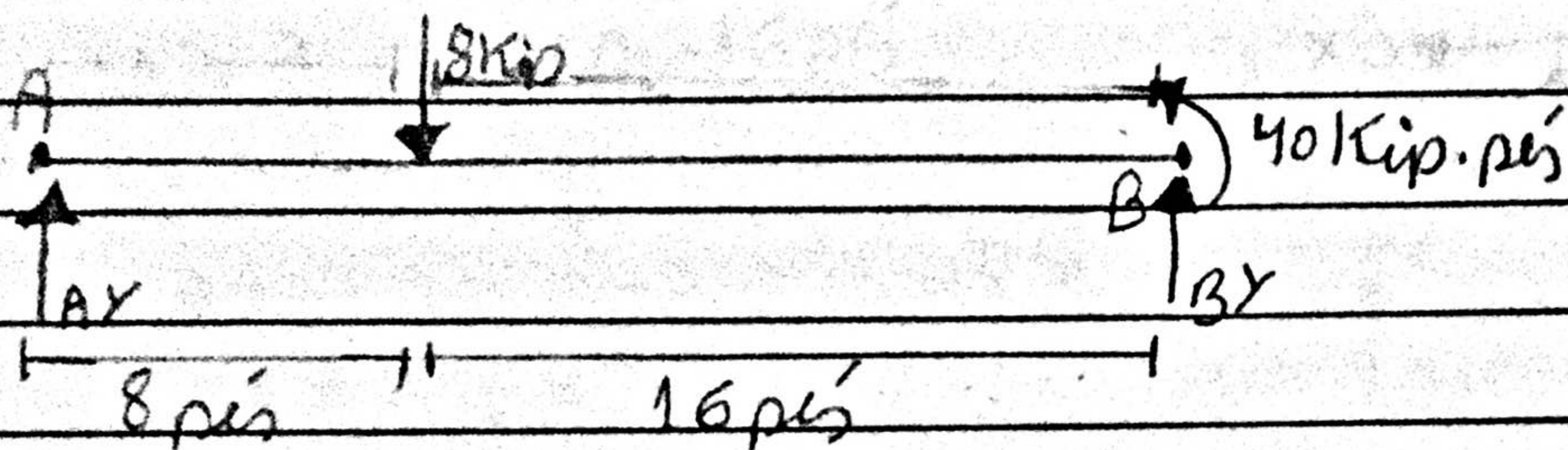
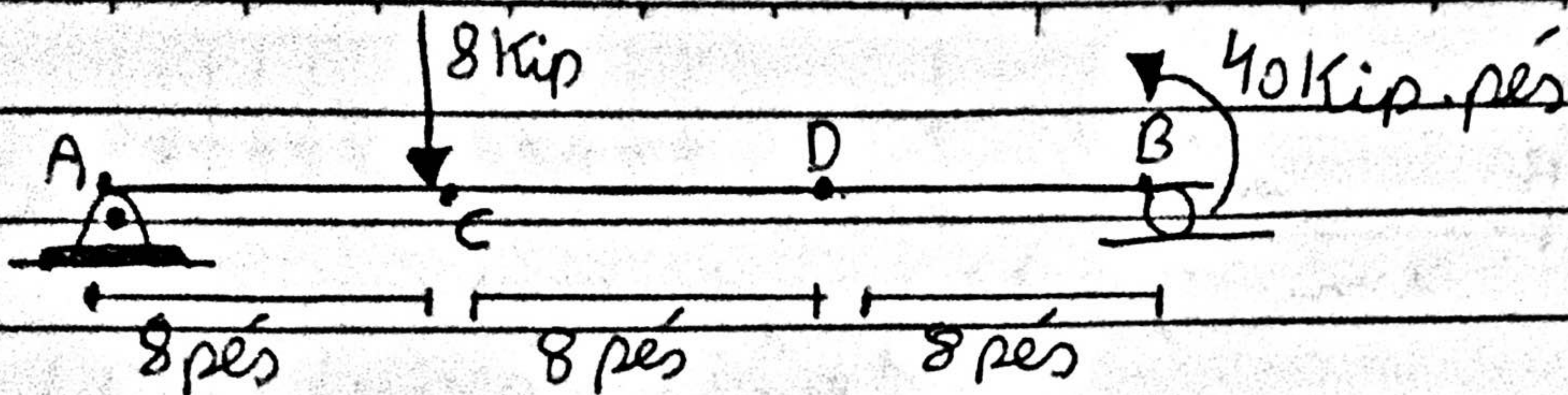
$$R = 65,4 \text{ N}$$

$$\sum F_y = 0; 3P - R = 0$$

$$R = 3P$$

$$P = \underline{\underline{21,8 \text{ N}}}$$

7.6

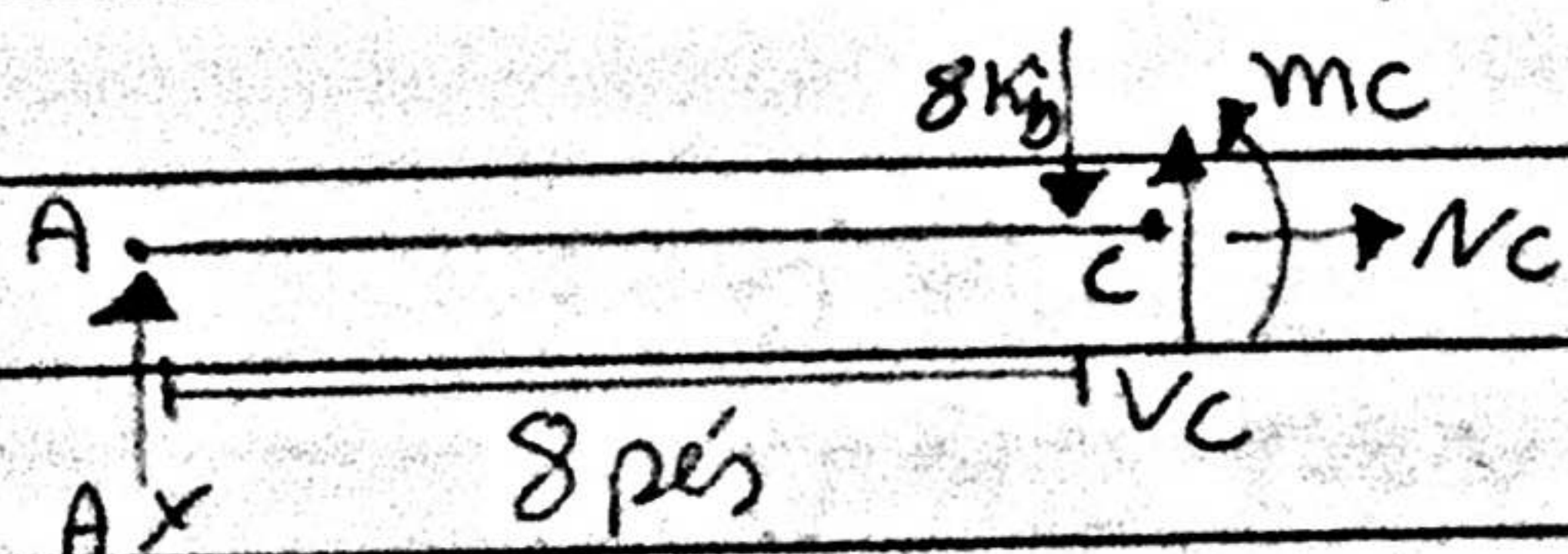


$$\sum M_A = 0; -8(8) + 40 + B_Y(24) = 0$$

$$B_Y = 1 \text{ Kip} \cdot \text{ft}$$

$$\sum F_Y = 0; A_Y - 8 + 1 = 0$$

$$A_Y = 7 \text{ Kip}$$



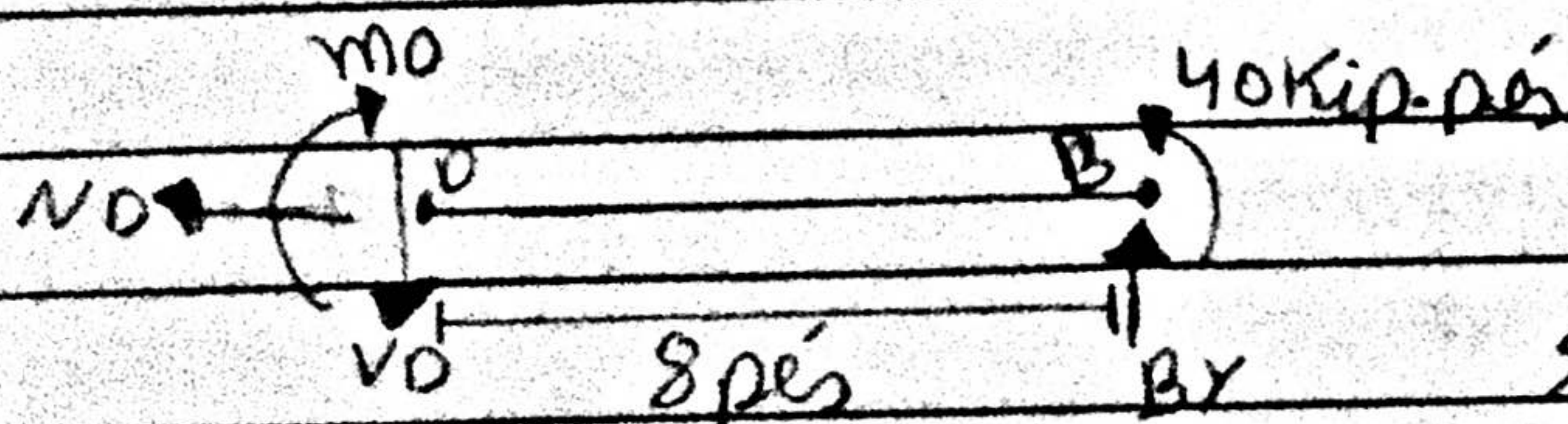
$$\sum F_Y = 0; 7 - 8 + V_C = 0$$

$$V_C = 1 \text{ Kip}$$

$$\sum F_X = 0; N_C = 0$$

$$\sum M_C = 0; -7(8) + M_C = 0$$

$$M_C = 56 \text{ Kip} \cdot \text{ft}$$



$$\sum F_Y = 0; 1 - V_D = 0$$

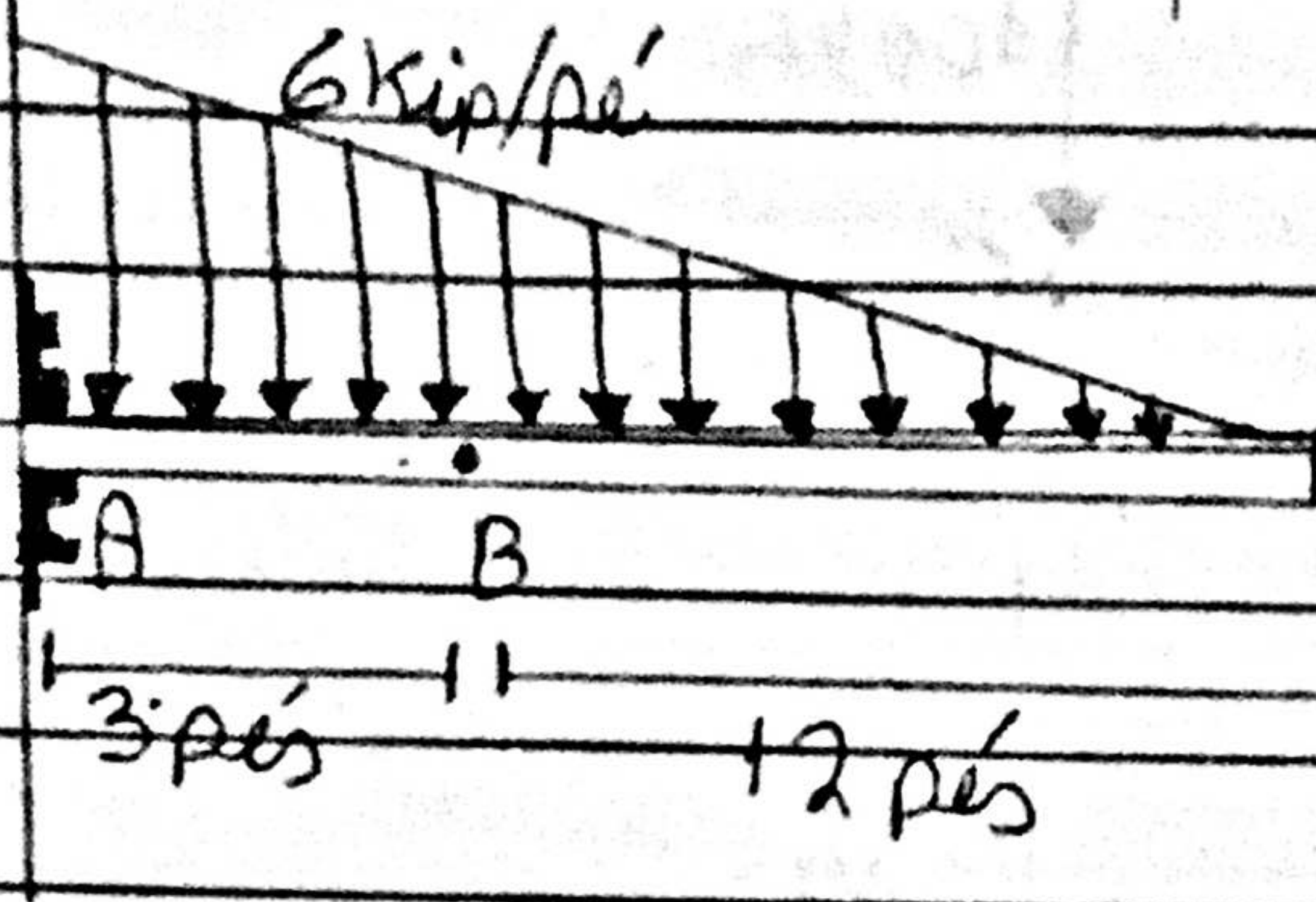
$$V = 1 \text{ Kip}$$

$$\sum F_X = 0; N_D = 0$$

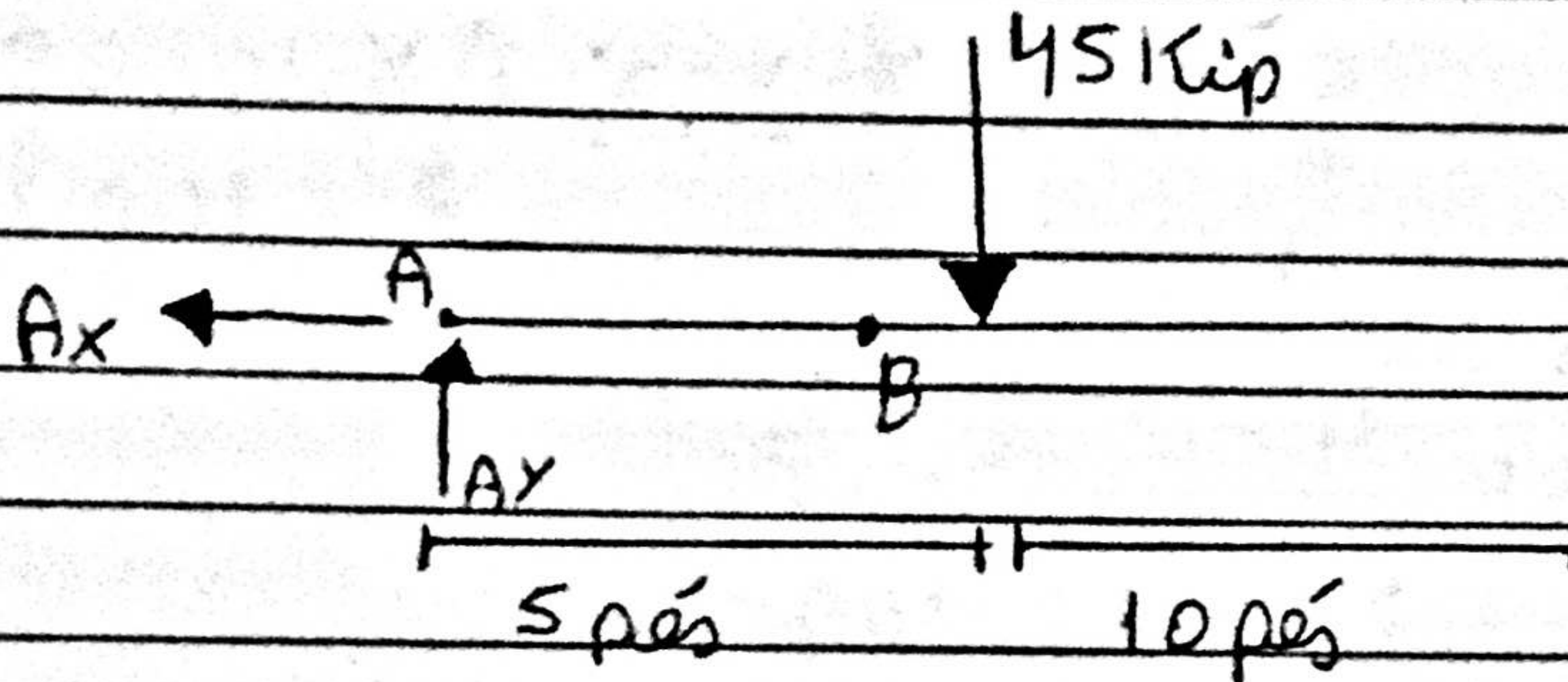
$$\sum M_D = 0; 1(8) + 40 - M_D = 0$$

$$M_D = 48 \text{ Kip} \cdot \text{ft}$$

7.2)



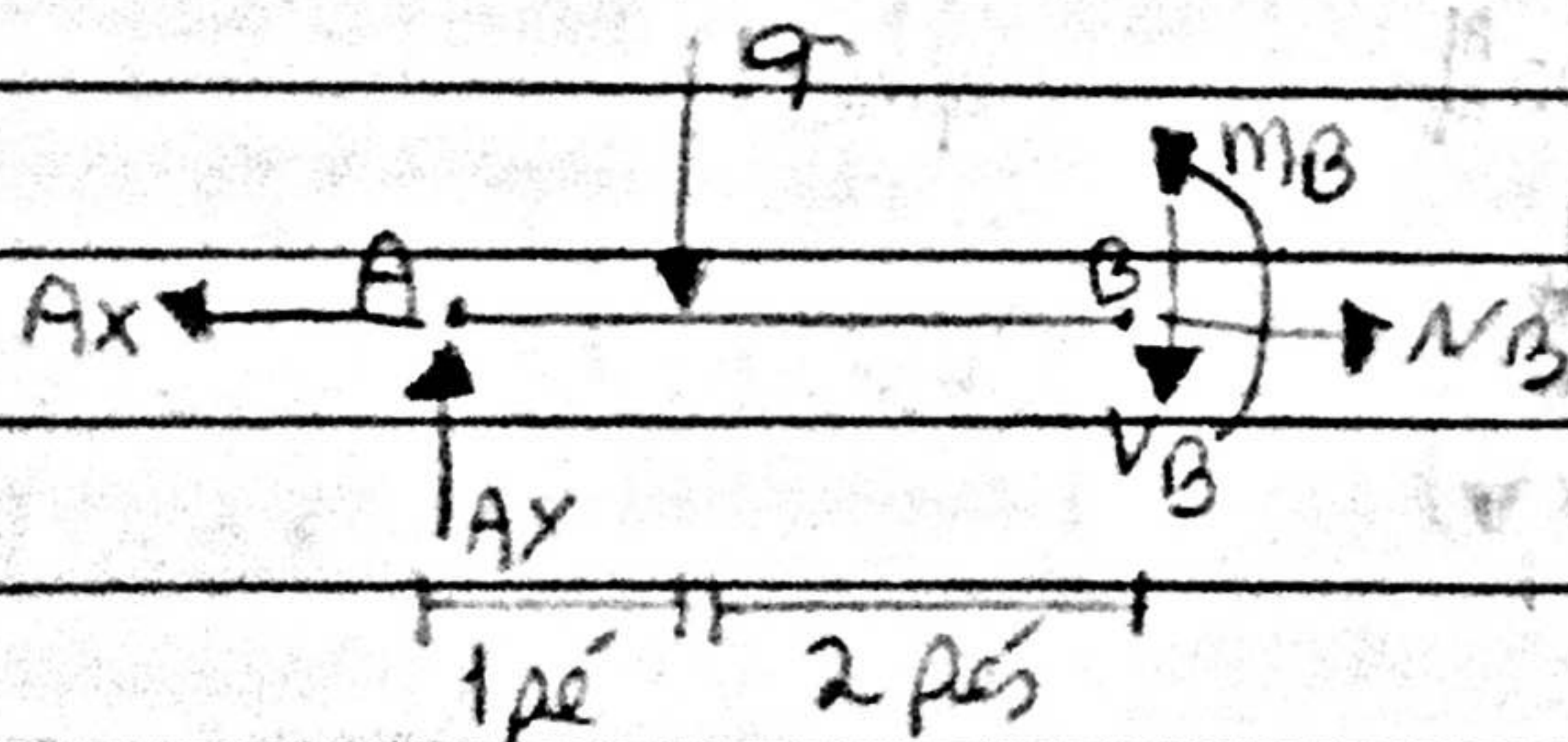
$$\frac{6 \cdot 15}{2} = 45$$



$$A_x = 0$$

$$\sum F_y = 0; \quad A_y - 45 = 0$$

$$A_y = 45 \text{ kip}$$



$$\frac{6 \cdot 3}{2} = \frac{18}{2} = 9$$

$$\sum F_y = 0; \quad 45 - 9 - V_B = 0$$

$$V_B = 36 \text{ kip}$$

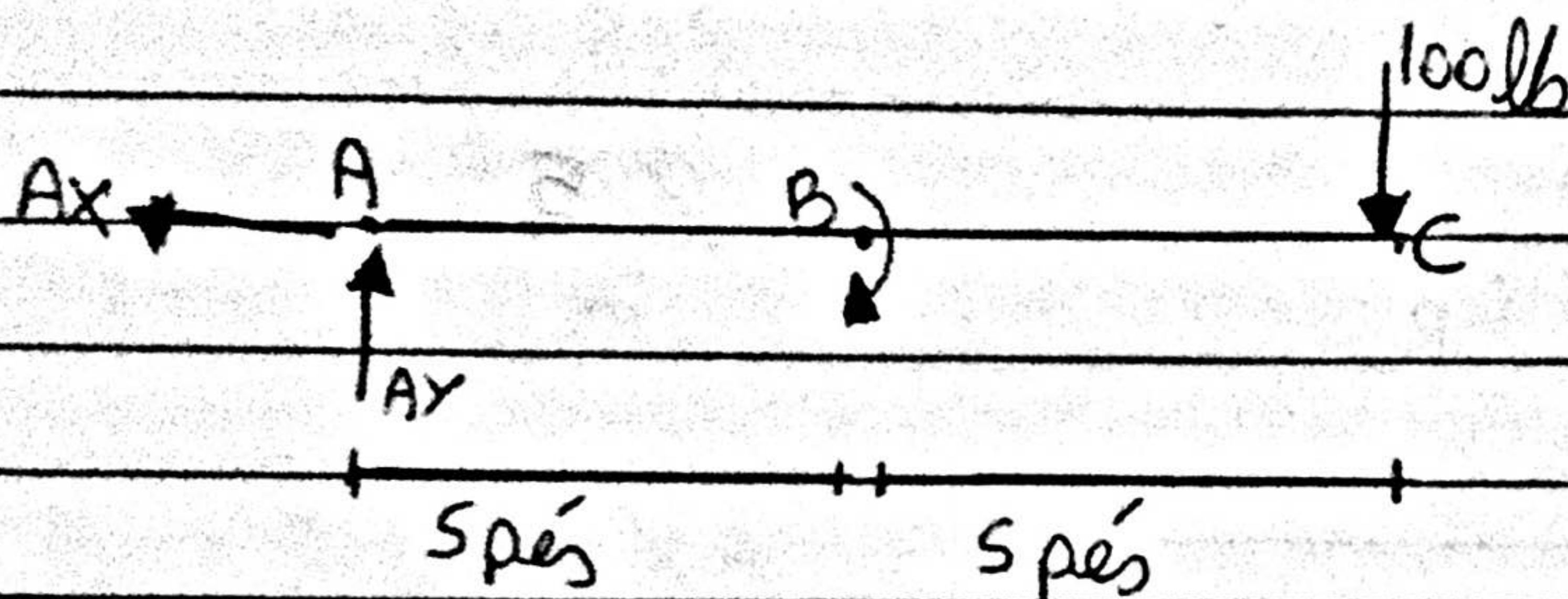
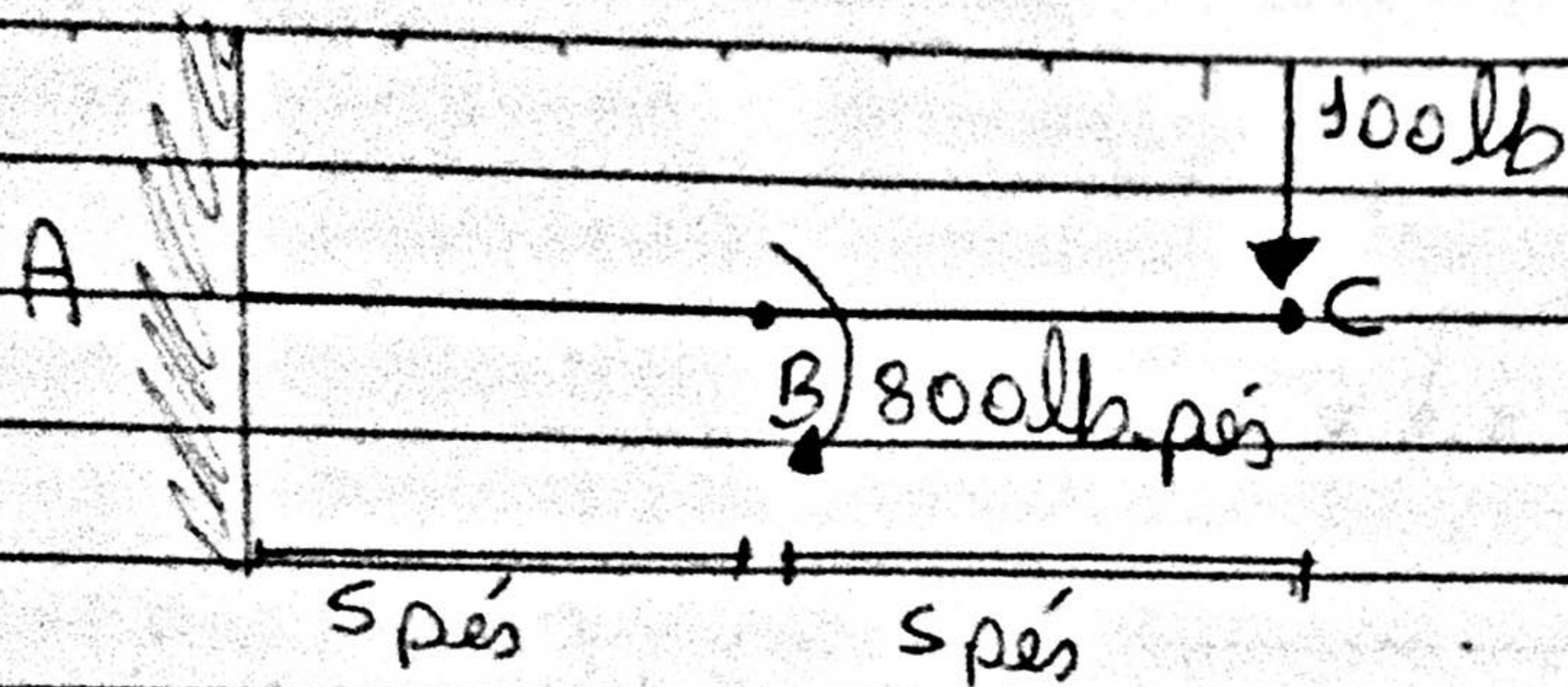
$$\sum F_x = 0; \quad -A_x + N_B = 0$$

$$N_B = 0$$

$$\sum M = 0; \quad -45(3) + 9(2) + M_B = 0$$

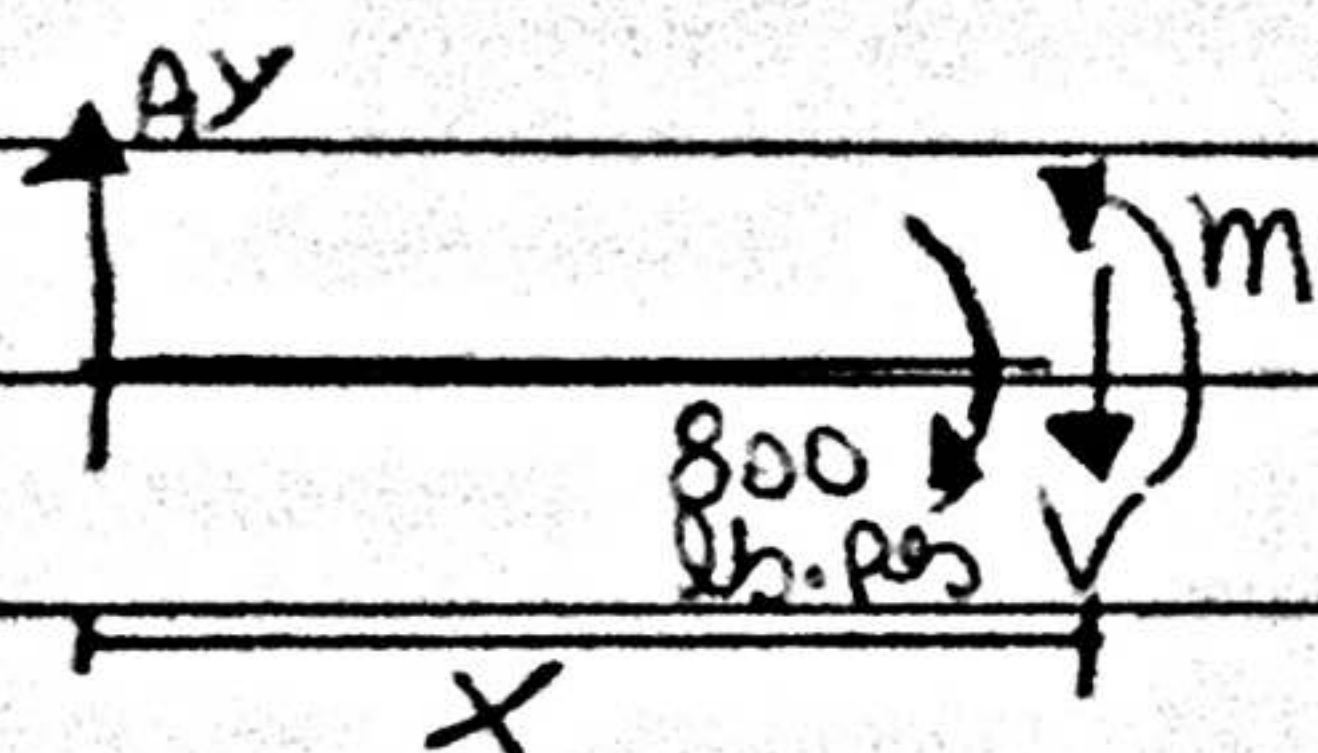
$$M_B = 117 \text{ kip} \cdot \text{ft}$$

7.43



$$\sum F_y = 0; A_y - 100 = 0$$

$$A_y = 100 \text{ lb}$$



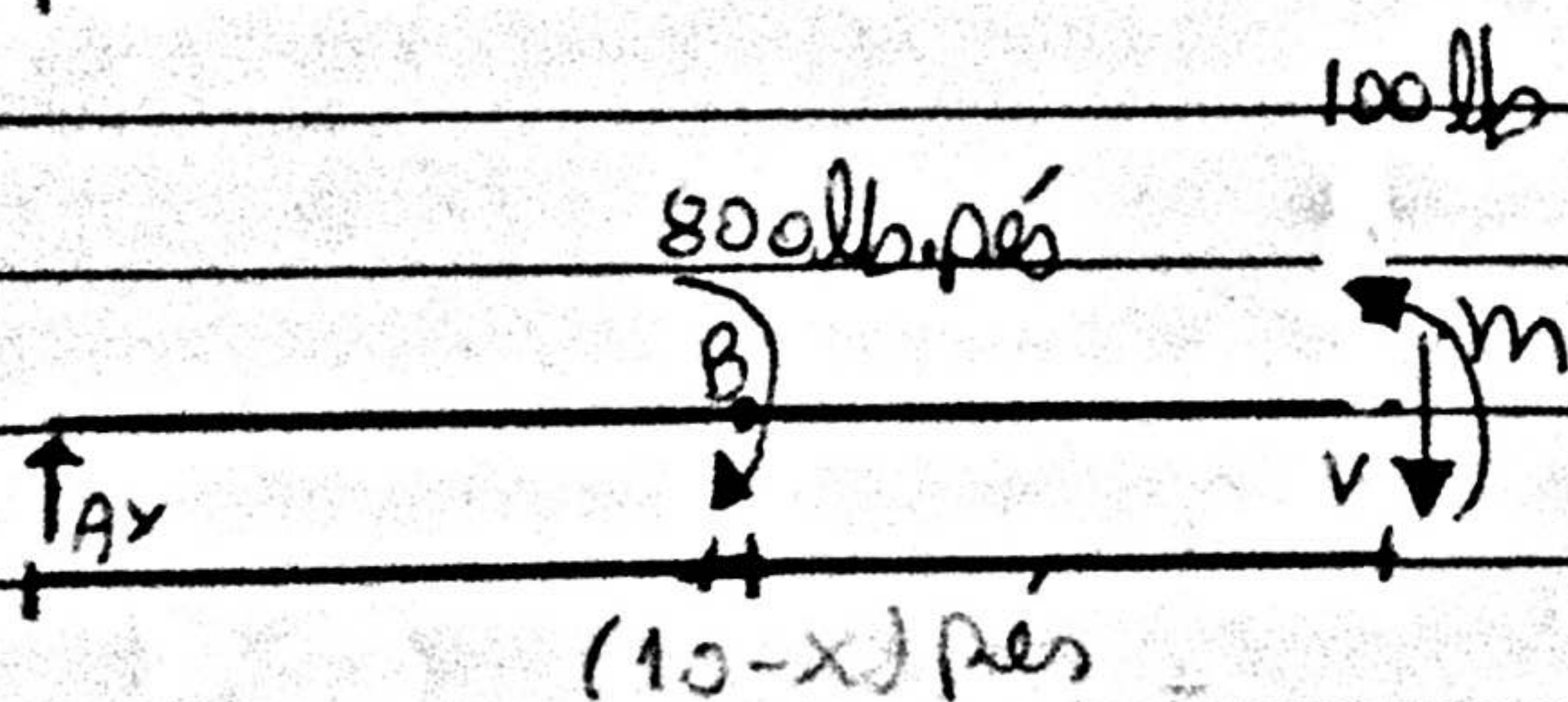
$$\sum F_y = 0; 100 - V = 0$$

$$V = 100 \text{ lb}$$

$$\sum M = 0; -100(x) + m = 800 = 0$$

$$m = +100x + 800 \text{ lb}\cdot\text{pés}$$

$$0 \leq x \leq 5 \text{ pés}$$



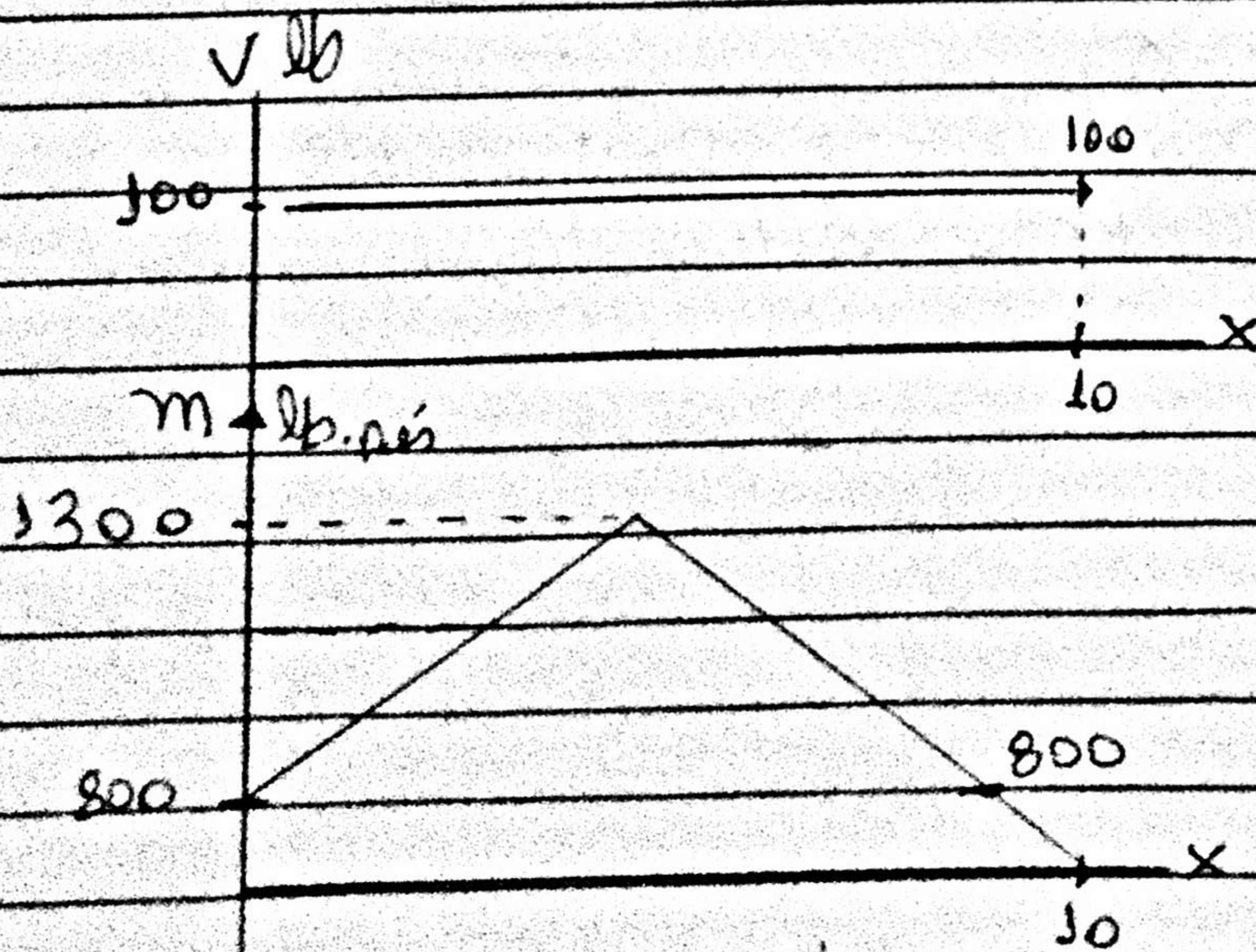
$$\sum F_y = 0; 100 - V = 0$$

$$V = 100 \text{ lb}$$

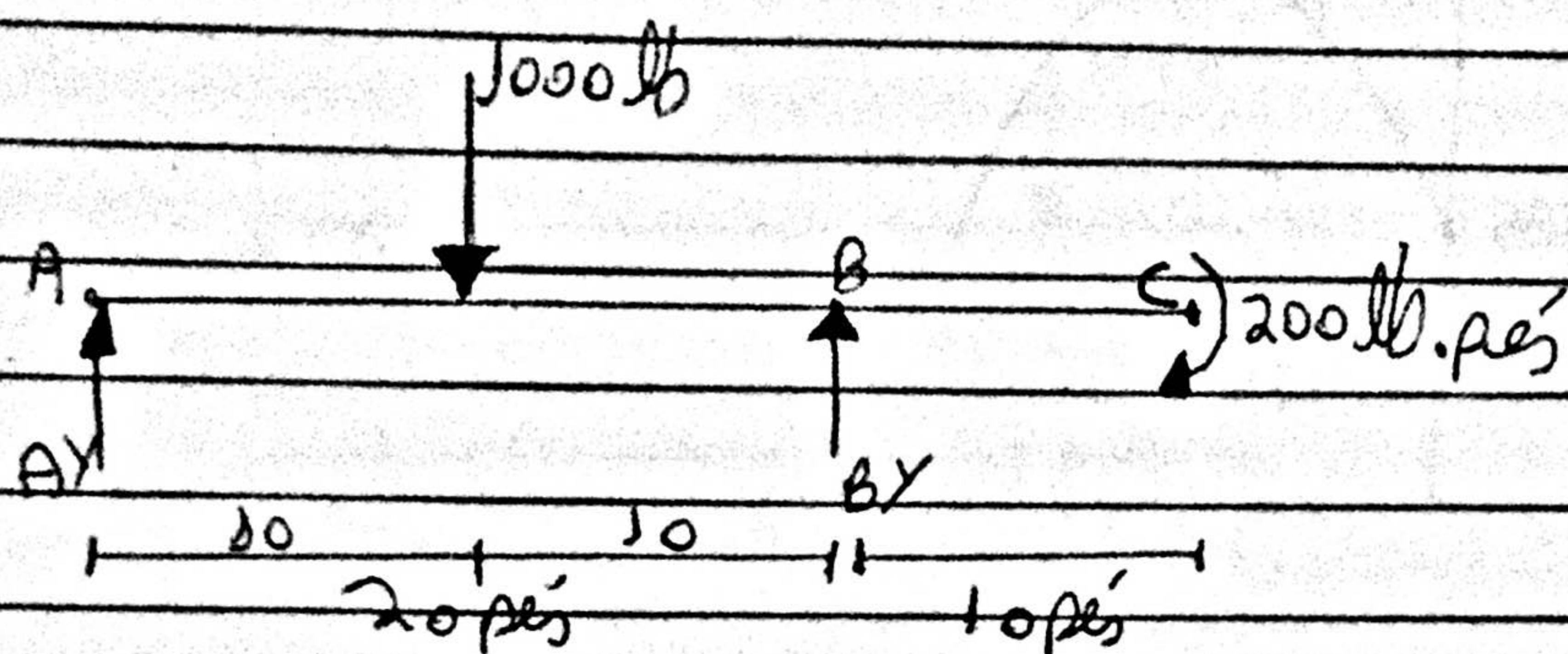
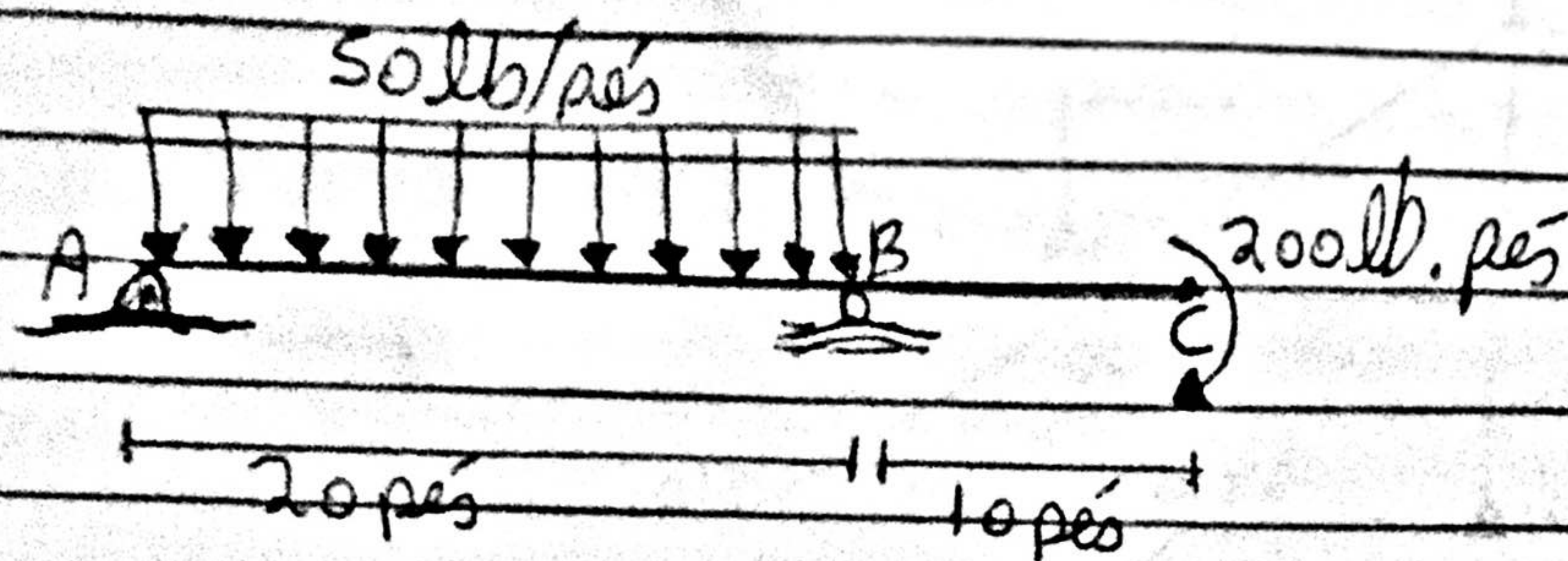
$$\sum M = 0; -100(10-x) - 800 + m = 0$$

$$m = -100x + 1800 \text{ lb}\cdot\text{pés}$$

$$5 < x \leq 10 \text{ pés}$$



7.49

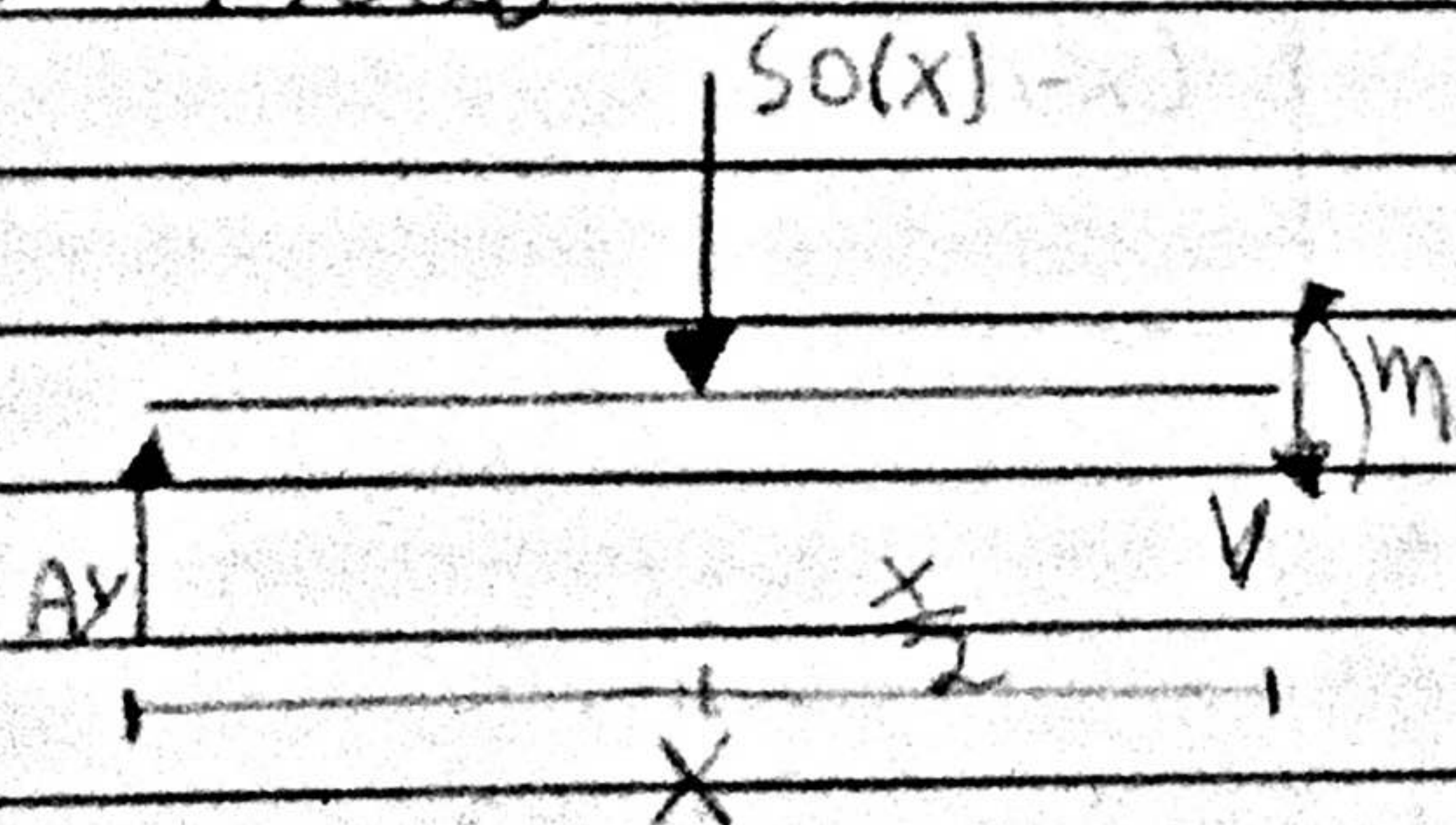


$$\sum M_A = 0; -1000(10) + B_y(20) - 200 = 0$$

$$B_y = 510 \text{ lb}\cdot\text{ft}$$

$$\sum F_y = 0; A_y - 1000 + 510 = 0$$

$$A_y = 490 \text{ lb}$$



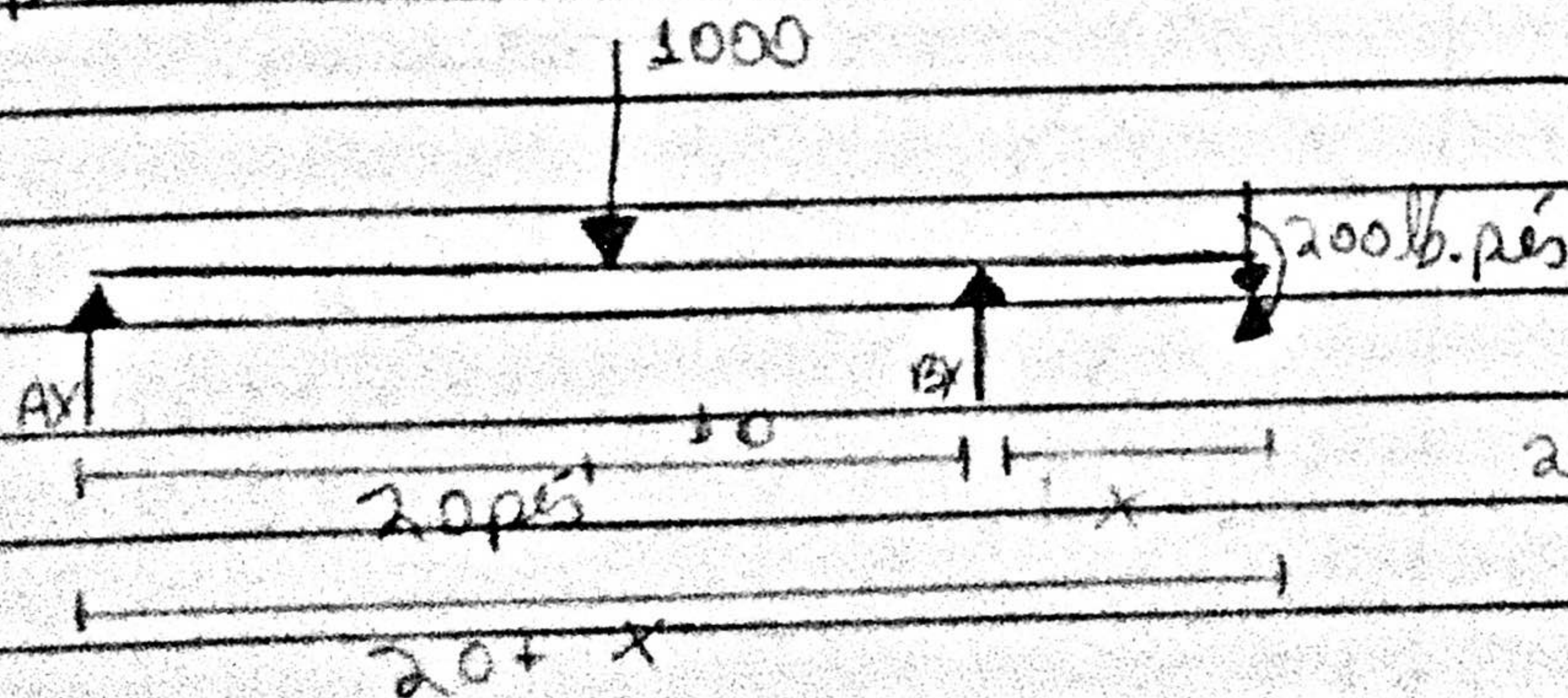
$$\sum F_y = 0; 490 - 50(x) - V = 0$$

$$V = 490 - 50(x) \text{ lb}$$

$$\sum M = 0; -490(x) + 50(x)\left(\frac{x}{2}\right) + M = 0$$

$$M = 490(x) - 25x^2 \text{ lb}\cdot\text{ft}$$

$0 \leq x \leq 20 \text{ ft}$



$20 < x < 30$

$$\sum F_y = 0; 490 - 1000 + 510 - V = 0$$

$$V = 0$$

$$\sum M = 0; 490(20 + x) - 1000(10 + x) - 510(x) - 200 = 0$$

$$-9800 - 490x + 10000 + 1000x - 510x - 200 = 0$$

$$m = 0$$

7.49

v lb

490

20

30

510

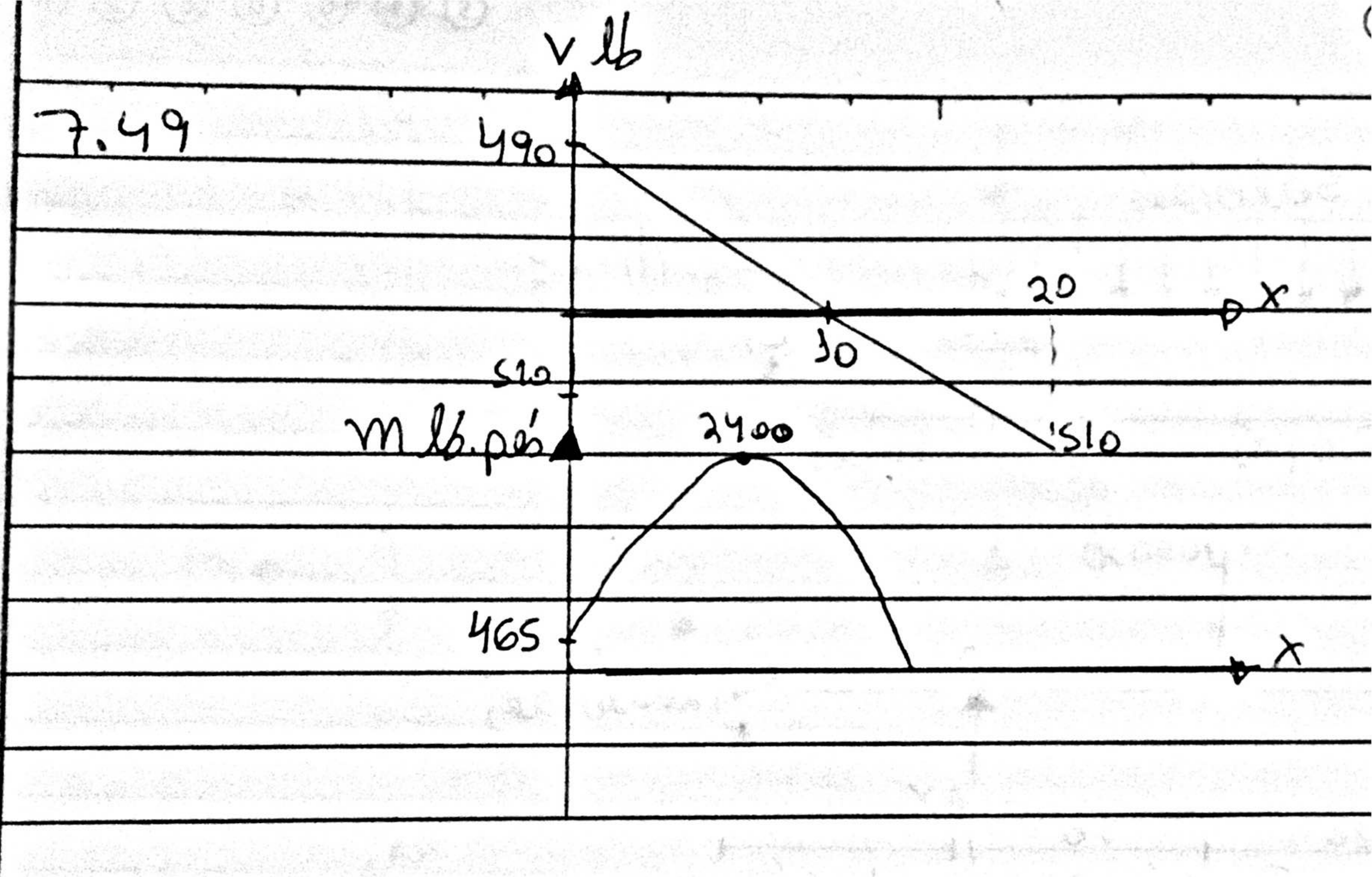
m lb. ps

2400

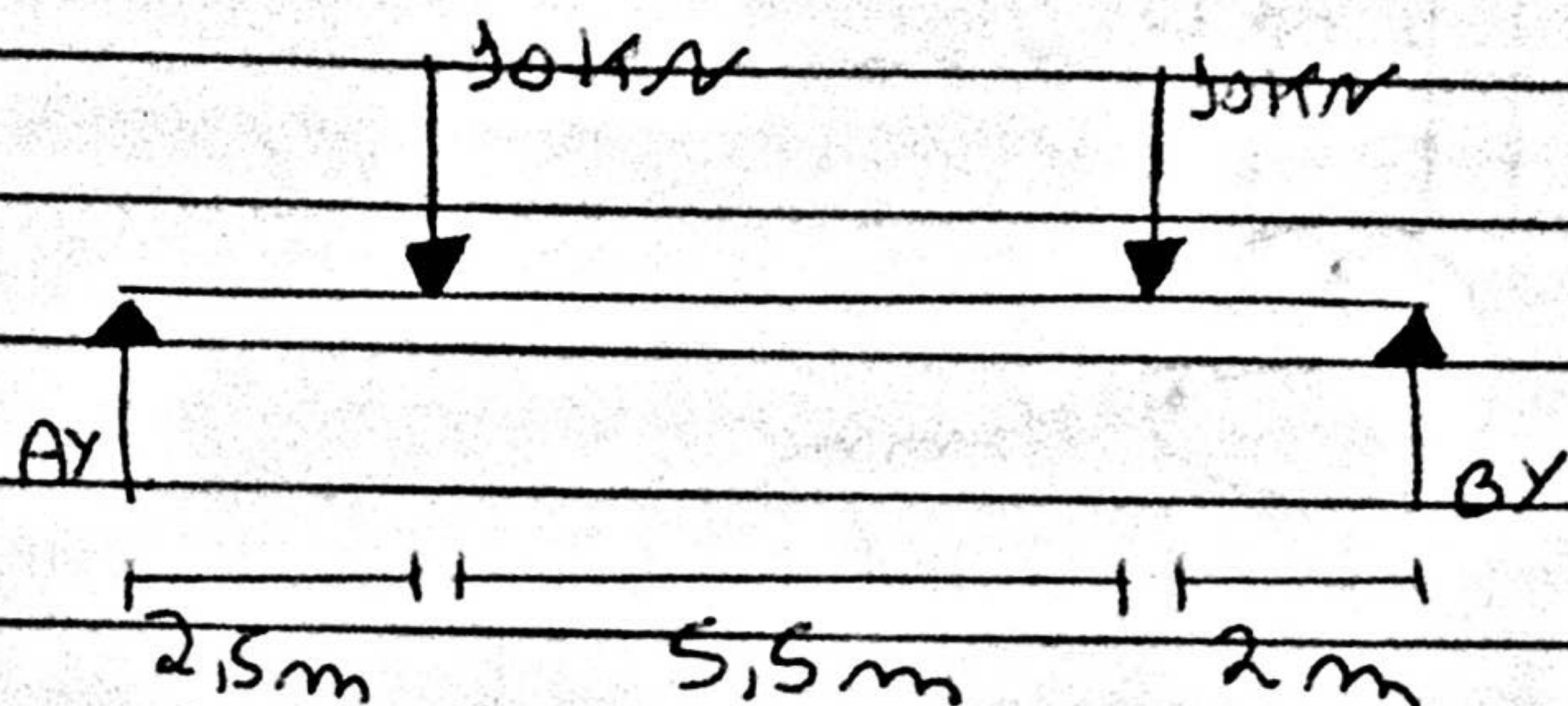
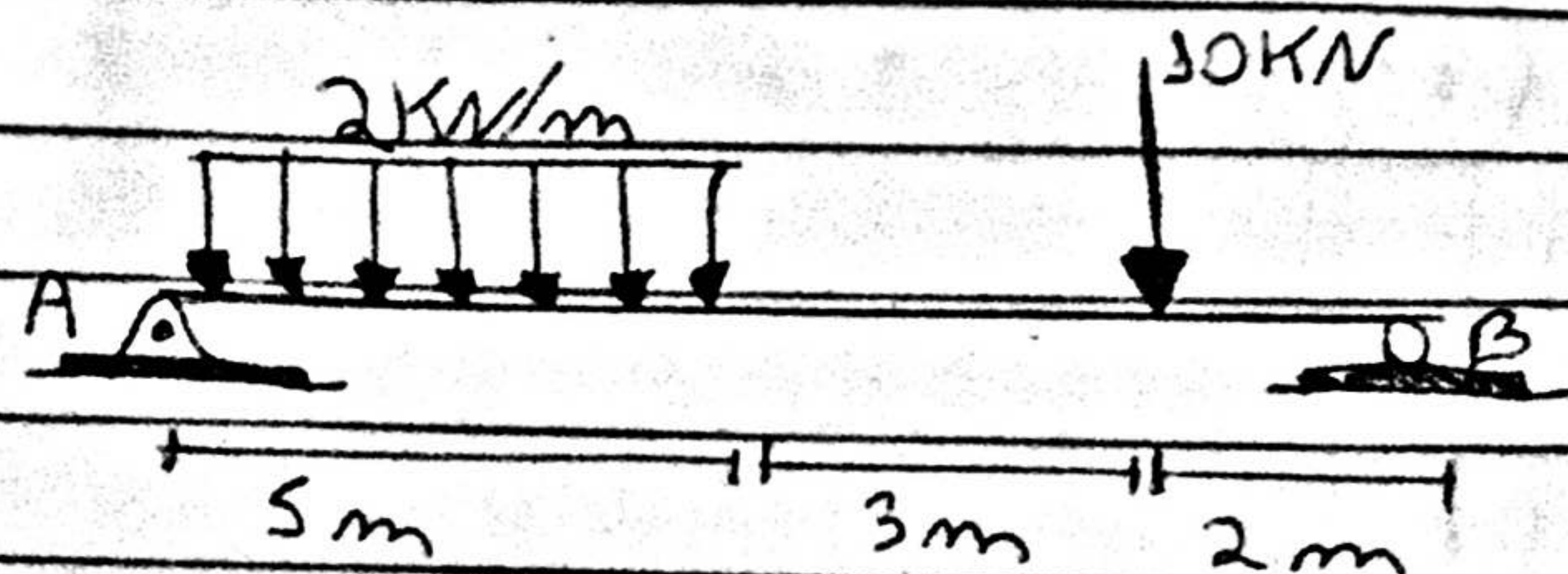
1510

465

x



7.73

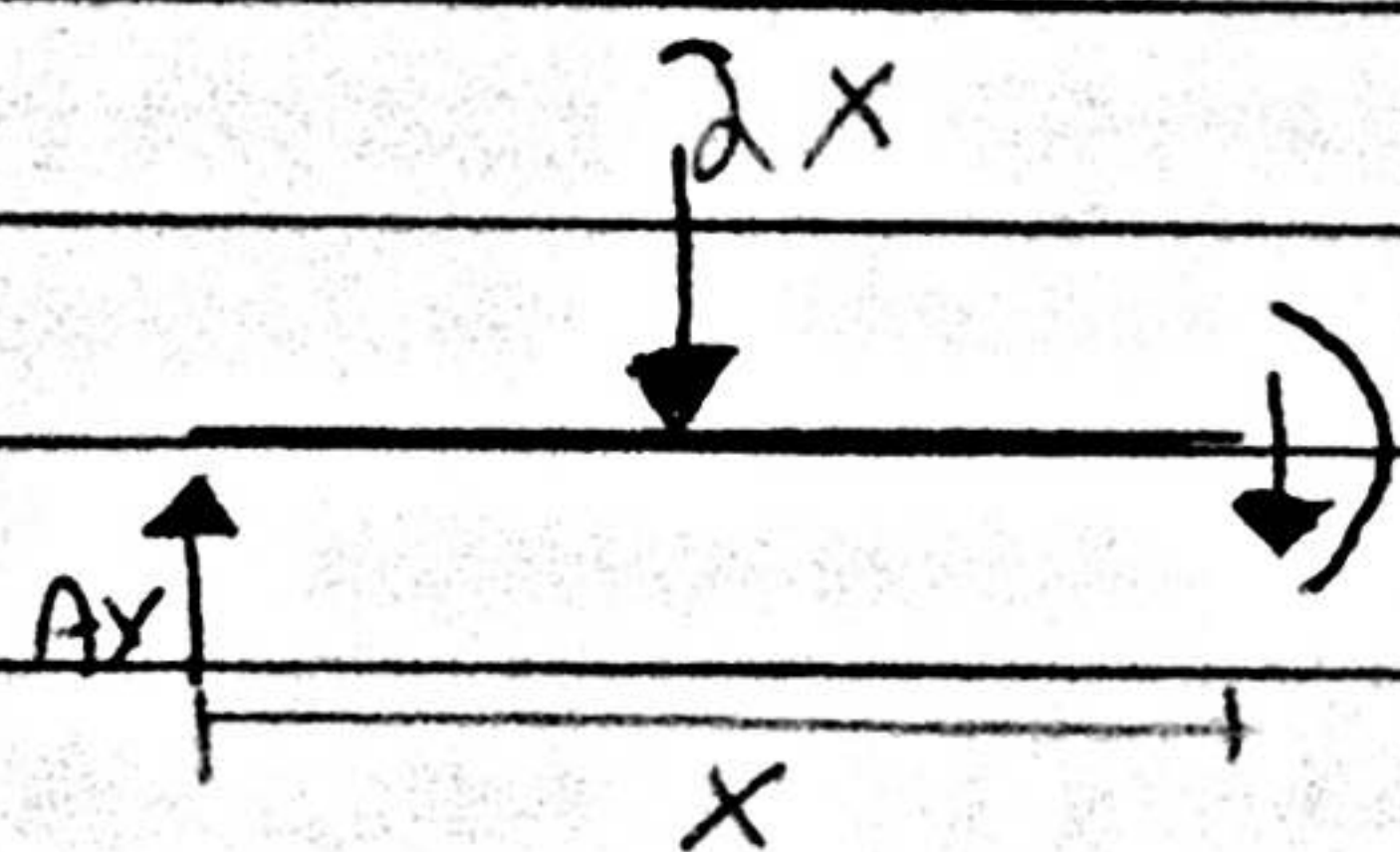


$$\sum M_A = 0; -10(2.5) - 10(8) + B_y(10) = 0$$

$$B_y = 10.5 \text{ kN}$$

$$\sum F_y = 0; -10 - 10 + 10.5 + A_y = 0$$

$$A_y = 9.5 \text{ kN}$$



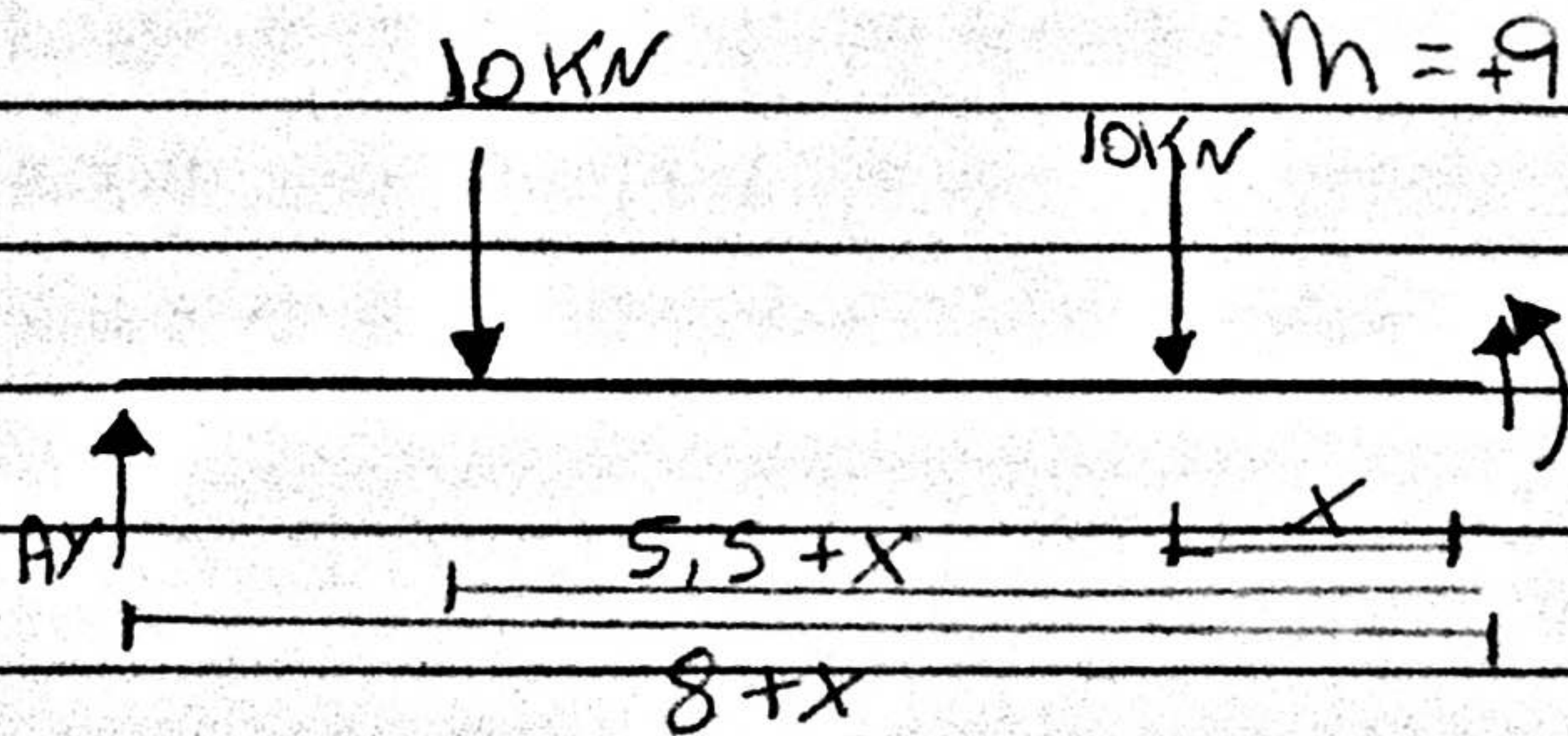
$$\sum F_y = 0; 9.5 - 2x - V = 0$$

$$V = 9.5 - 2x \text{ kN}$$

$$0 \leq x \leq 5 \text{ m}$$

$$\sum M = 0; -9.5(x) + 2x\left(\frac{x}{2}\right) + m = 0$$

$$m = 9.5(x) - x^2 \text{ kN}\cdot\text{m}$$



$$8 \leq x \leq 10 \text{ m}$$

$$\sum F_y = 0; 9.5 - 10 - 10 + V = 0$$

$$V = 10.5 \text{ kN}$$

$$\sum M = 0; -9.5(8+x) + 10(5.5+x) + 10x + m = 0$$

$$-76 - 9.5x + 55 + 10x + 10x + m = 0$$

$$m = 21 - 10.5x \text{ kN}\cdot\text{m}$$

7.73

y

s

$x(m)$

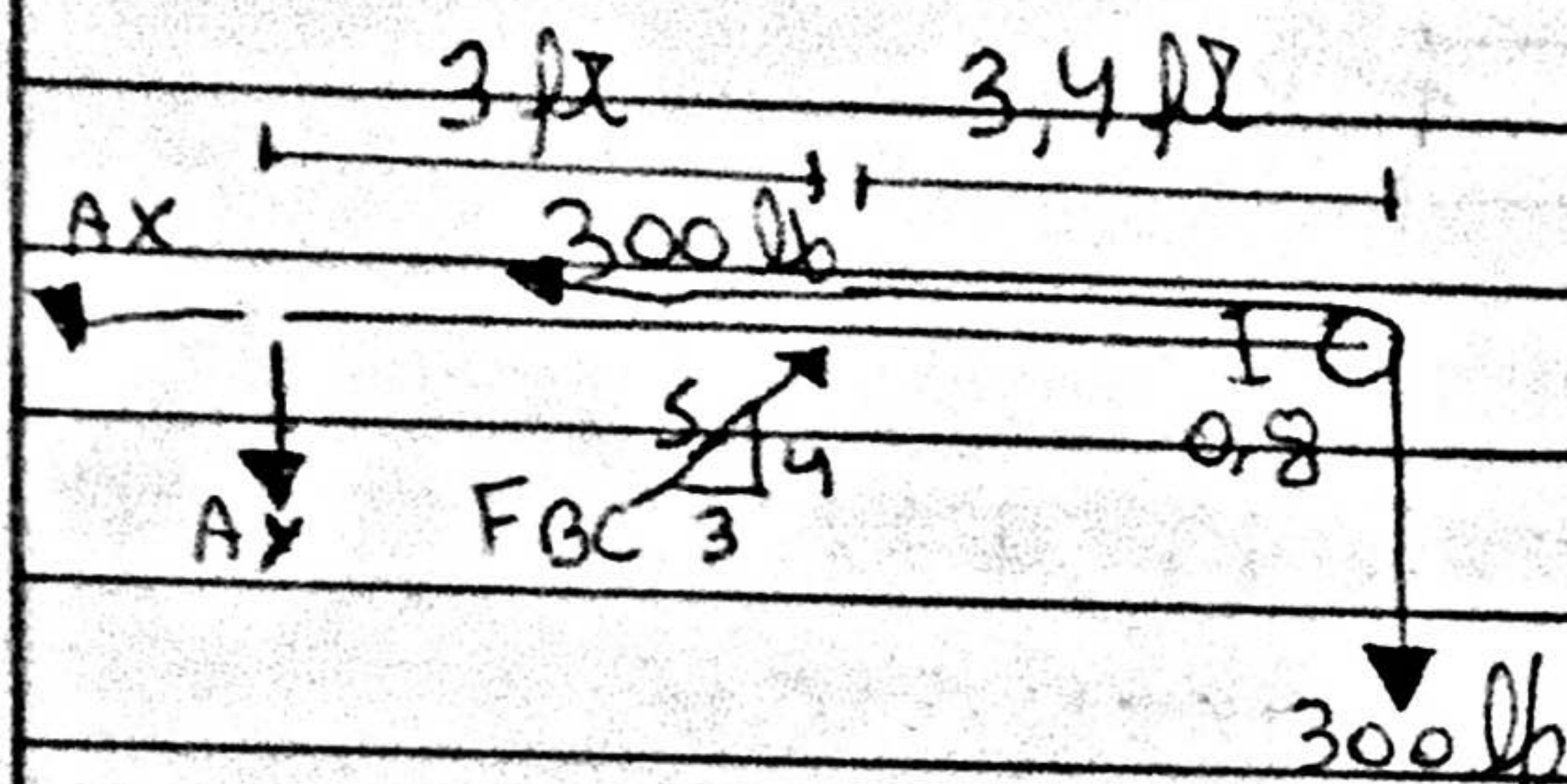
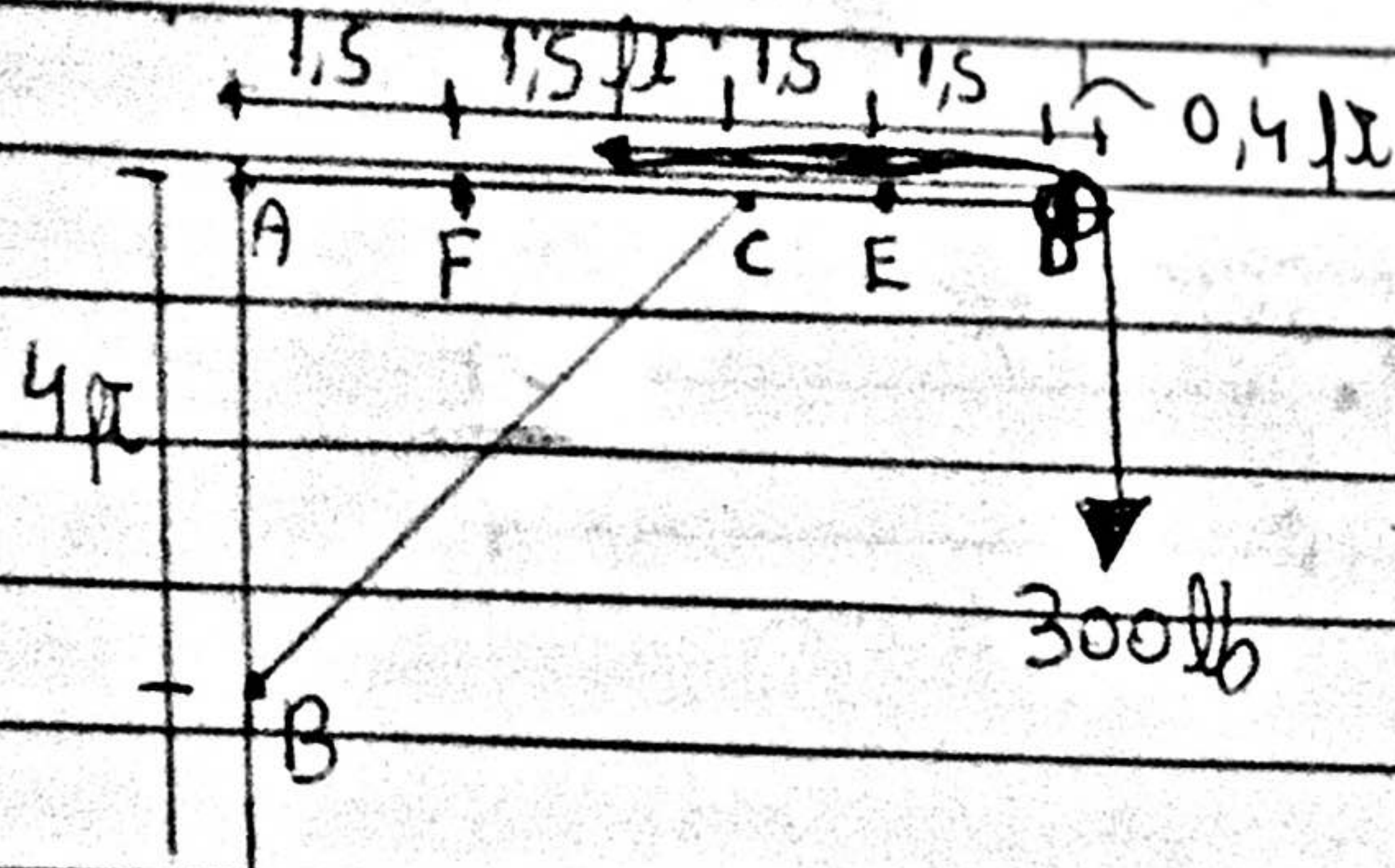
m

22.5

s

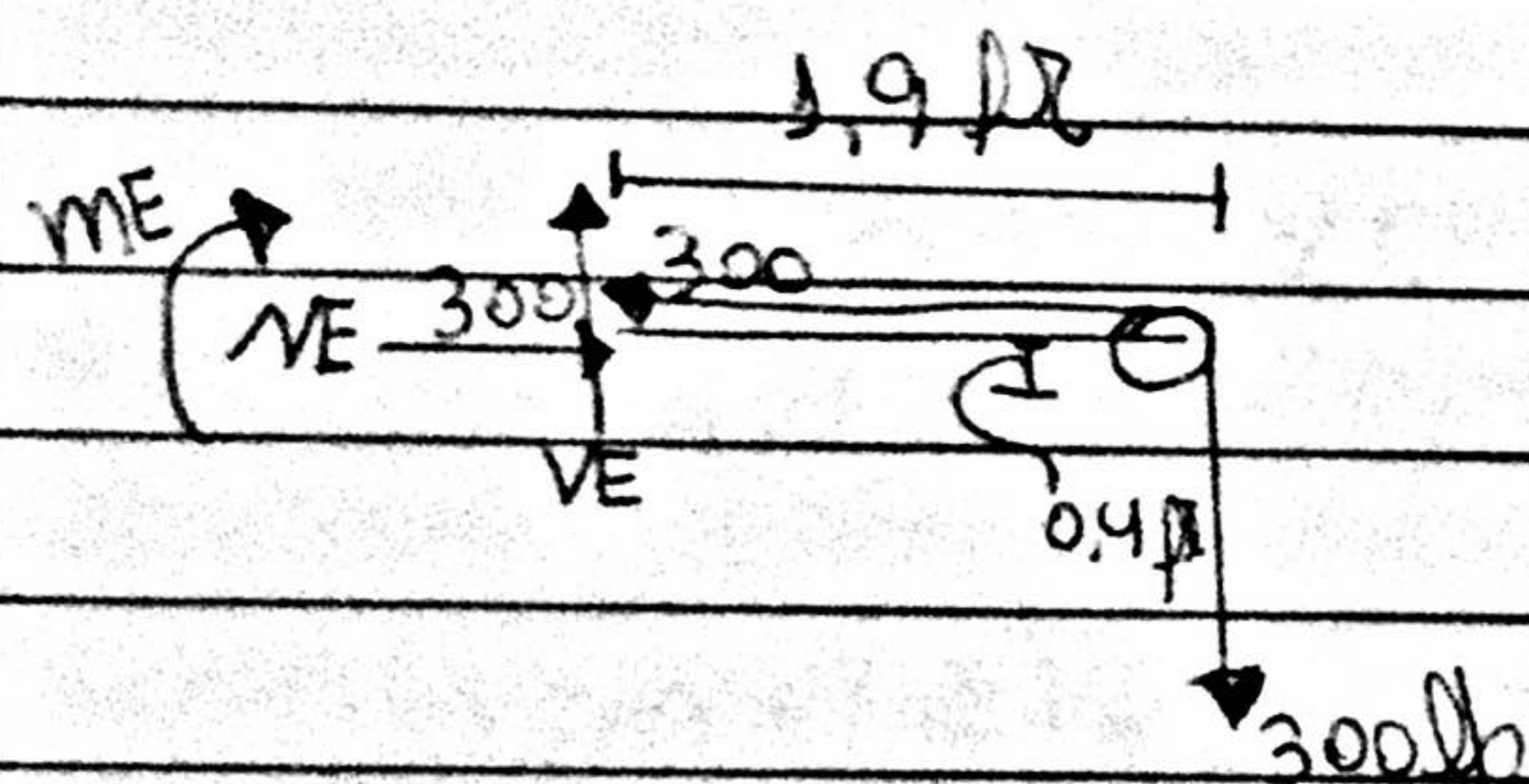
$x(m)$

7.24(12)



$$\sum M_A = 0; F_{BC} \left(\frac{4}{3} \right) (3) + 300(0.4) - 300(6.4) = 0$$

$$F_{BC} = 750 \text{ lb} \cdot \text{ft}$$

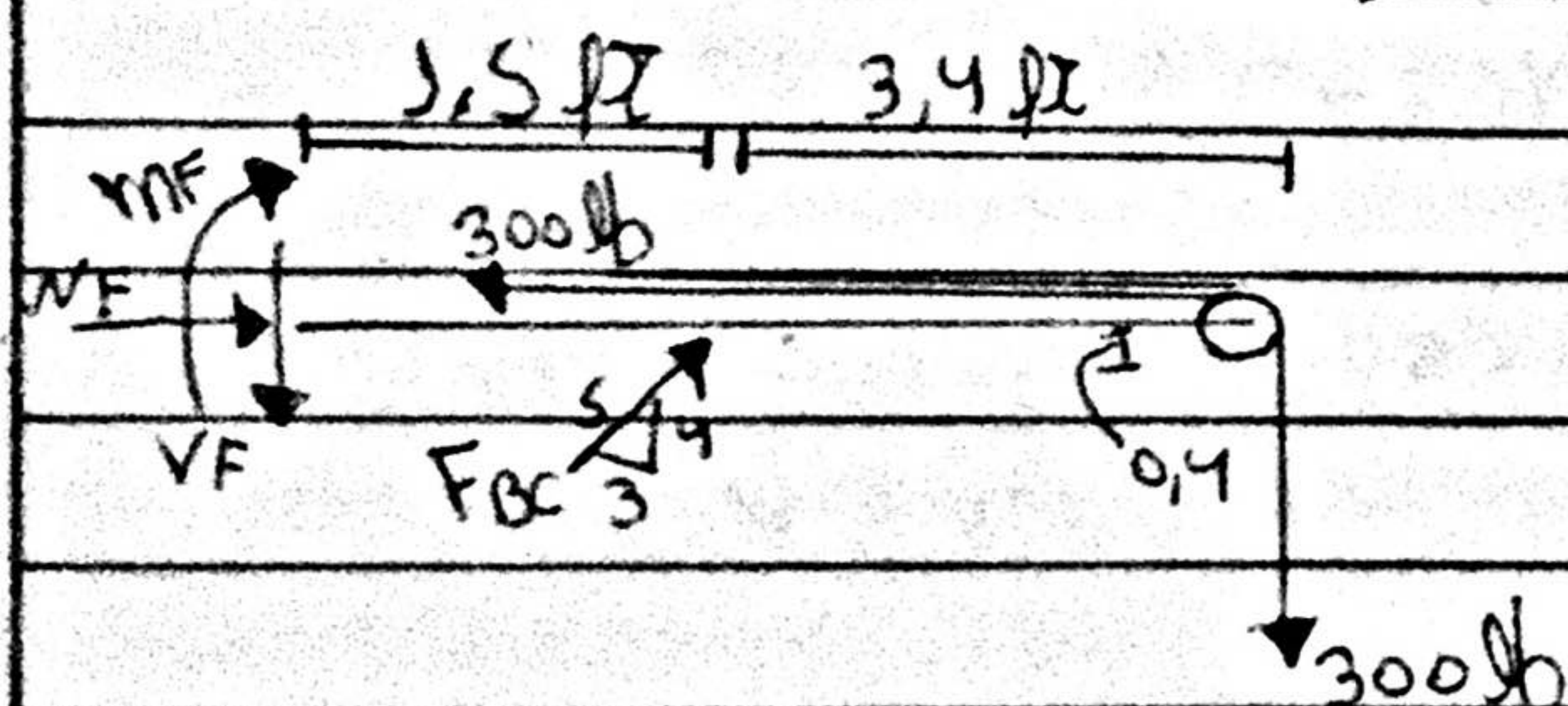


$$\sum F_x = 0; N_E - 300 = 0$$

$$N_E = 300 \text{ lb}$$

$$\sum F_y = 0; V_E - 300 = 0$$

$$V_E = 300 \text{ lb}$$



$$\sum M_E = 0; -300(1.9) + 300(0.4) - M_E = 0$$

$$M_E = 450 \text{ lb} \cdot \text{ft}$$

$$\sum F_x = 0; 750 \left(\frac{3}{3} \right) - 300 - N_E = 0$$

$$N_E = 150 \text{ lb} \leftarrow$$

$$\sum F_y = 0; -V_E + 750 \left(\frac{4}{3} \right) - 300 = 0$$

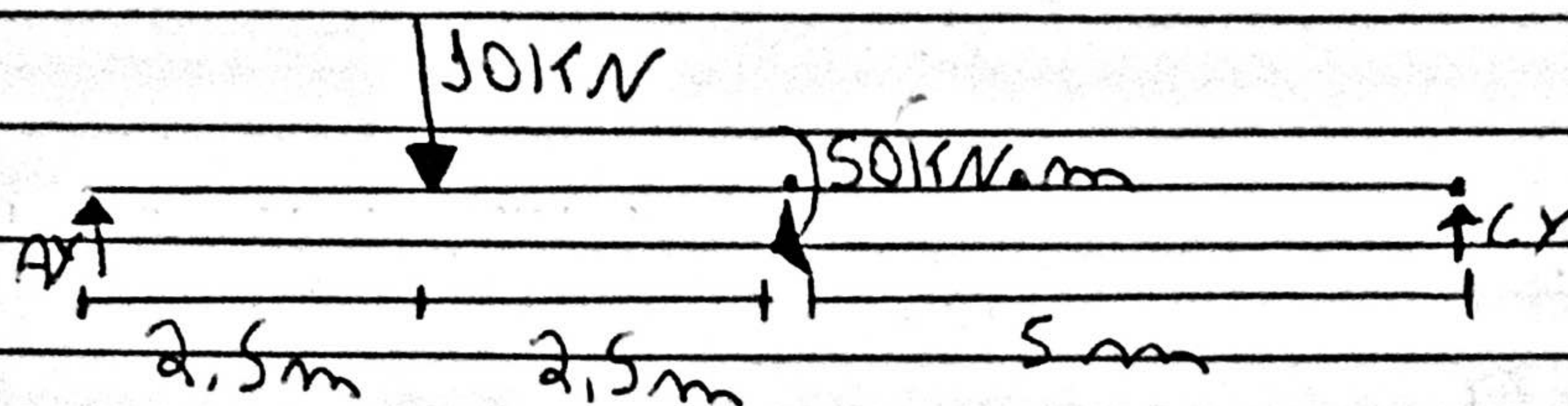
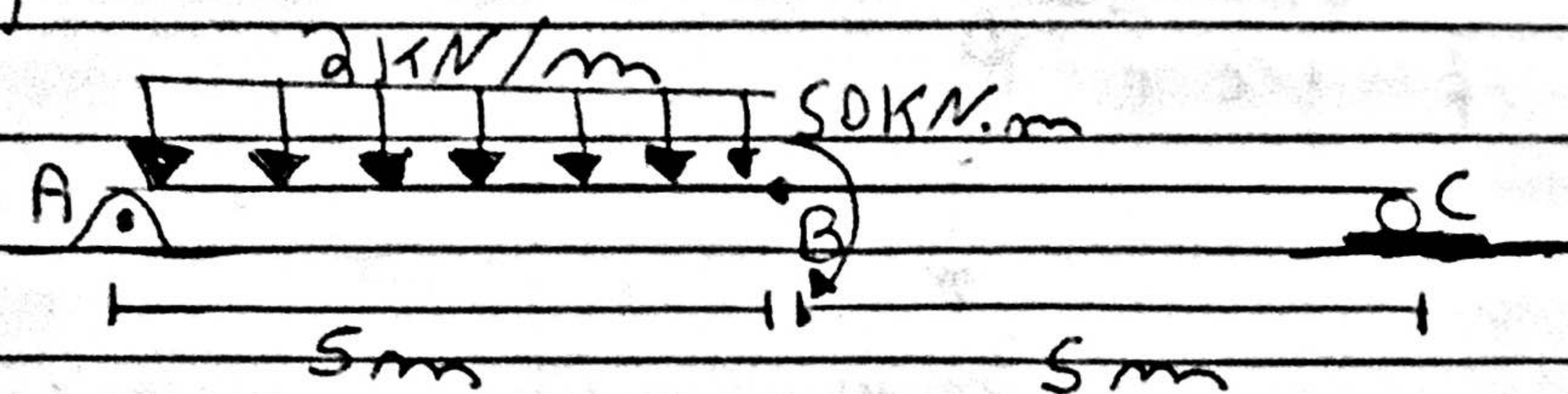
$$V_E = 300 \text{ lb}$$

$$\sum M_F = -300(4.9) + 750 \left(\frac{4}{3} \right) (1.5) + 300(0.4) - M_F = 0$$

$$-1470 + 900 + 120 - M_F = 0$$

$$M_F = -450 \text{ lb} \cdot \text{ft}$$

7.49 (12°)

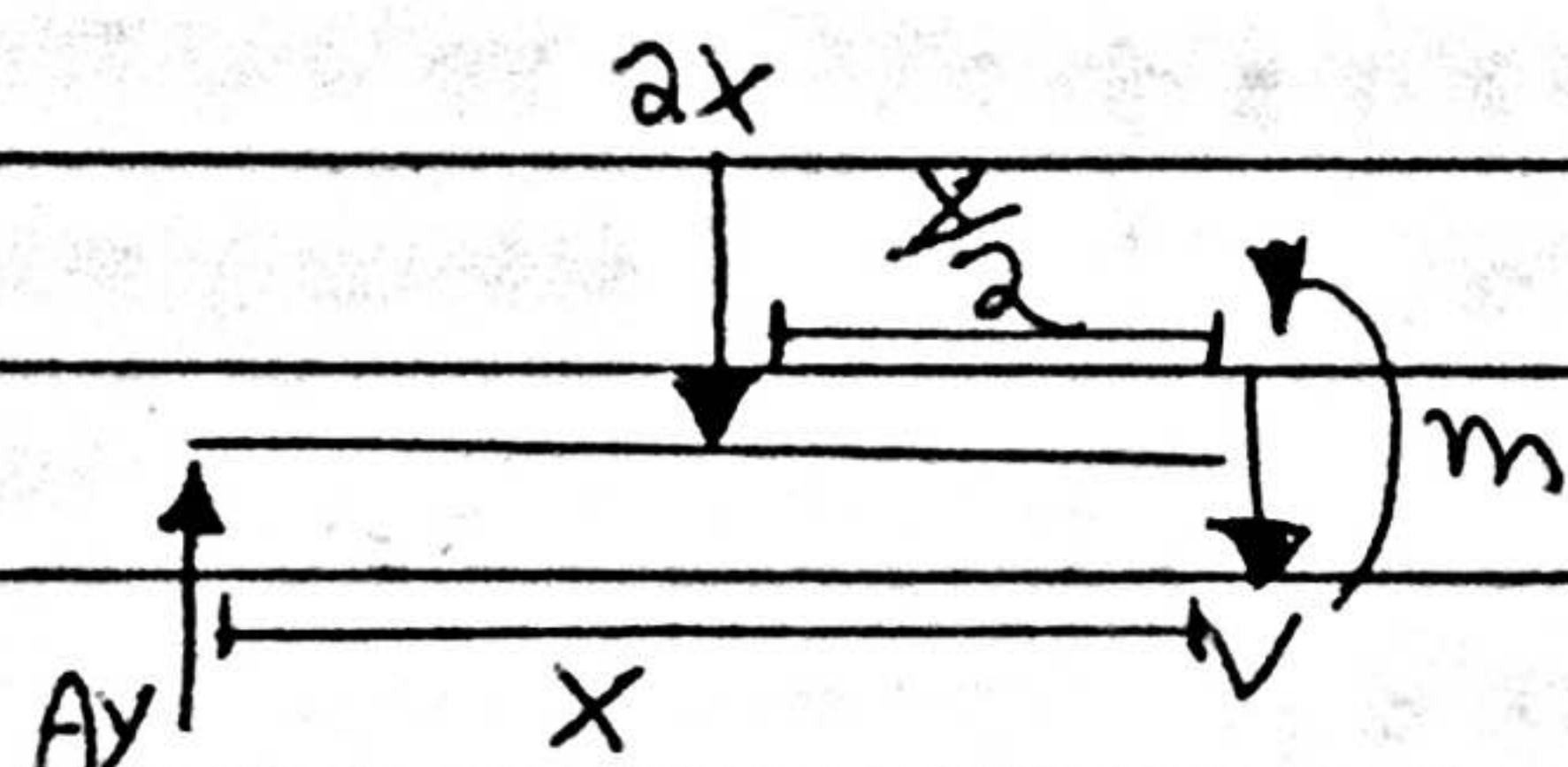


$$\sum M_A = 0; -10(2.5) - 50 + C_y(10) = 0$$

$$C_y = 7.5 \text{ kN}$$

$$\sum F_y = 0; -10 + 7.5 + A_y = 0$$

$$A_y = 2.5 \text{ kN}$$



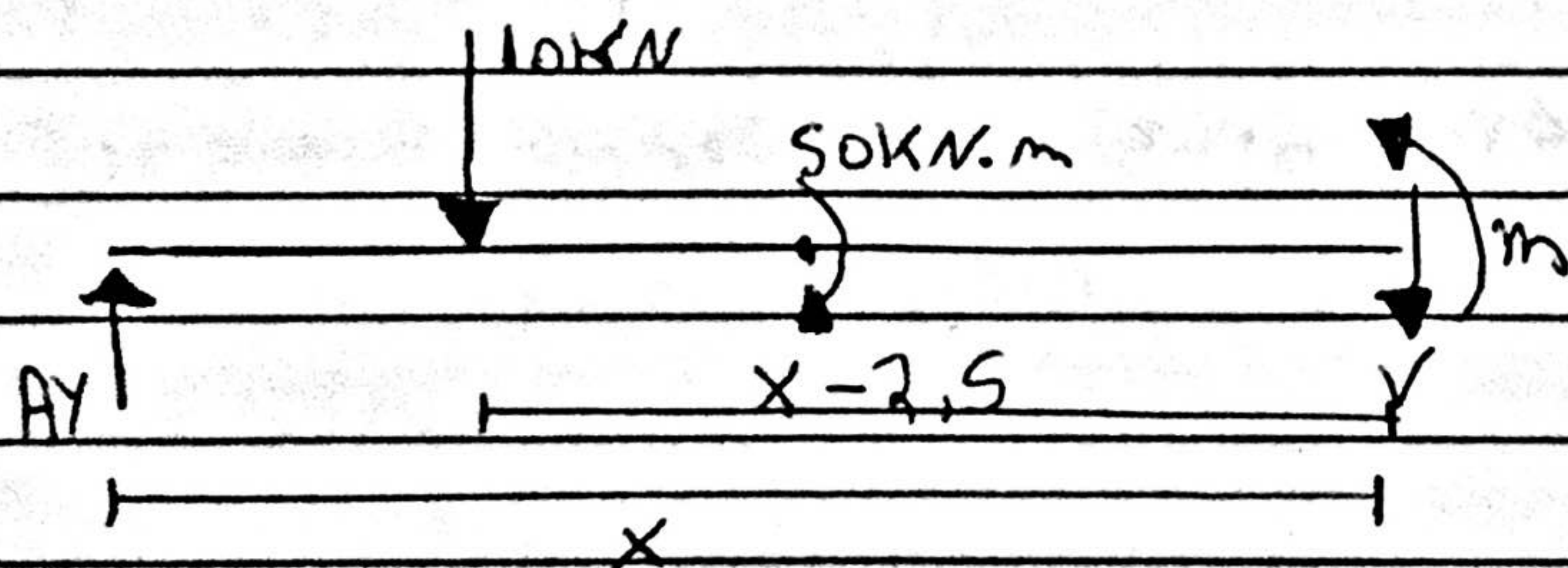
$$0 \leq x \leq 5 \text{ m}$$

$$\sum F_y = 0; 2.5 - 2x - V = 0$$

$$V = +2.5 - 2x \text{ kN}$$

$$\sum M = 0; -2.5(x) + 2x\left(\frac{x}{2}\right) + M = 0$$

$$M = +2.5(x) - x^2 \text{ kN.m}$$



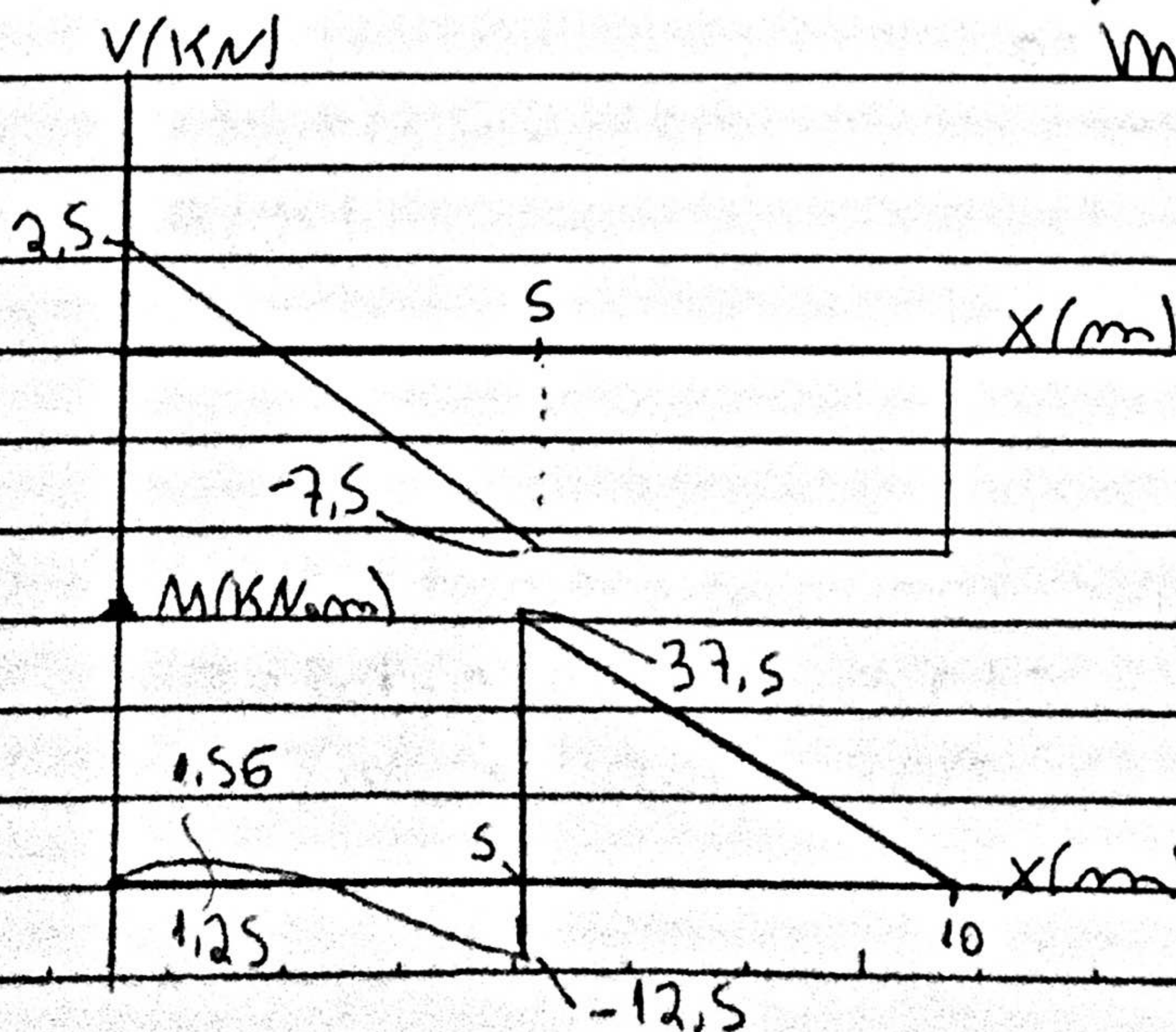
$$5 \leq x \leq 10 \text{ m}$$

$$\sum F_y = 0; 2.5 - 10 - V = 0$$

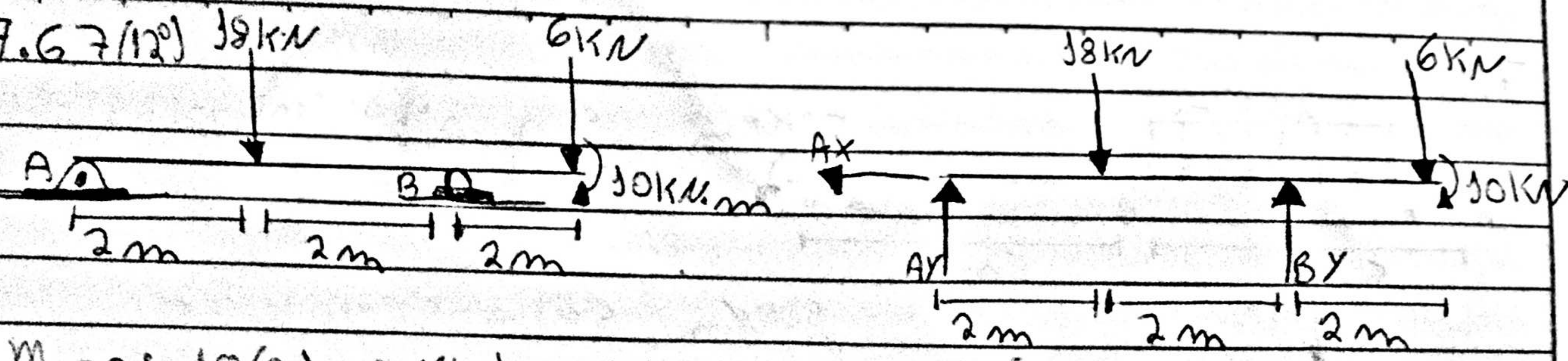
$$V = -7.5 \text{ kN}$$

$$\sum M = 0; -2.5(x) + 10(x - 2.5) - 50 + M = 0$$

$$M = 7.5 - 7.5(x) \text{ kN.m}$$



7.67/120) 18 kN

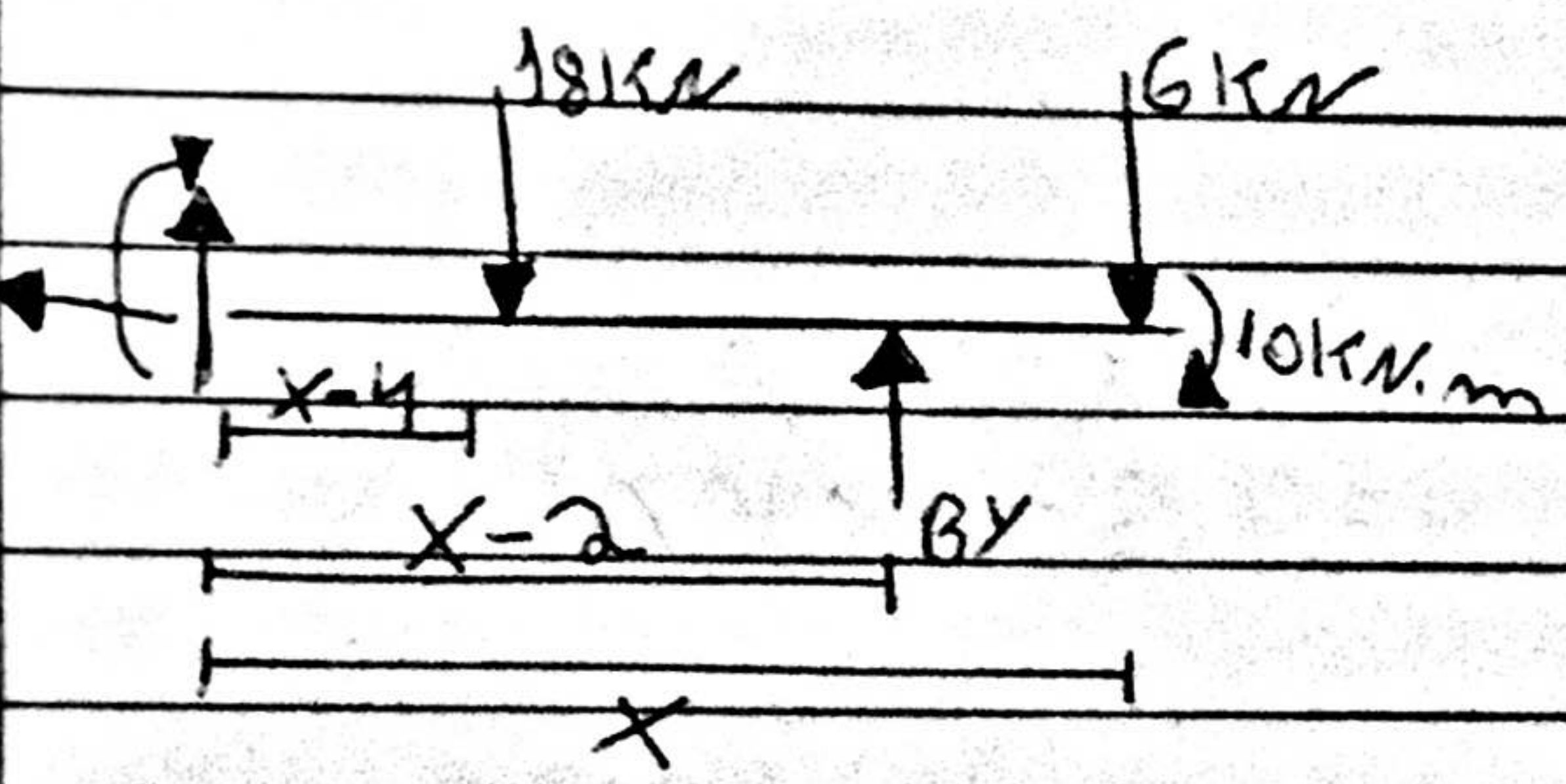


$$\sum M_A = 0; -18(2) + B_y(4) - 6(6) - 10 = 0$$

$$B_y = 20,5 \text{ kN}$$

$$\sum F_x = 0; -18 - 6 + 20,5 + A_x = 0$$

$$A_x = 3,5 \text{ kN}$$



$$\sum F_x = 0; -18 - 6 + 20,5 + V = 0$$

$$V = 3,5 \text{ kN}$$

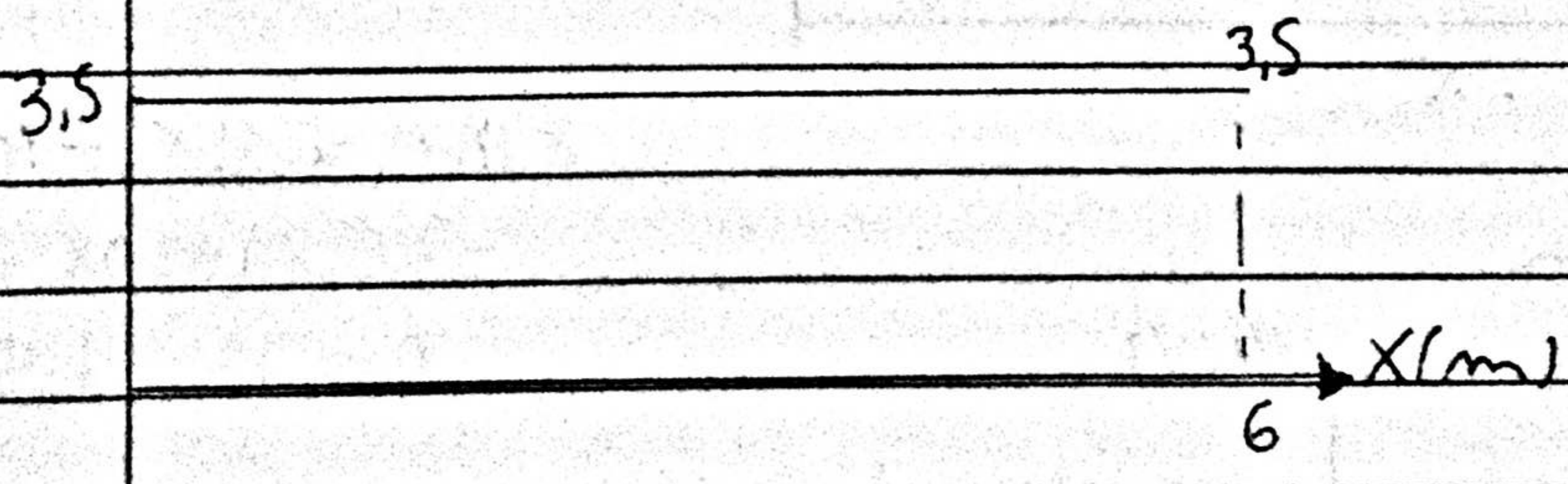
$$\sum M = 0; -6(x) - 18(x-4) + 20,5(x-2) - 10 - m = 0$$

$$-6x - 18x + 72 + 20,5x - 41 - 10 - m = 0$$

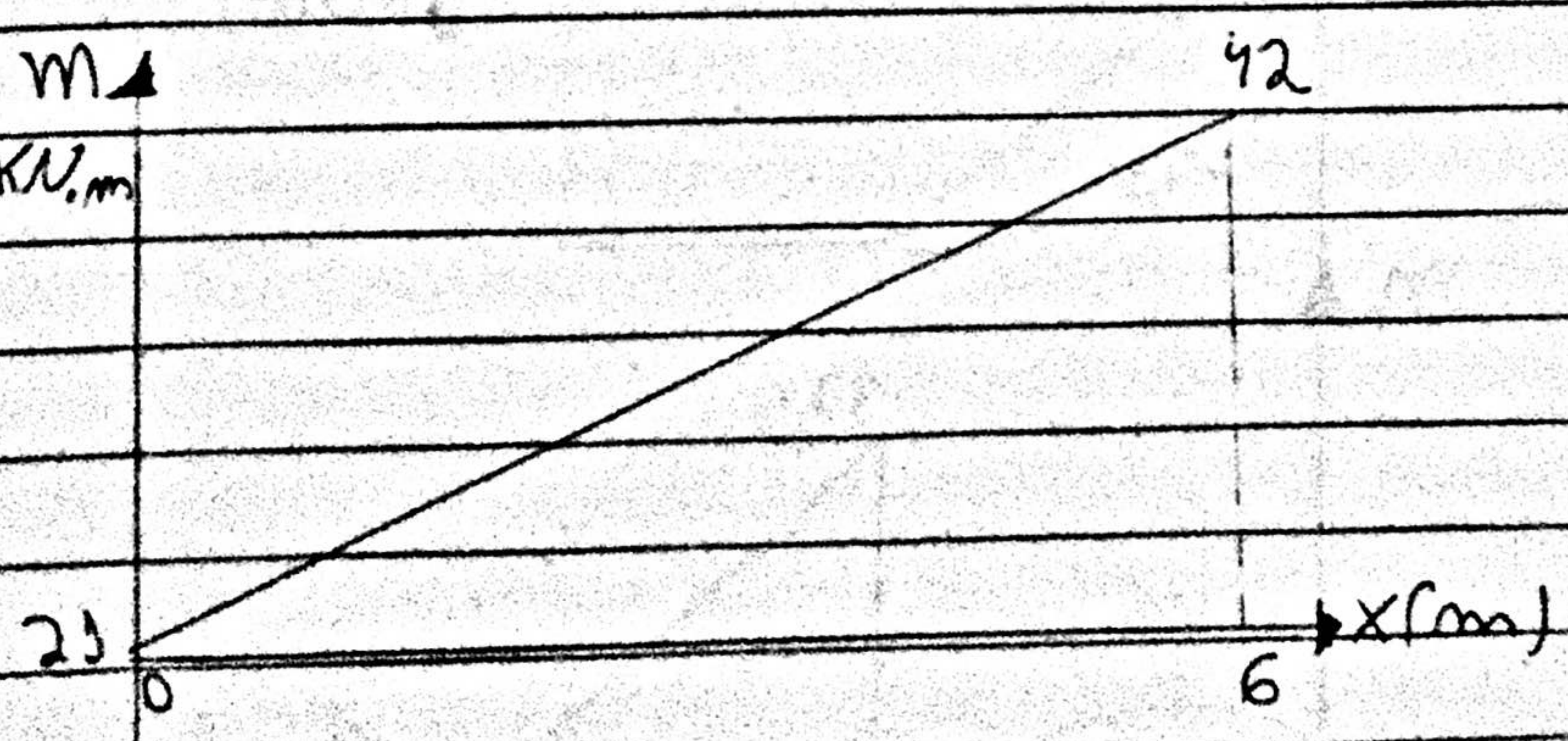
$$m = 21 + 3,5x \text{ kN.m}$$

$$0 \leq x \leq 6 \text{ m}$$

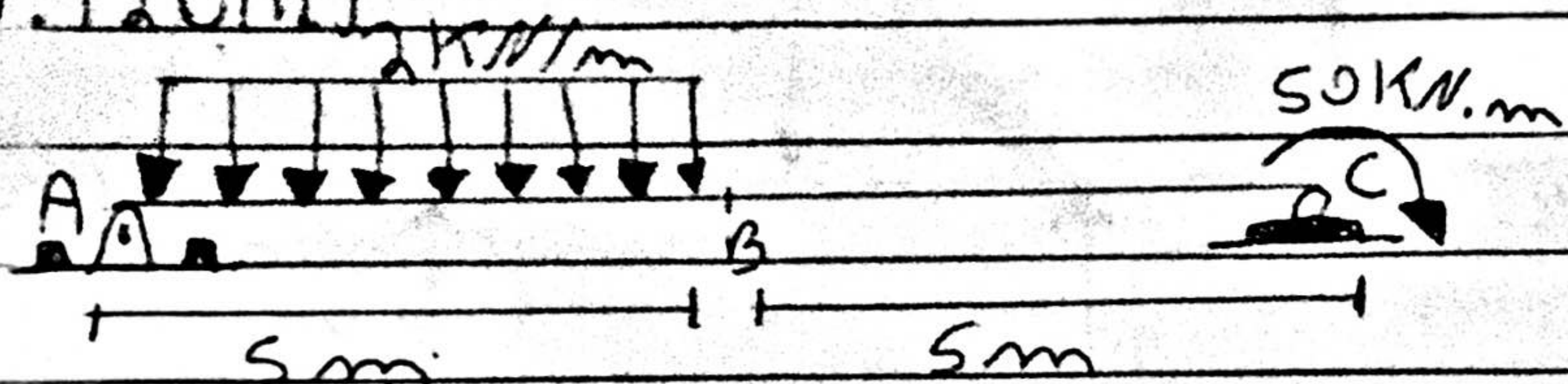
V(kN)



M
kN.m

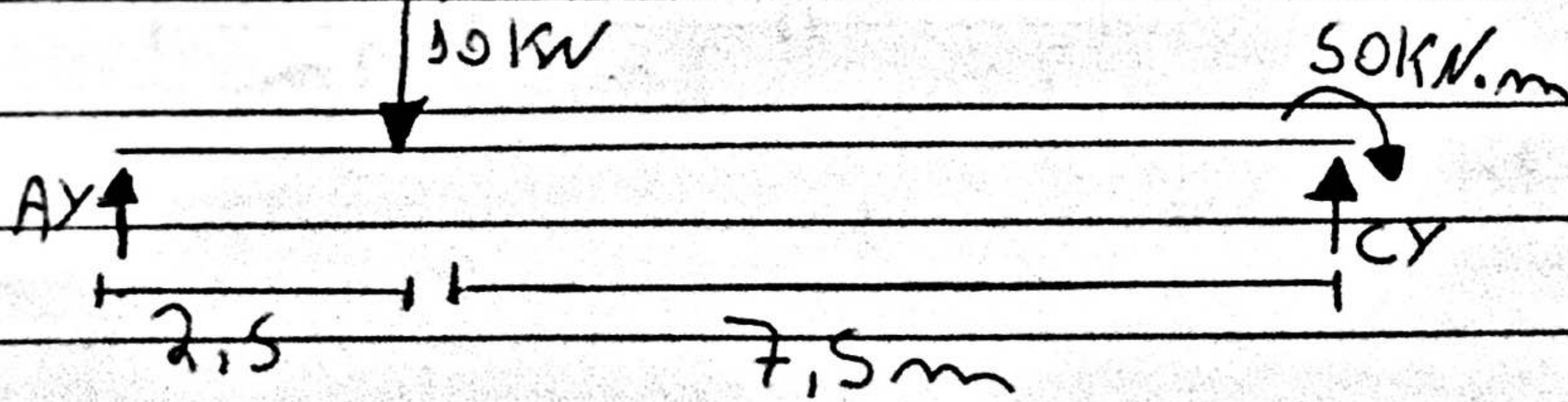


7.120(12)



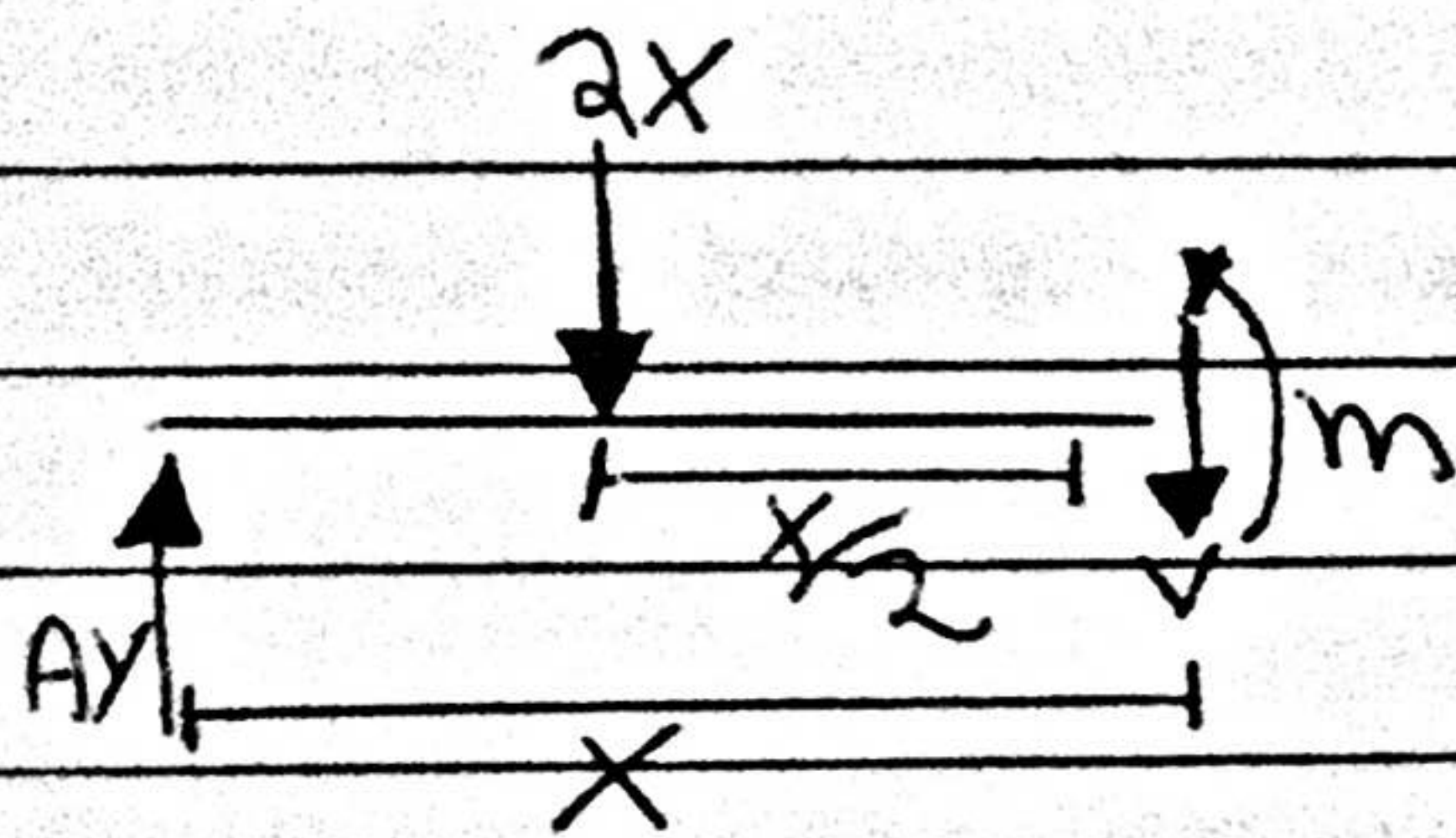
$$\sum M_C = 0; -A_Y(10) + 10(7.5) - 50 = 0$$

$$A_Y = 2.5 \text{ kN}$$



$$\sum F_Y = 0; 2.5 - 10 + C_Y = 0$$

$$C_Y = 7.5 \text{ kN}$$



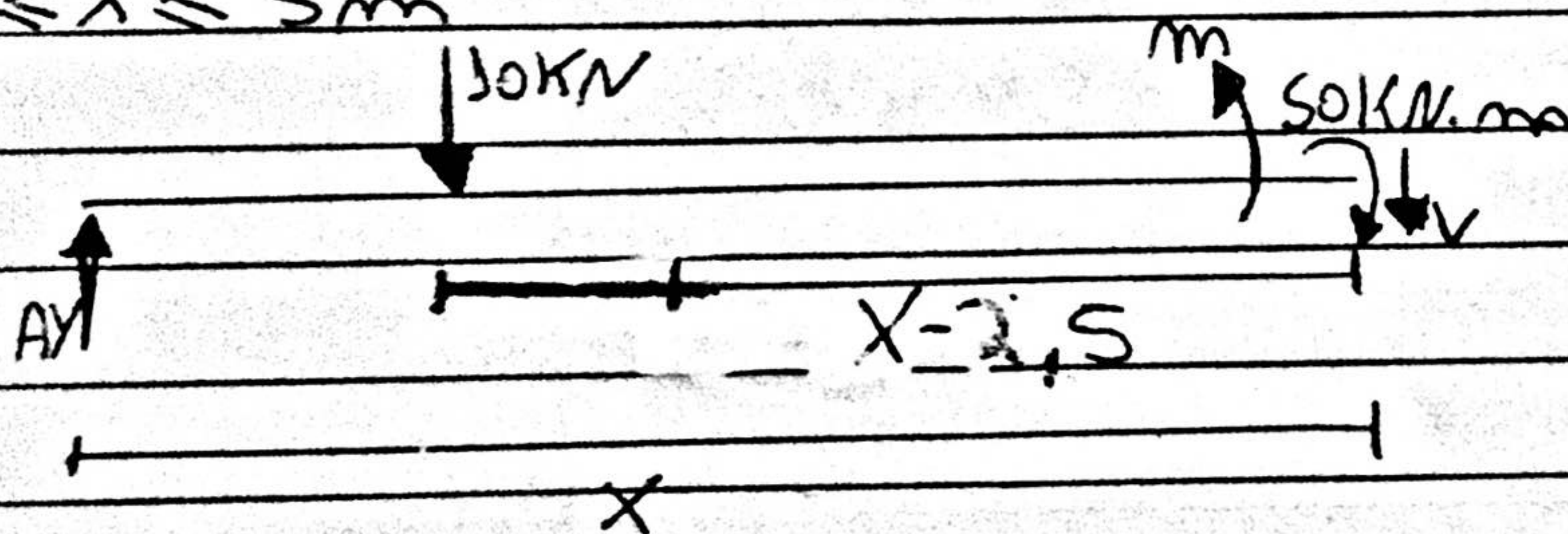
$$\sum F_Y = 0; 2.5 - 2x - V = 0$$

$$V = 2.5 - 2x \text{ kN}$$

$$\sum M = 0; -2.5(x) + 2x\left(\frac{x}{2}\right) + m = 0$$

$$m = 2.5x - x^2 \text{ kN.m}$$

$$0 \leq x \leq 5 \text{ m}$$



$$\sum F_Y = 0; 2.5 - 10 - V = 0$$

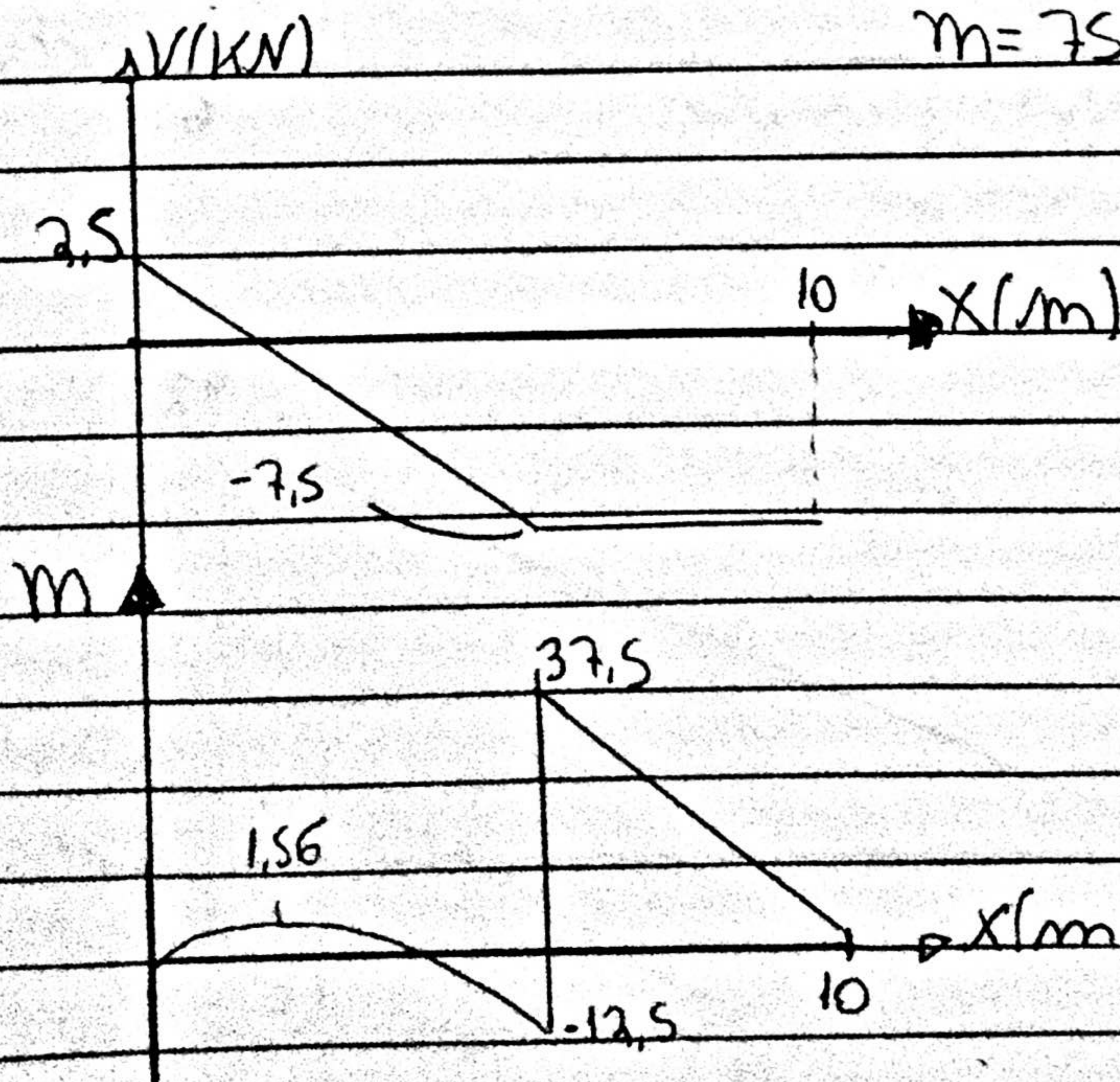
$$V = 7.5 \text{ kN} \uparrow$$

$$\sum M = 0; 2.5(x) + 10(x - 2.5) - 50 + m = 0$$

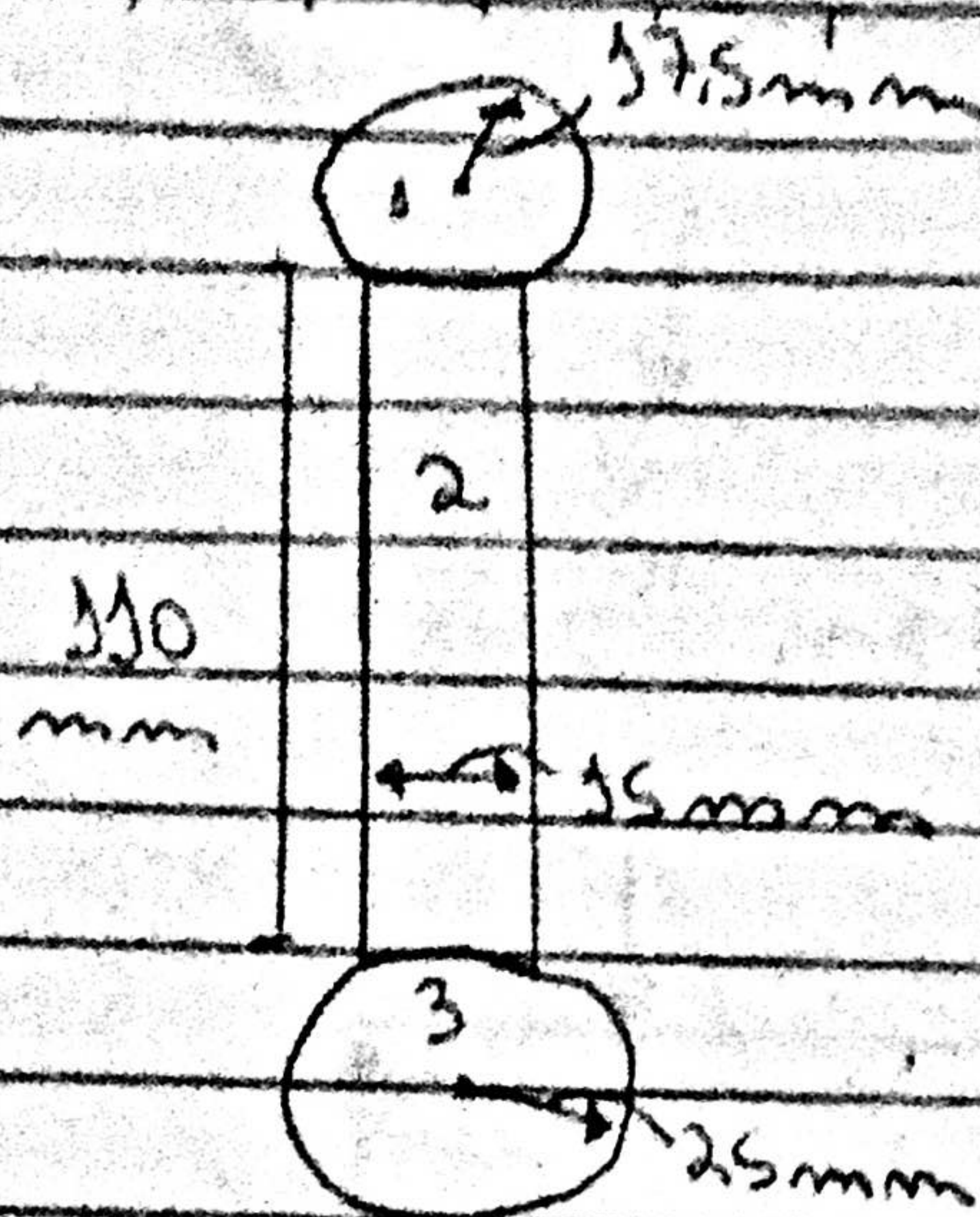
$$-2.5(x) + 10x - 25 - 50 + m = 0$$

$$m = 75 - 7.5x \text{ kN.m}$$

$$5 \leq x \leq 10 \text{ m}$$



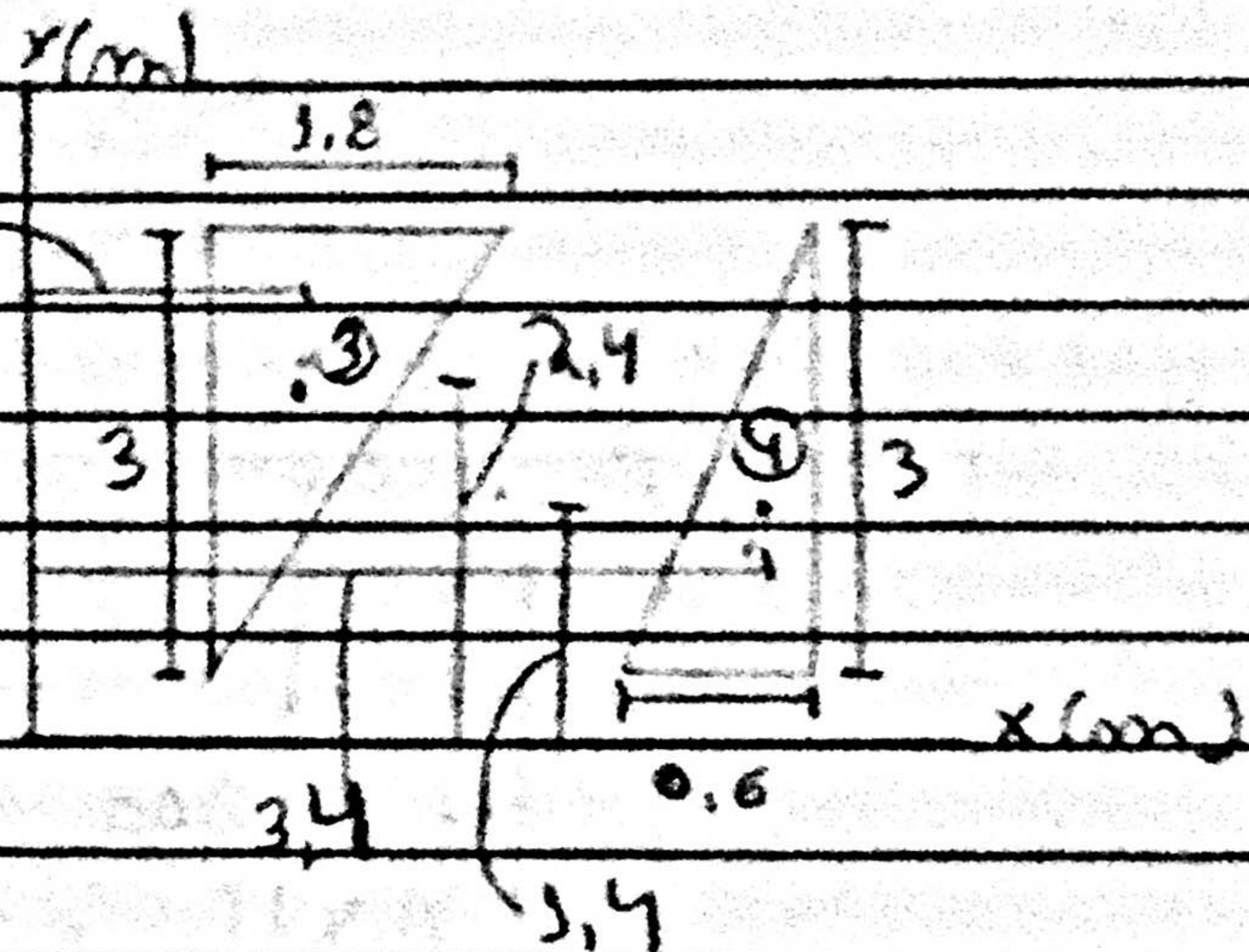
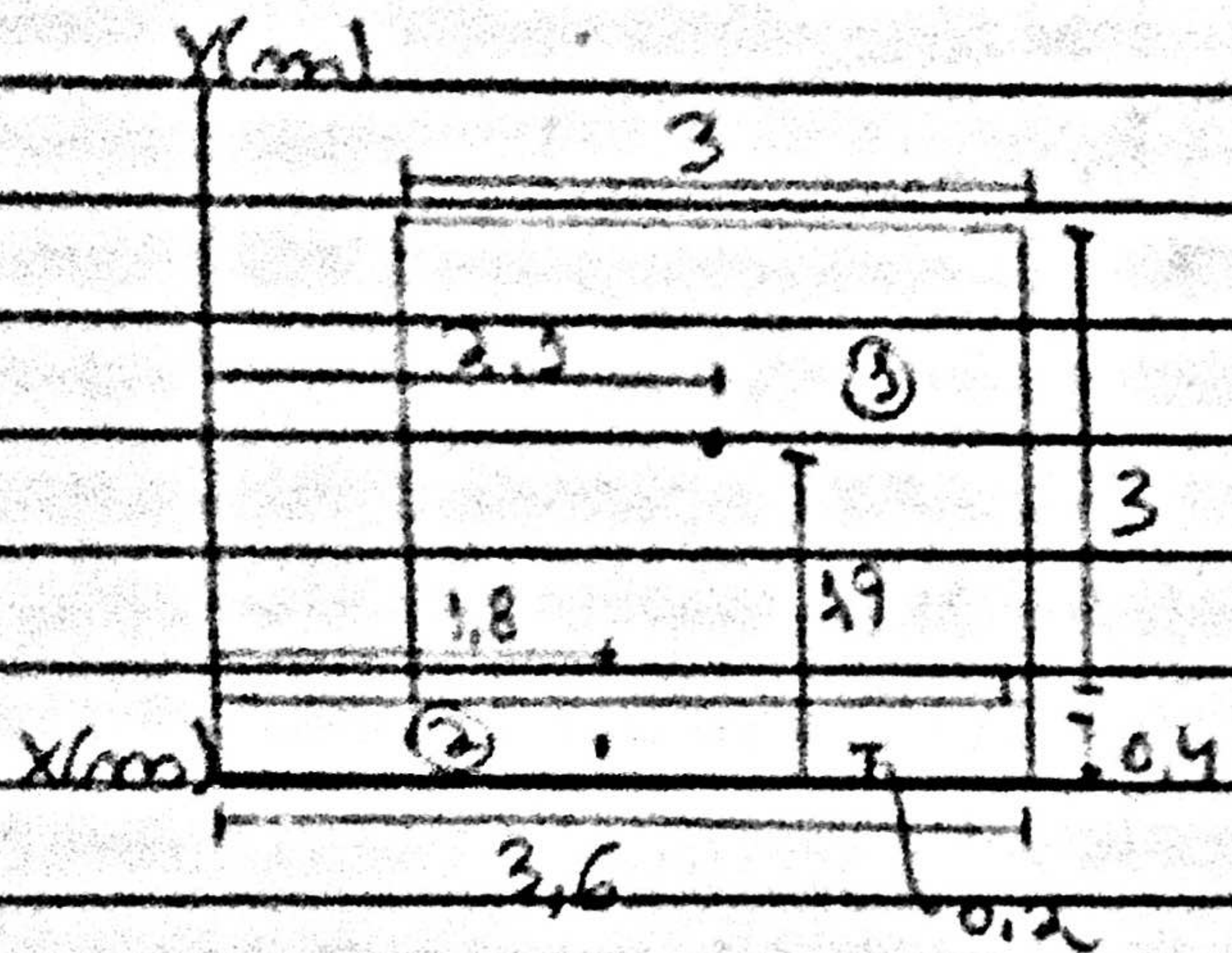
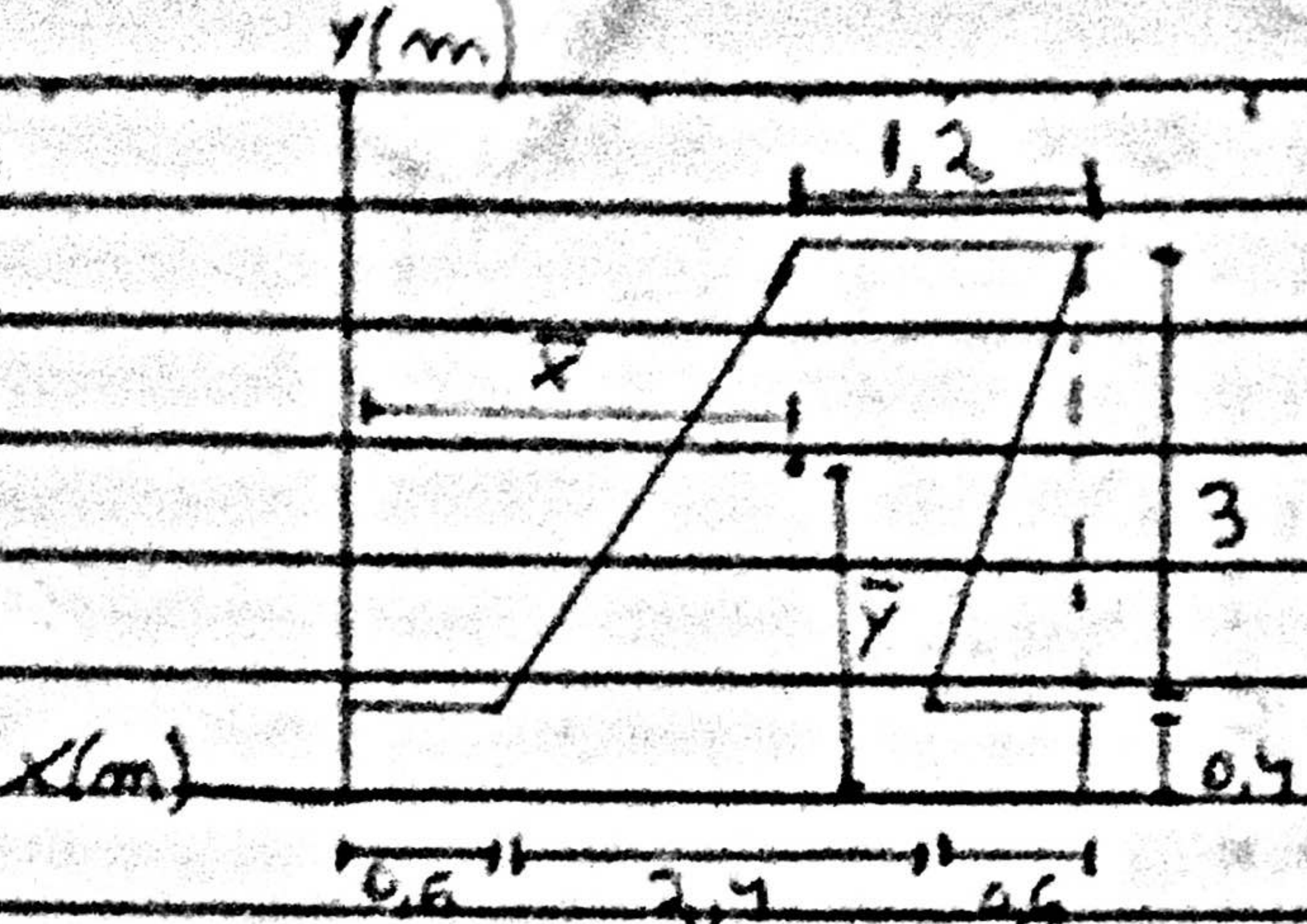
9.53



segments	$A (\text{mm}^2)$	$\bar{Y} (\text{mm})$	$\bar{Y} A$
1	$\pi \cdot 17.5^2 = 962.11$	$50 + 110 + 17.5 = 177.5$	170774.525
2	$15 \cdot 330 = 1650$	$50 + 55 = 105$	173250
3	$\pi \cdot 25^2 = 1963.49$	25	49087.25
$\Sigma = 4575.6$			$\Sigma = 393111.775$

$$\bar{Y} = \frac{\Sigma \bar{Y} A}{\Sigma A} = 85.9 \text{ mm}$$

9.54

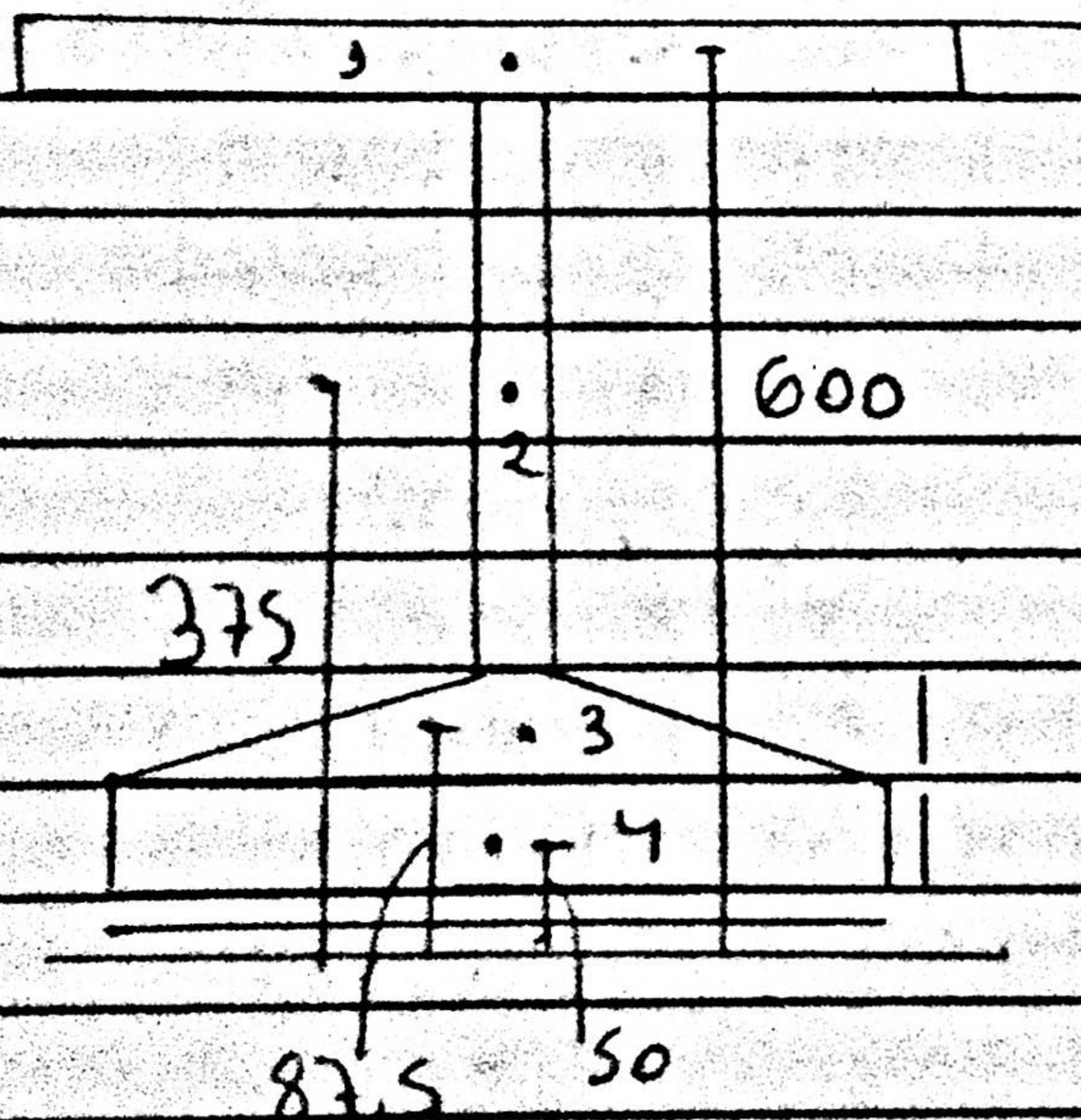
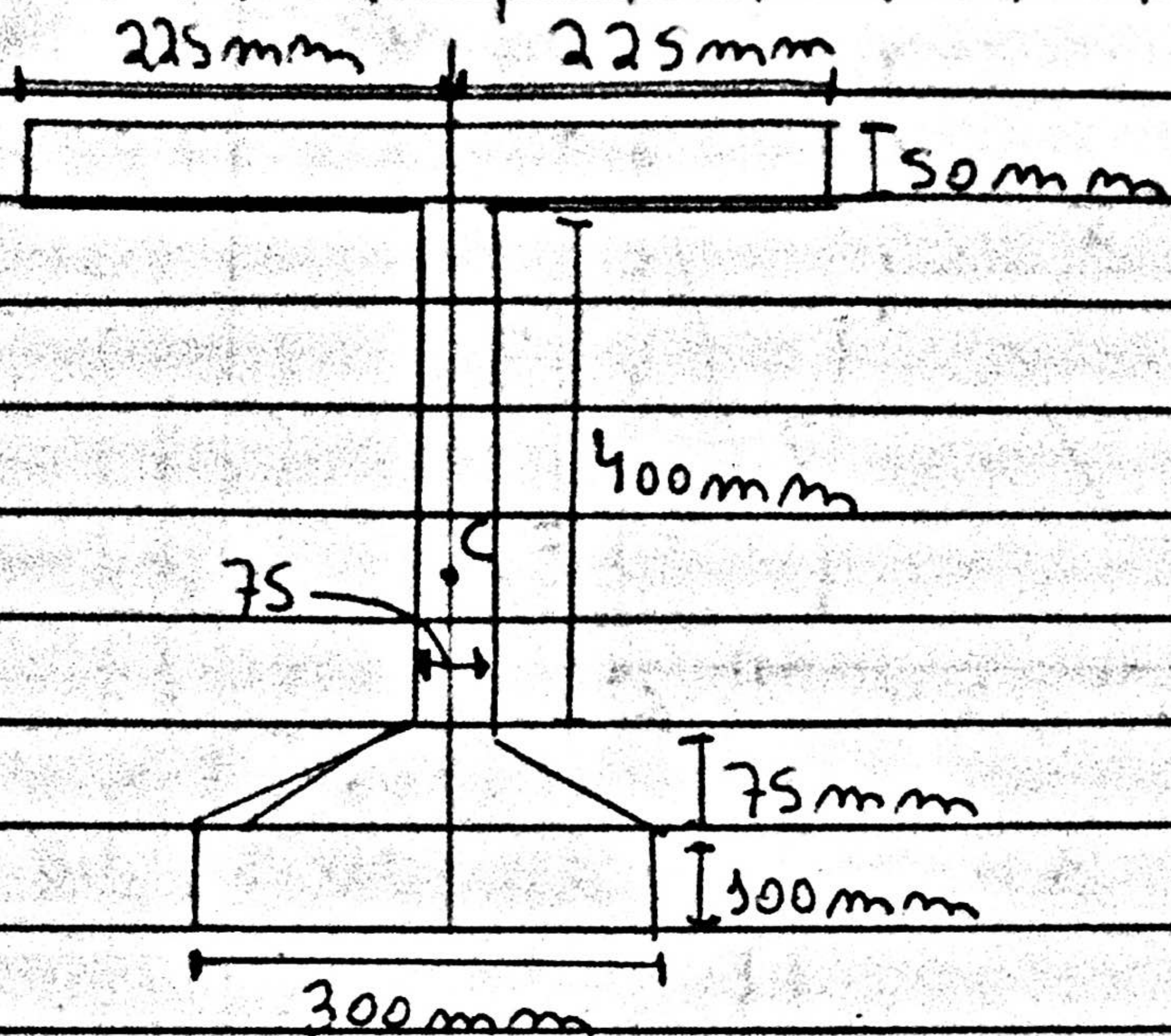


Segment	$A(m^2)$	$\bar{x}$	$\bar{y}$	$\bar{x}A(m)$	$\bar{y}A(m)$
1	$3.3 \times 1.8 = 5.94$	2.1	1.8	12.672	10.692
2	$3.6 \times 0.2 = 0.72$	1.8	0.2	1.296	0.144
3	$0.6 \times 0.2 = 0.12$	1.2	0.2	0.144	0.024
4	$0.6 \times 0.2 = 0.12$	3.4	0.2	1.064	0.024
	$\Sigma A = 6.84$			$\Sigma \bar{x}A = 15.192$	$\Sigma \bar{y}A = 10.88$

$$\bar{x} = \frac{\Sigma \bar{x}A}{\Sigma A} = 2.22 \text{ m}$$

$$\bar{y} = \frac{\Sigma \bar{y}A}{\Sigma A} = 1.59 \text{ m}$$

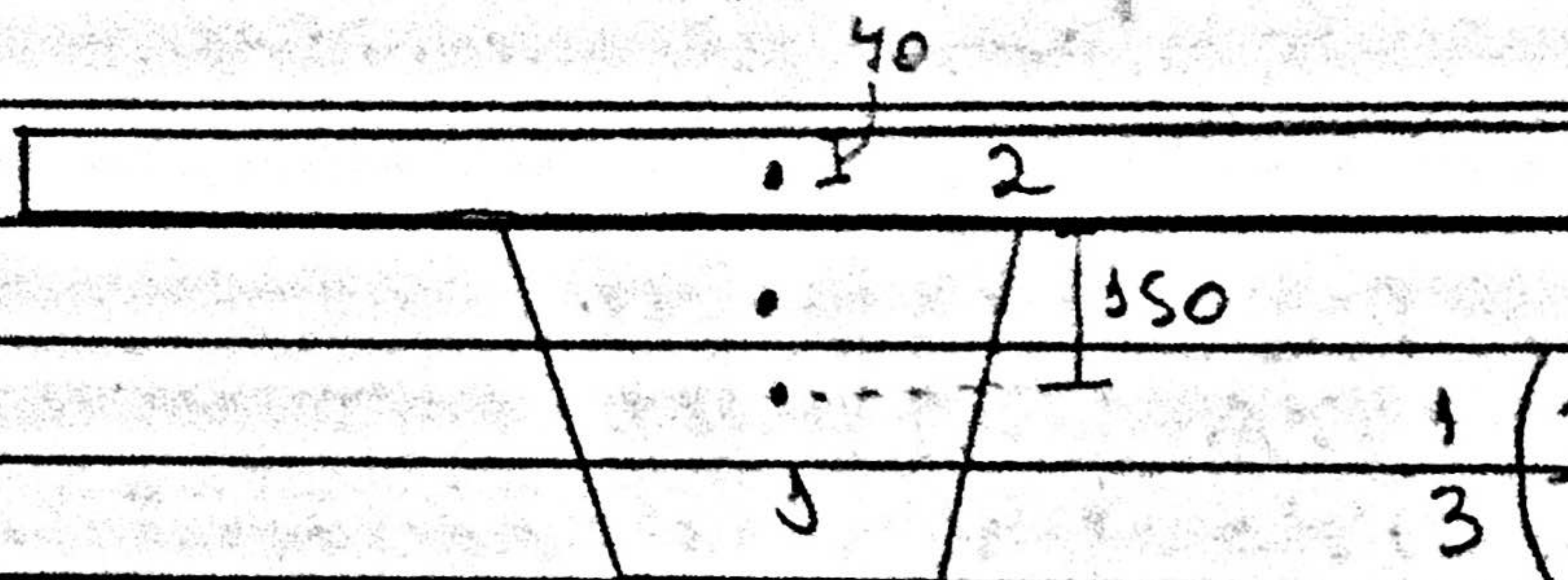
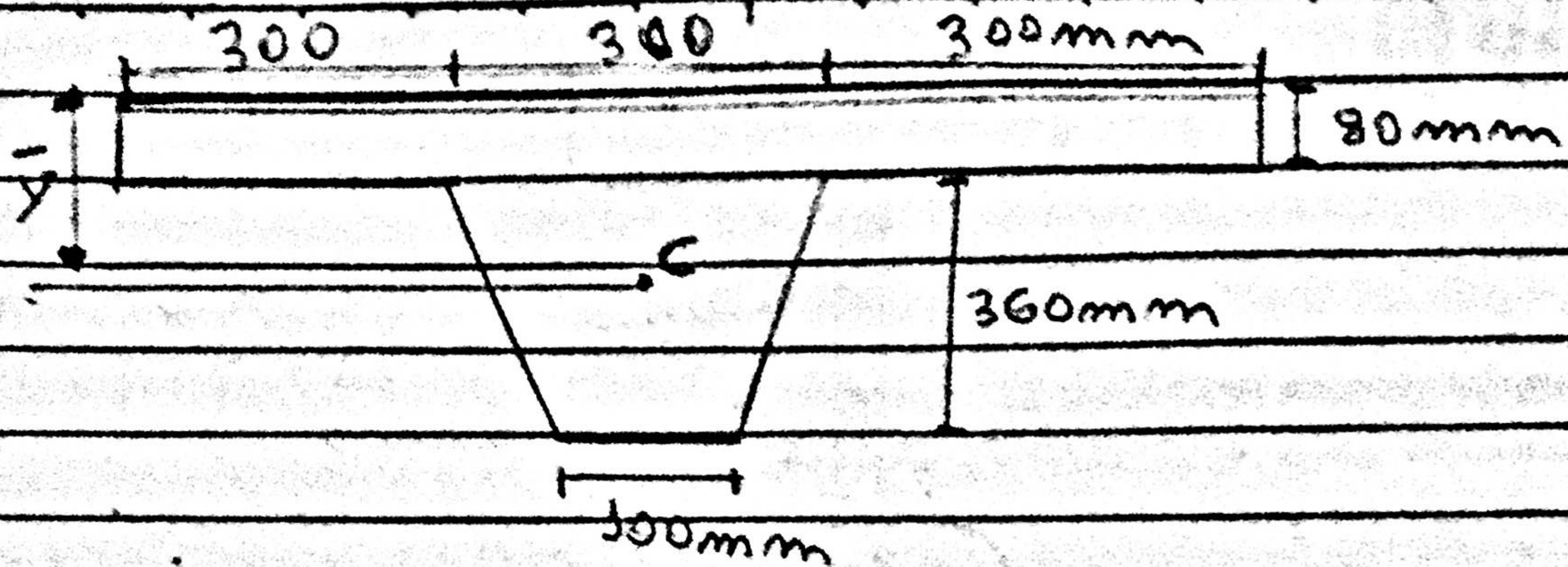
9.68



Segmento	$A(\text{mm}^2)$	$\bar{y}$	$\bar{y}A$
1	$450 \cdot 50 = 22500$	600	13500000
2	$75 \cdot 400 = 30000$	375	11250000
3	$\frac{75}{2}(75+300) = 14062,5$	87,5	1230468,75
4	$300 \cdot 100 = 30000$	50	1500000
$\Sigma A = 69562,5$			$\Sigma \bar{y}A = 27480468,75$

$$\bar{y} = 395 \text{ mm}$$

9.66



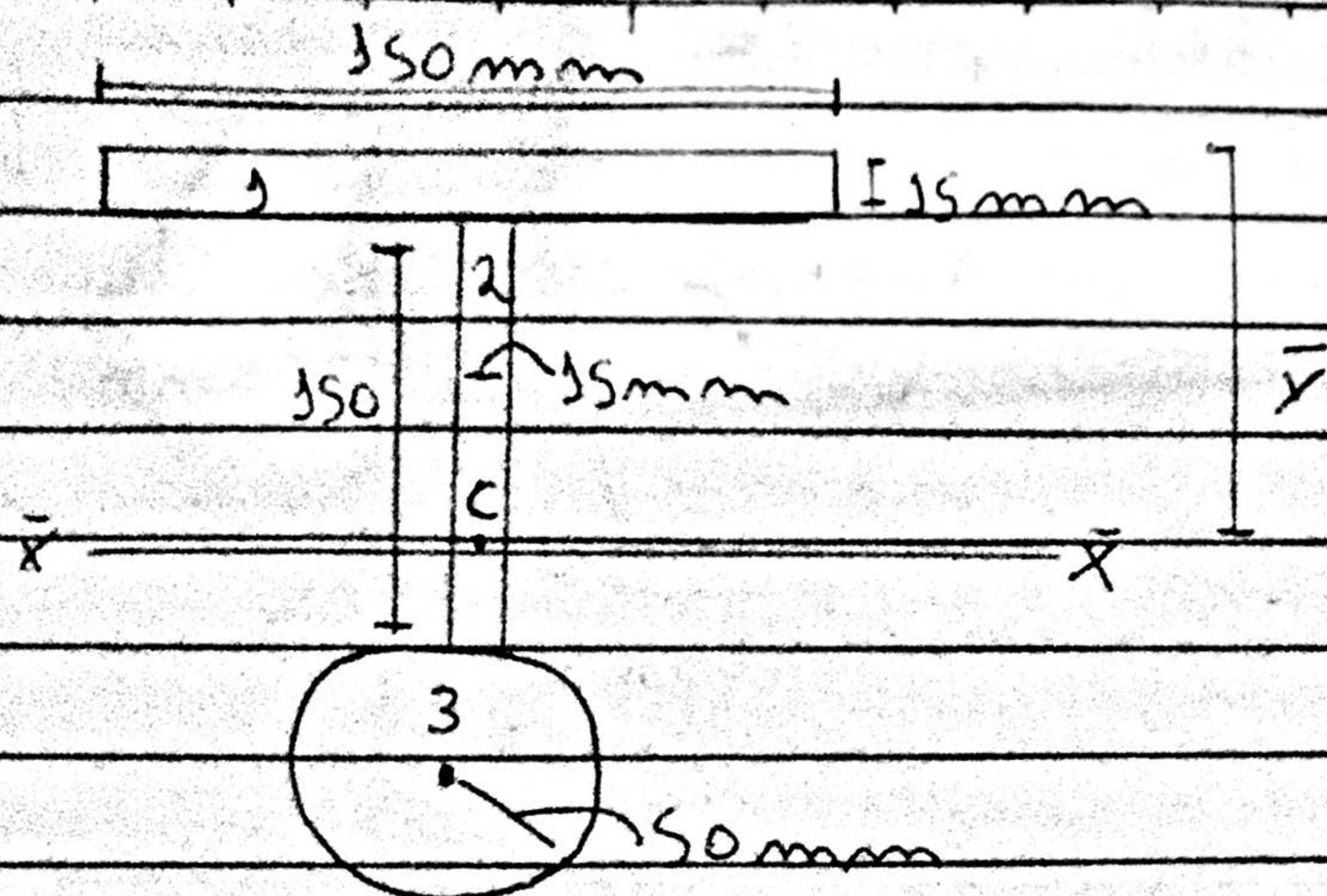
$$\frac{1}{3} \left(\frac{2(100) + 300}{400} \right) 360$$

$$Y = 150$$

Segment	A (mm ²)	$\bar{Y}$	$\bar{Y}A$
1	$900 \cdot 80 = 72000$	40	2880000
2	$360(300+100) = 72000$	230	16560000
	2		
	$\Sigma A = 144000$		$\Sigma \bar{Y}A = 19440000$

$$\bar{Y} = 135 \text{ mm}$$

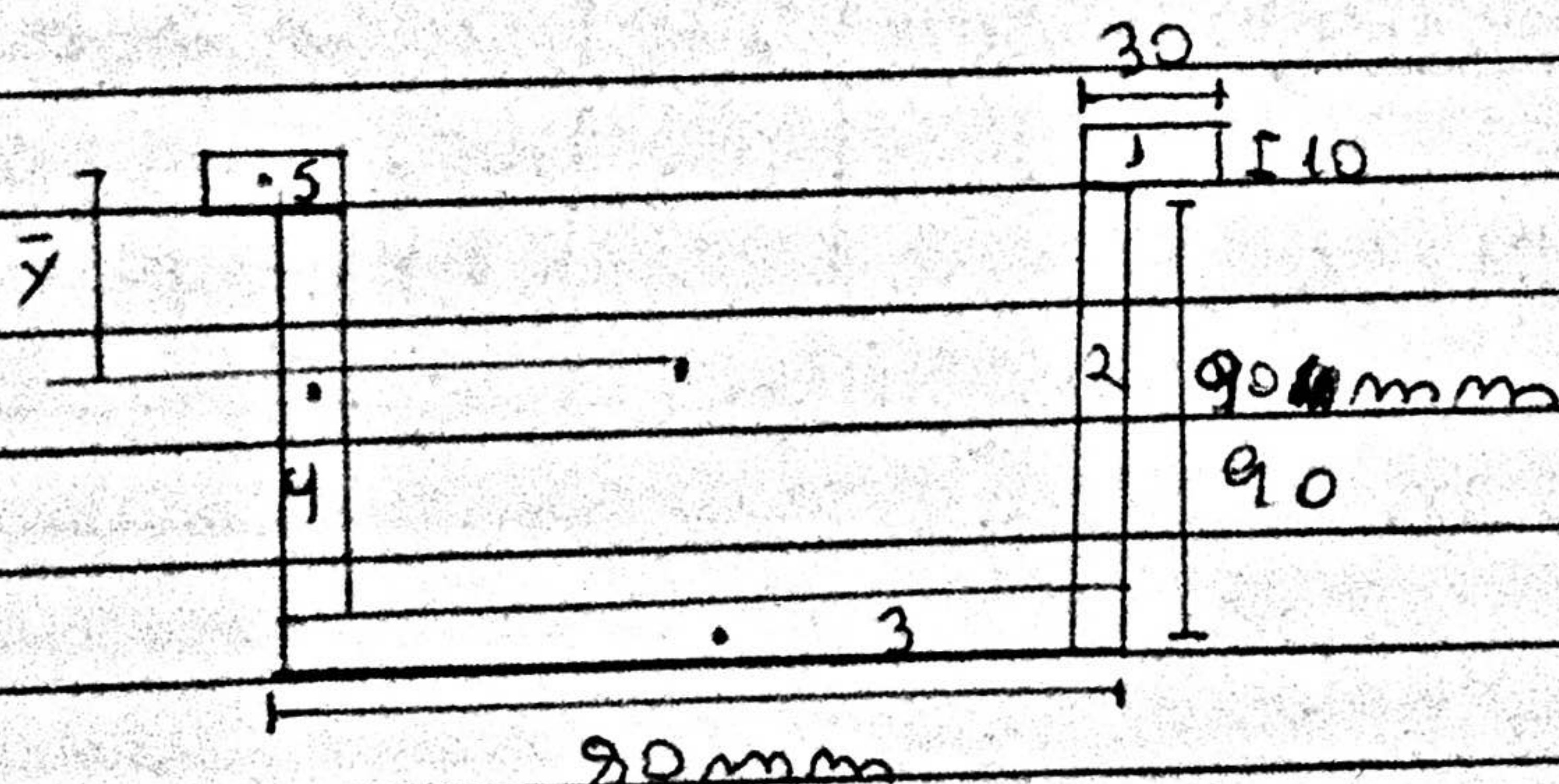
9.57



segmento	$A(\text{mm}^2)$	$\bar{y}$	$\bar{y}A$
1	$150 \cdot 15 = 2250$	7,5	16875
2	$150 \cdot 15 = 2250$	90	202500
3	$\pi 50^2 = 7853,98$	215	1688605,7
	$\Sigma A = 12353,98$		$\Sigma \bar{y}A = 1907980,7$

$$\bar{y} = 154,4 \text{ mm}$$

9.55

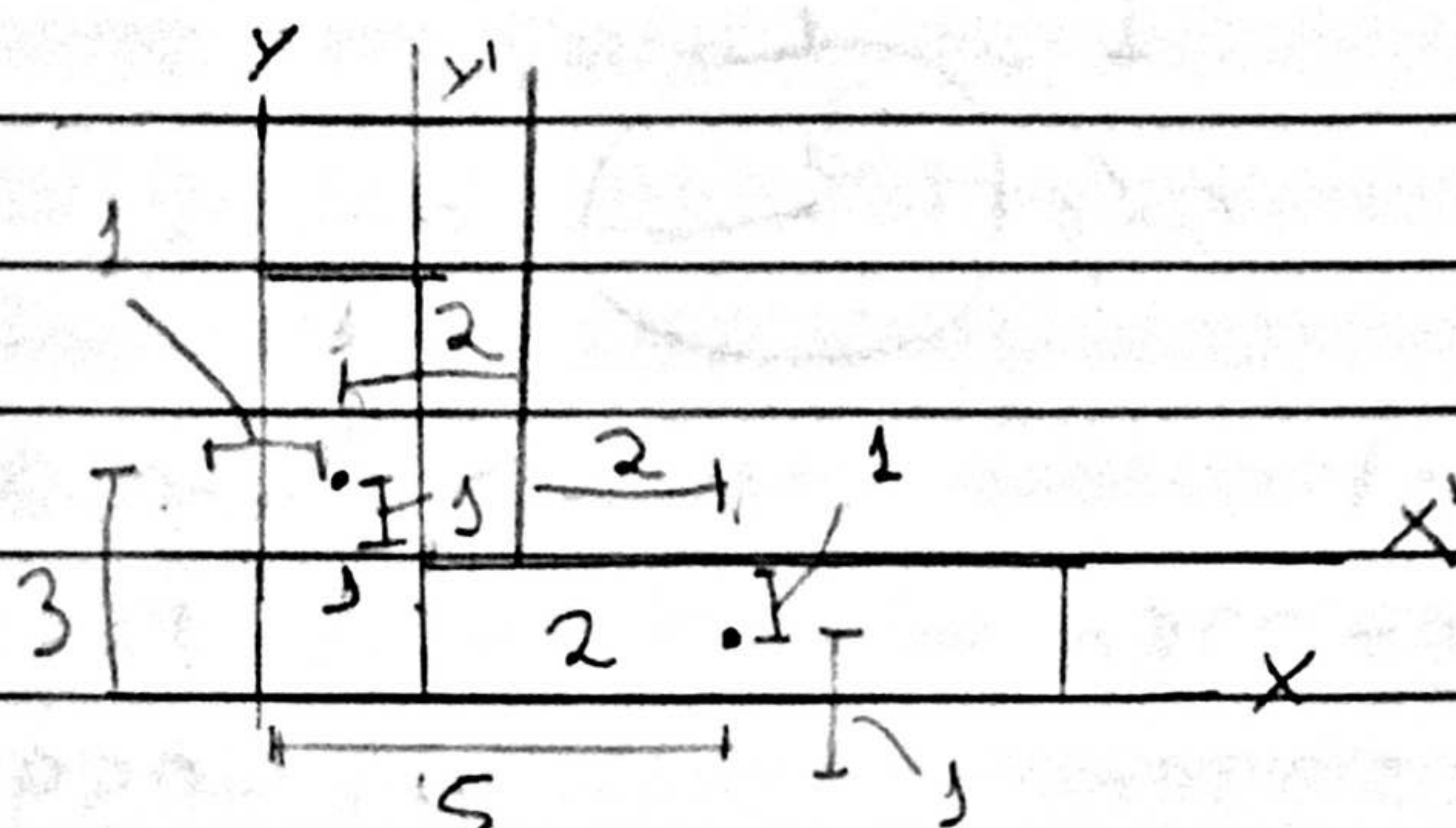
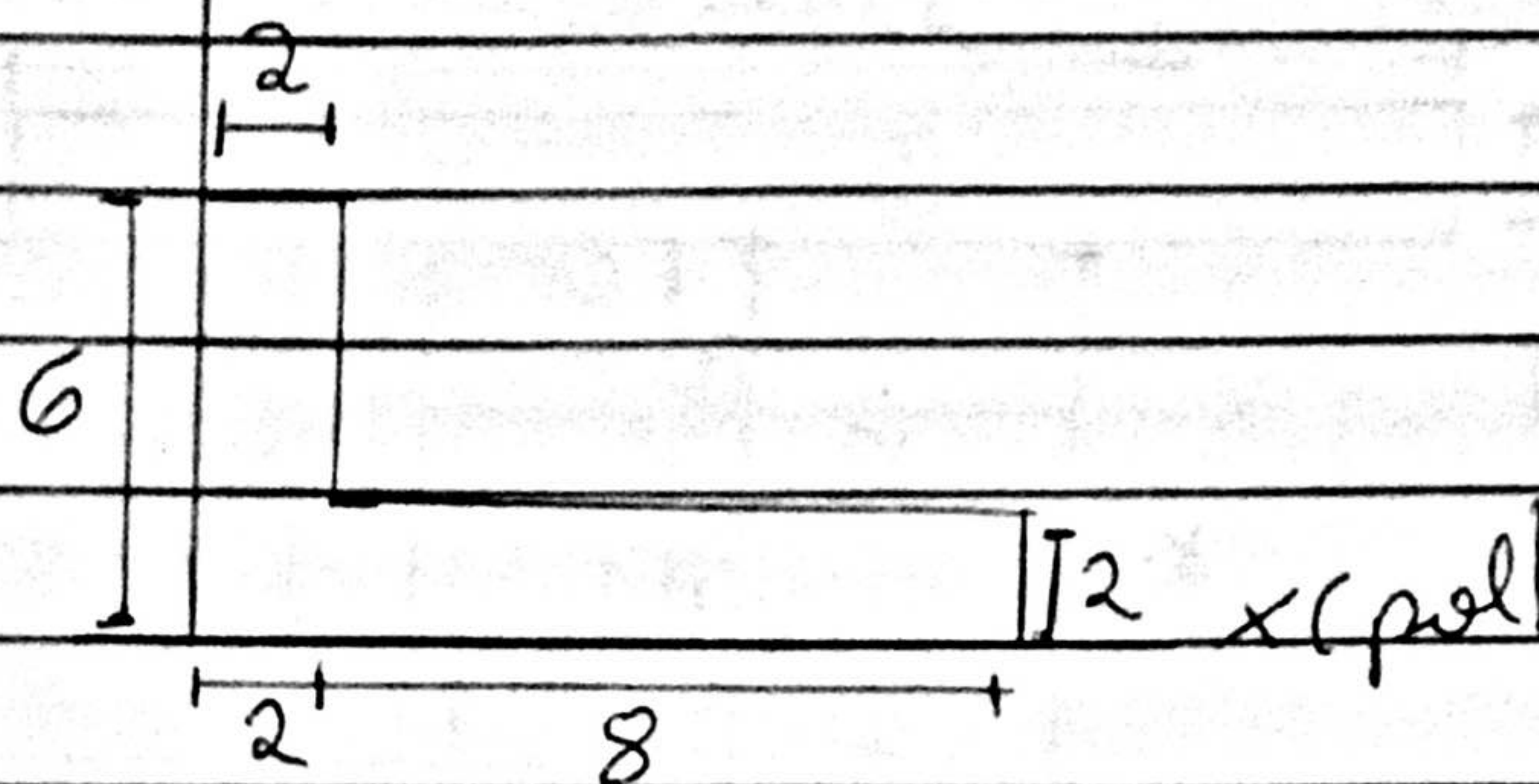


$$\bar{y} = 53 \text{ mm}$$

segmento	$A(\text{mm}^2)$	$\bar{y}$	$\bar{y}A$
1	$30 \cdot 10 = 300$	5	1500
2	$90 \cdot 10 = 900$	55	49500
3	$60 \cdot 10 = 600$	95	57000
4	$90 \cdot 10 = 900$	55	49500
5	$30 \cdot 10 = 300$	5	1500
	$\Sigma A = 3000$		$\Sigma \bar{y}A = 159000$

$y(\text{pol})$

10.30



Segmento	$A(\text{pol}^2)$	$\bar{X}$	$\bar{Y}$	$\bar{X}A$	$\bar{Y}A$
1	$6 \cdot 2 = 12$	1	3	12	36
2	$6 \cdot 2 = 12$	5	1	60	12
	$\Sigma A = 24$			$\Sigma \bar{X}A = 72$	$\Sigma \bar{Y}A = 48$

$$\bar{X} = 3 \text{ pol}$$

$$\bar{Y} = 2 \text{ pol}$$

10.31

$$I_x = \bar{I}_x + A(dx)^2$$

$$I_x = \frac{b(h)^3}{12} + A(dx)^2$$

$$\textcircled{1} I_x = \frac{2(6)^3}{12} + (6 \cdot 2)(1)^2$$

$$I_x = 36 + 12 = 48 \text{ pol}^4$$

$$\textcircled{2} I_x = \frac{6(2)^3}{12} + (6 \cdot 2)(-1)^2$$

$$I_x = 16 \text{ pol}^4$$

$$\Sigma I_x = 64 \text{ pol}^4$$

$$I_y = \bar{I}_y + A(dx)^2$$

$$I_y = \frac{h(b)^3}{12} + A(dx)^2$$

$$\textcircled{1} I_y = \frac{6(2)^3}{12} + (6 \cdot 2)(2)^2$$

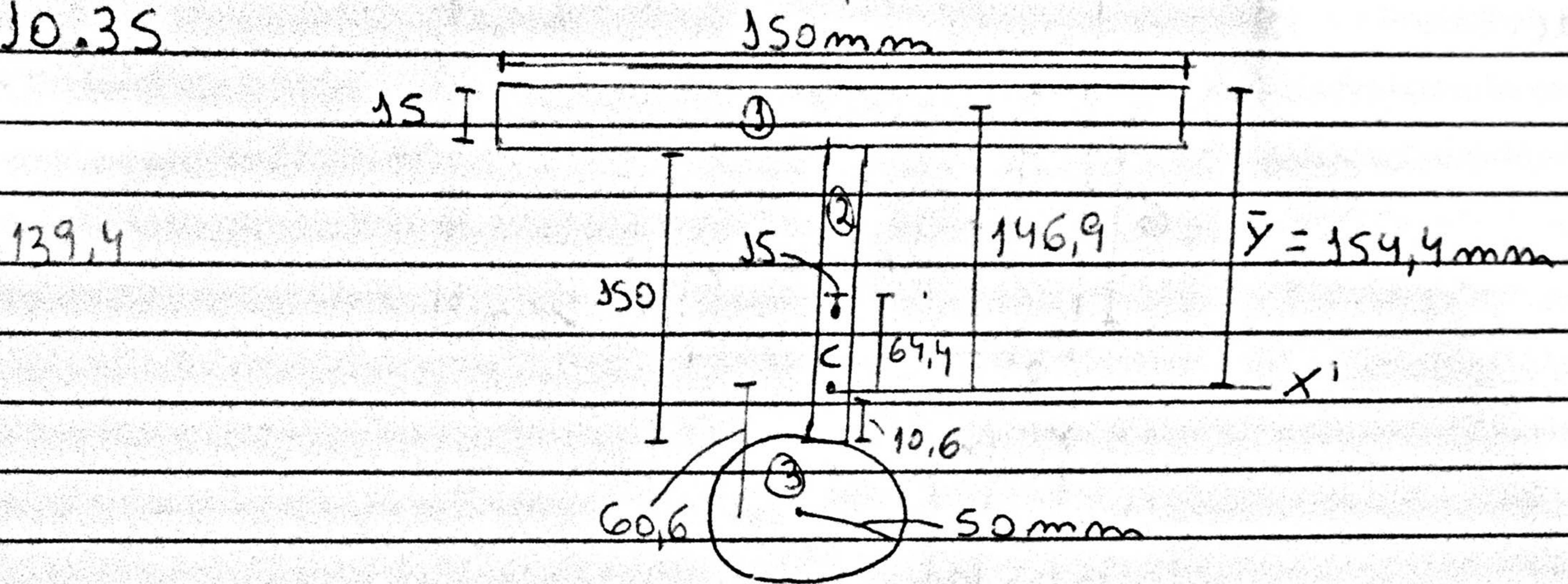
$$I_y = 4 + 48 = 52 \text{ pol}^4$$

$$\textcircled{2} I_y = \frac{2(6)^3}{12} + (6 \cdot 2)(2)^2$$

$$I_y = 36 + 48 = 84 \text{ pol}^4$$

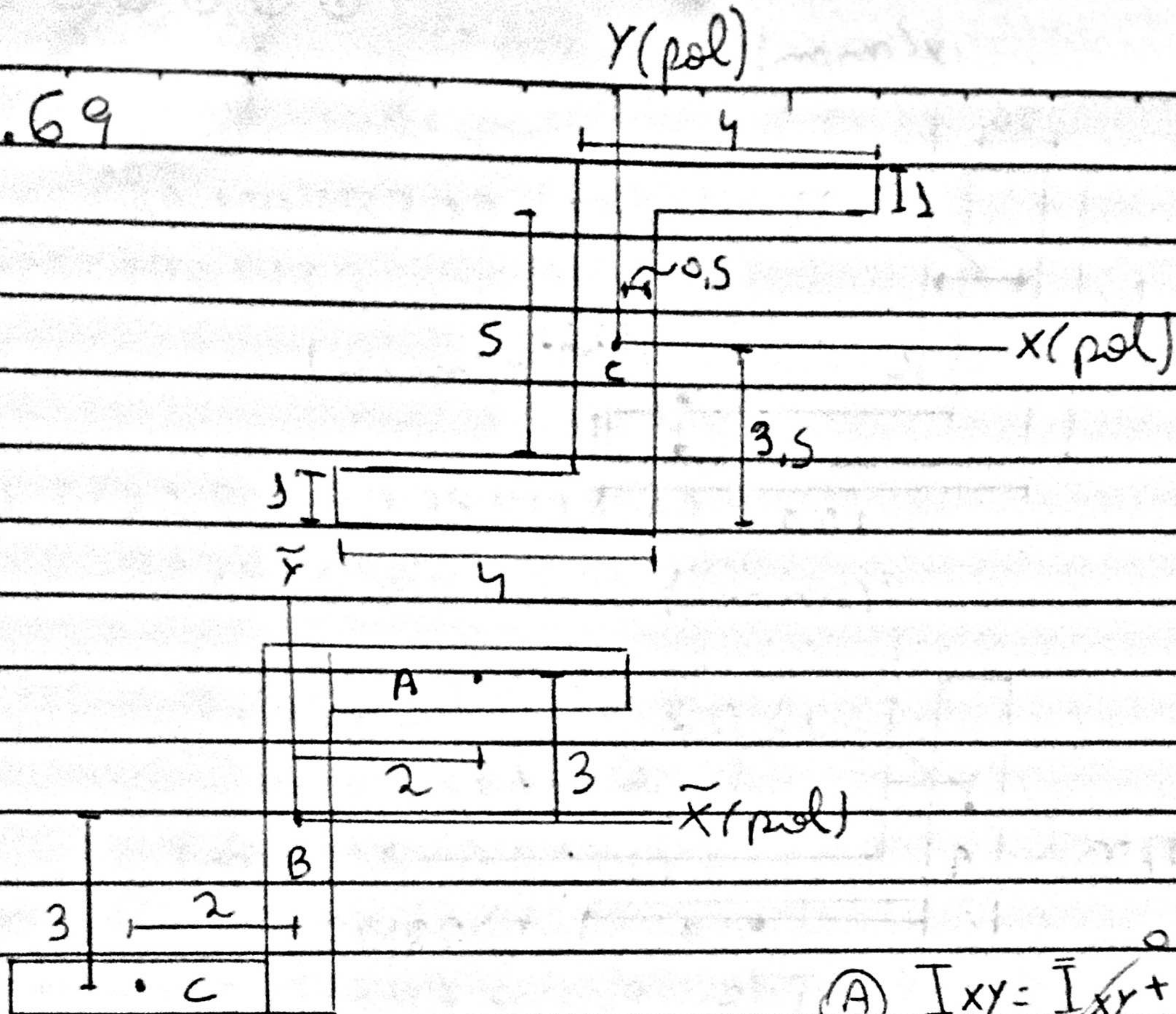
$$\Sigma I_y = 136 \text{ pol}^4$$

10.35



Segment	A (mm ²)	① $I_x = \frac{150(15)^3}{12} + 2250 \cdot (146.9)^2$
1	$150 \cdot 15 = 2250$	
2	$150 \cdot 15 = 2250$	$I_x = 48596310$
3	$\pi 50^2 = 7853.98$	
③		② $I_x = \frac{15(150)^3}{12} + 2250 \cdot (64.4)^2$
	$I_x = \frac{\pi 50^4}{4} + 7853.98 \cdot (60.6)^2$	$I_x = 4218750 + 9331560$
	$I_x = 4908738.52 + 28842641.99$	$= 13550310$
	$= 33751380.51$	
		$\Sigma I_x = 95.9(10^6) \text{ mm}^4$

10.69



$$\textcircled{A} \quad I_{xy} = \bar{I}_{xy} + A d_x d_y$$

$$I_{xy} = (3.1)(+2)(+3)$$

$$I_{xy} = 18 \text{ pol}^4$$

$$\textcircled{B} \quad I_{xy} = 0$$

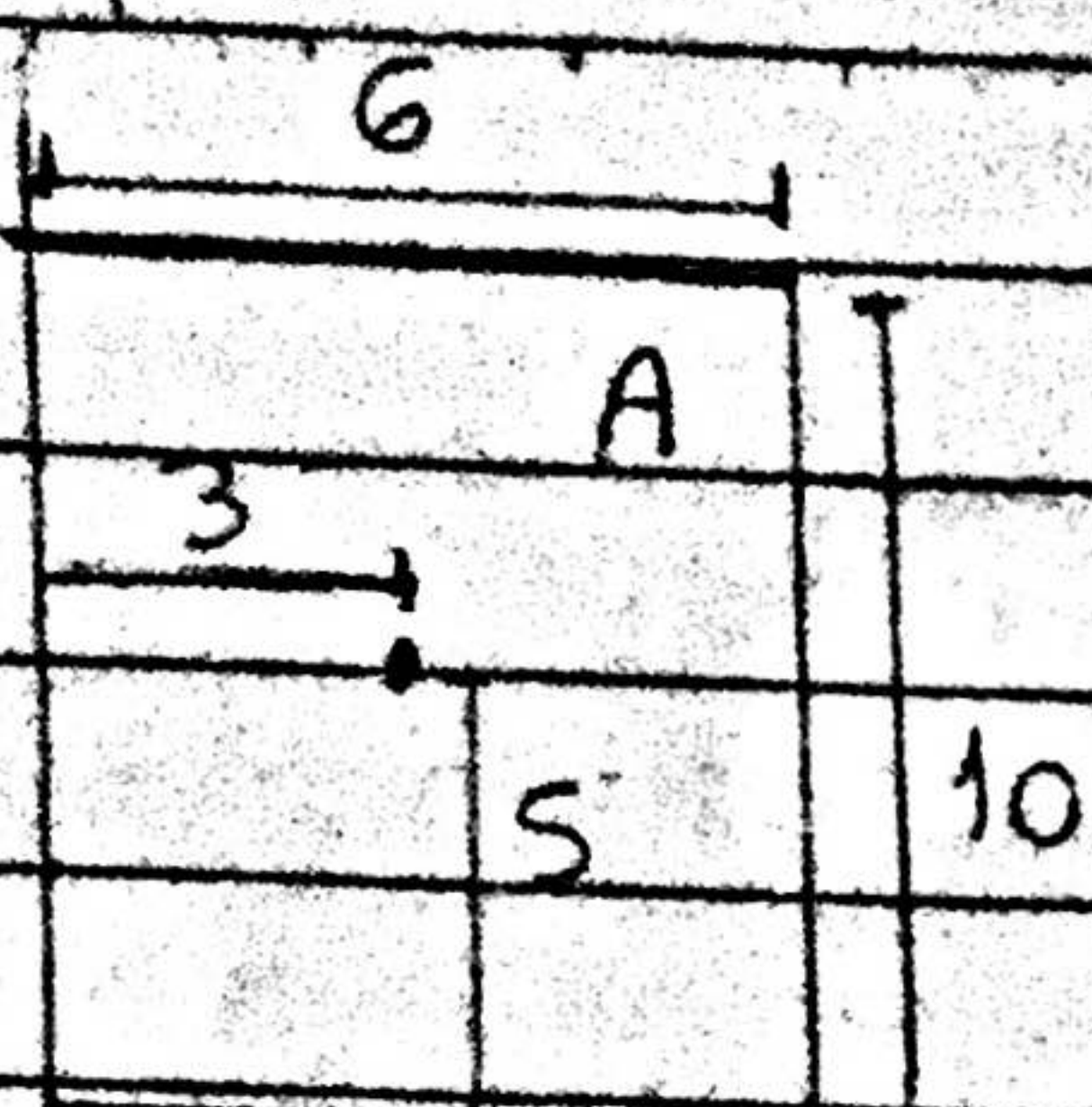
$$\textcircled{C} \quad I_{xy} = (3.1)(-2)(-3)$$

$$I_{xy} = 18 \text{ pol}^4$$

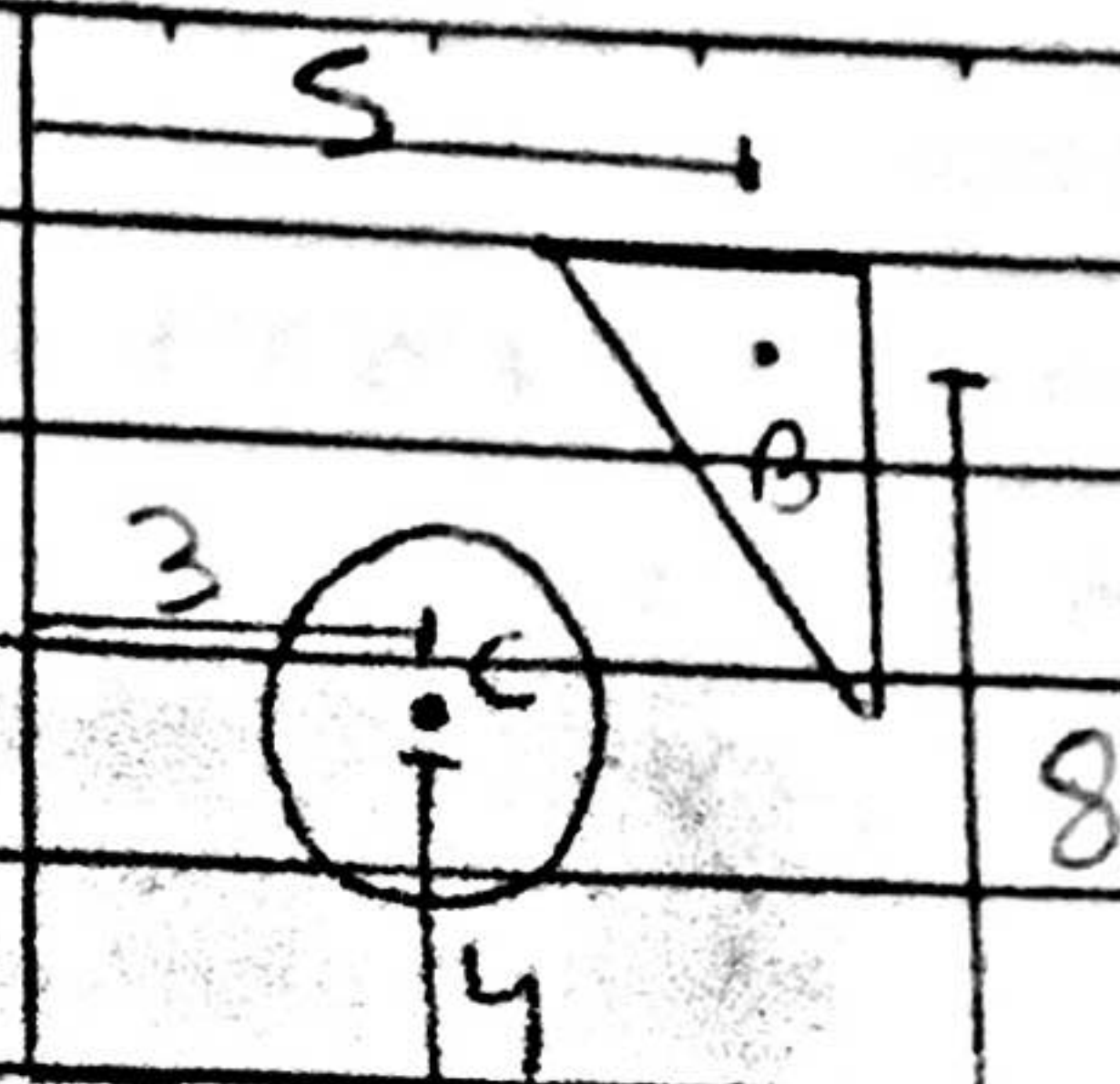
$$\sum I_{xy} = 36 \text{ pol}^4$$

$\bar{y}(\text{pol})$

10.34

 $\bar{x}(\text{pol})$ $\bar{y}(\text{pol})$

⑤ ① ④ ④ ⑤ ⑤

 $\bar{x}(\text{pol})$

①

$$I_x = 6(10)^3/12 + (6 \cdot 10)(5)^2$$

$$I_x = 500 + 1500$$

$$I_x = 2000 \text{ pol}^4$$

$$\Sigma I_x = A - B - C$$

$$\textcircled{B} I_x = 3(6)^3/36 + (3 \cdot 6/2)(8)^2$$

$$I_x = 18 + 9.64$$

$$I_x = +594 \text{ pol}^4$$

$$\Sigma I_x = 1192.48 \text{ pol}^4$$

$$\textcircled{C} I_x = \pi \cdot 2^4/4 + (\pi \cdot 2^2)(4)^2$$

$$I_x = 12.56 + 12.56 \cdot 16$$

$$I_x = 213.62 \text{ pol}^4$$

$$\textcircled{A} I_y = 10(6)^3/12 + (10 \cdot 6)(3)^2$$

$$I_y = 180 + 540$$

$$I_y = 720$$

$$\textcircled{B} I_y = 6(3)^3/36 + (3 \cdot 6/2)(5)^2$$

$$I_y = 4.5 + 9(25)$$

$$I_y = 229.5$$

$$\Sigma I_y = A - C - B$$

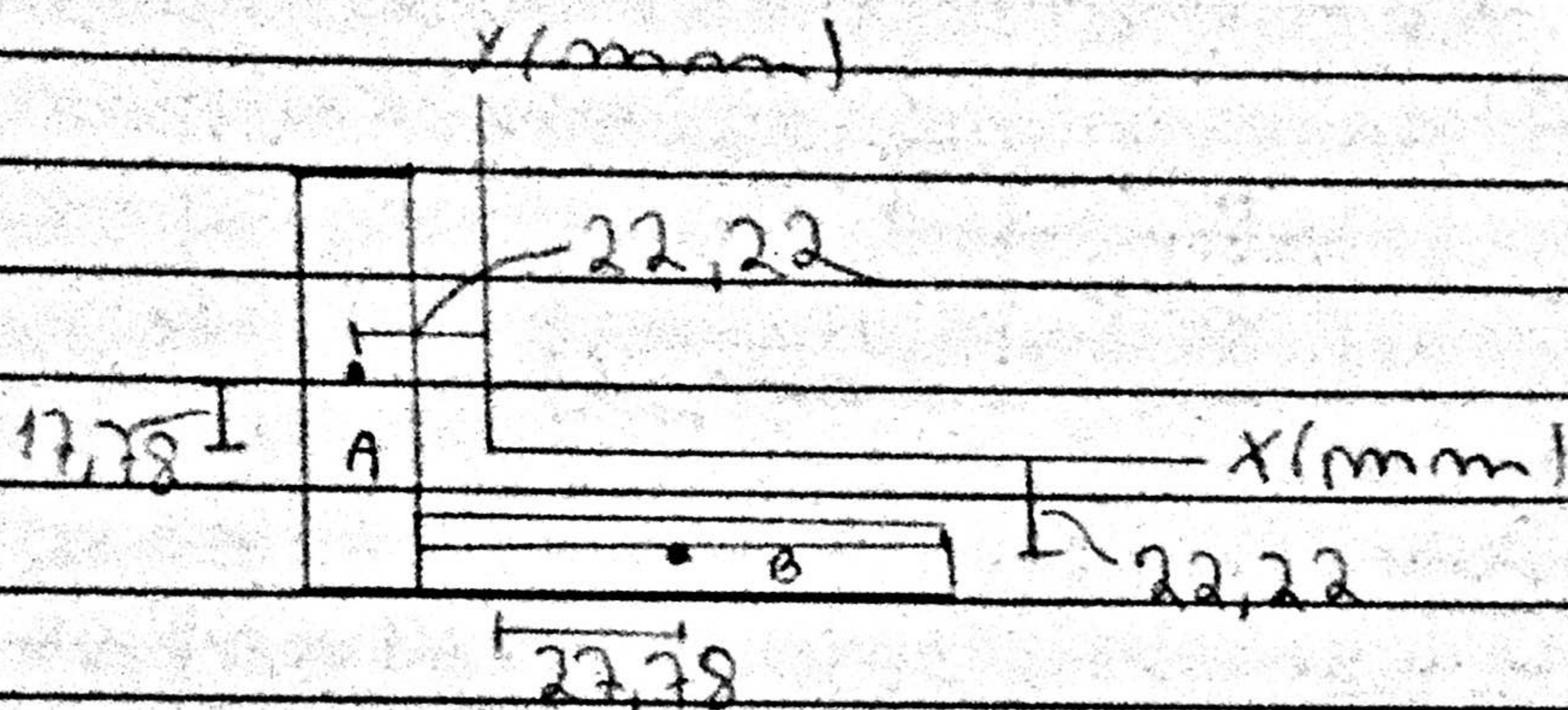
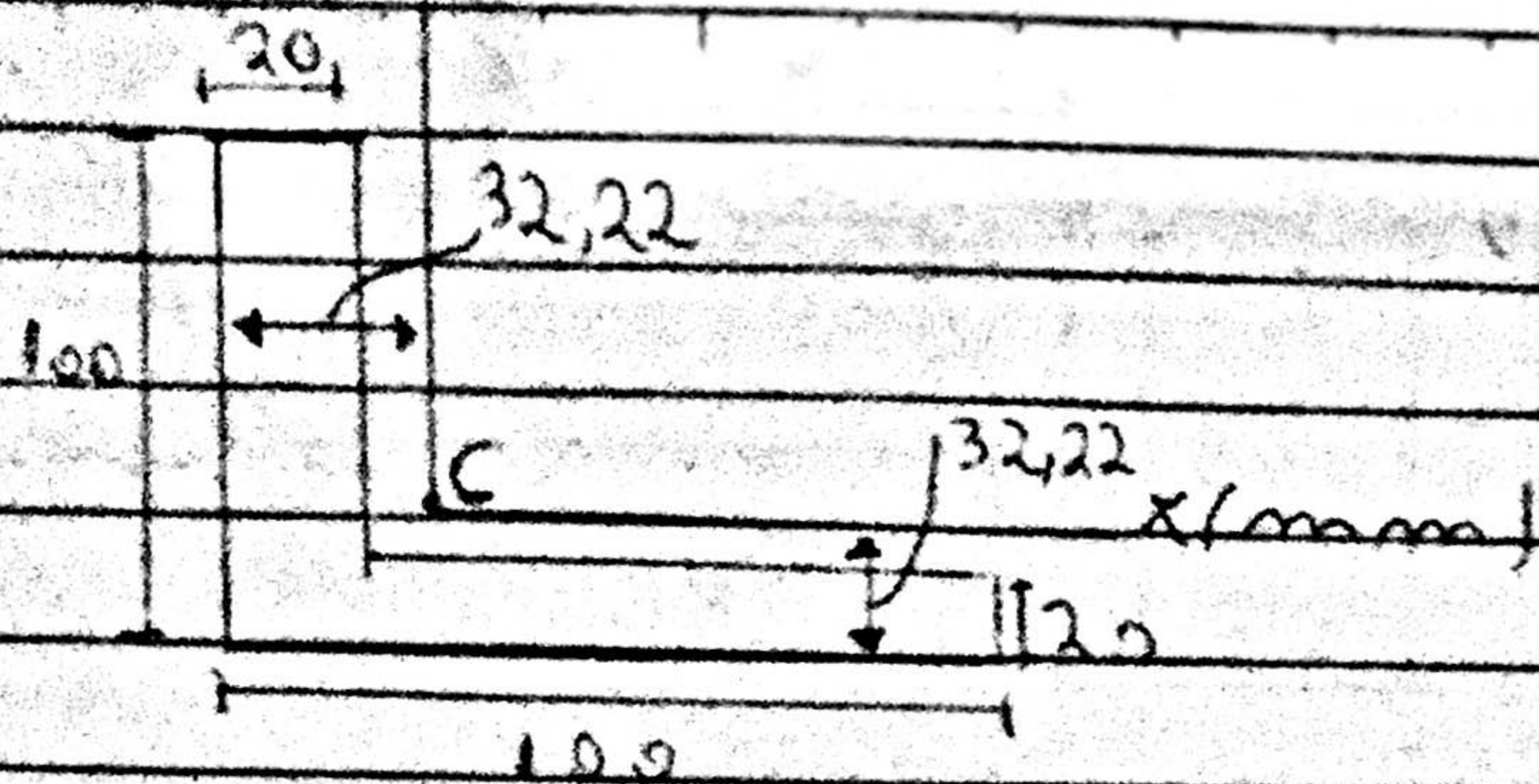
$$\Sigma I_y = 364.9 \text{ pol}^4$$

$$\textcircled{C} I_y = \pi (2)^4/4 + (\pi \cdot 2^2)(3)^2$$

$$I_y = 12.56 + 12.56 \cdot 9$$

$$I_y = 125.6$$

10.82



①

$$I_x = 20(100)^3/12 + (20 \cdot 100)(17,78)^2$$

$$I_x = 1,6(10^9) + 632256,8$$

$$I_x = 2298923,5 \text{ mm}^4$$

$$\Sigma I_x = 3142222,27 \text{ mm}^4$$

②

$$I_x = 80(20)^3/12 + (80 \cdot 20)(22,22)^2$$

$$I_x = 53333,33 + 789965,44$$

$$I_x = 843298,77 \text{ mm}^4$$

③

$$I_y = 100(20)^3/12 + (100 \cdot 20)(22,22)^2$$

$$I_y = 66666,66 + 987456,8$$

$$I_y = 1054123,46 \text{ mm}^4$$

$$\Sigma I_y = 3142222,22 \text{ mm}^4$$

④

$$I_y = 20(80)^3/12 + (20 \cdot 80)(27,78)^2$$

$$I_y = 853333,33 + 1234765,44$$

$$I_y = 2088098,77 \text{ mm}^4$$

A

$$I_{xy} = (20.100)(-22,22)(17,78)$$

$$I_{xy} = -790.143,2$$

$$\Sigma I_{xy} = -1777777,36$$

B

$$I_{xy} = (20.80)(27,78)(-22,22)$$

$$I_{xy} = -987634,56$$

$$I_{\max} = \frac{I_x + I_y}{2} \pm \sqrt{\left(\frac{I_x - I_y}{2}\right)^2 + I_{xy}^2}$$

$$I_{\min} = 3142222,23 \pm 1777777,36$$

$$I_{\max} = 4919999,99 \text{ mm}^4$$

$$I_{\min} = 1364444,47 \text{ mm}^4$$