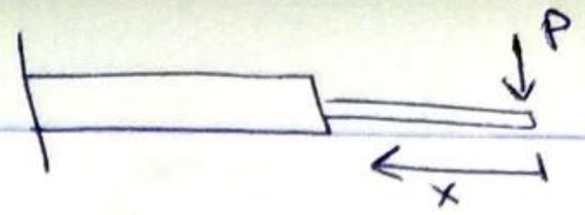
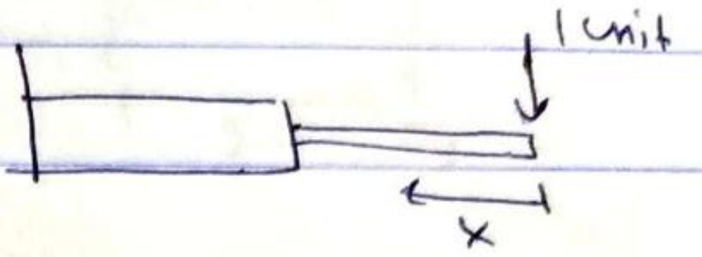
*Q 1: @ .



$M = Px$



$m = x$

Δ_c = maximum deflection.

$$\Delta_c = \int_0^{2L/3} \frac{(-Px)(-x)}{EI}\,dx + \int_{2L/3}^{L} \frac{(-Px)(-x)}{E(2I)}\,dx$$

$$= \frac{Px^3}{3EI}\Big|_0^{2L/3} + \frac{Px^3}{6EI}\Big|_{2L/3}^{L}$$

$$= \frac{8PL^3}{81EI} + \frac{27\times PL^3}{27\times 6EI} - \frac{8PL^3}{27\times 6EI} = \frac{35PL^3}{162EI}$$

- maximum deflection $\frac{L}{360}$

$L = 6m$

$P = 120\,kN$

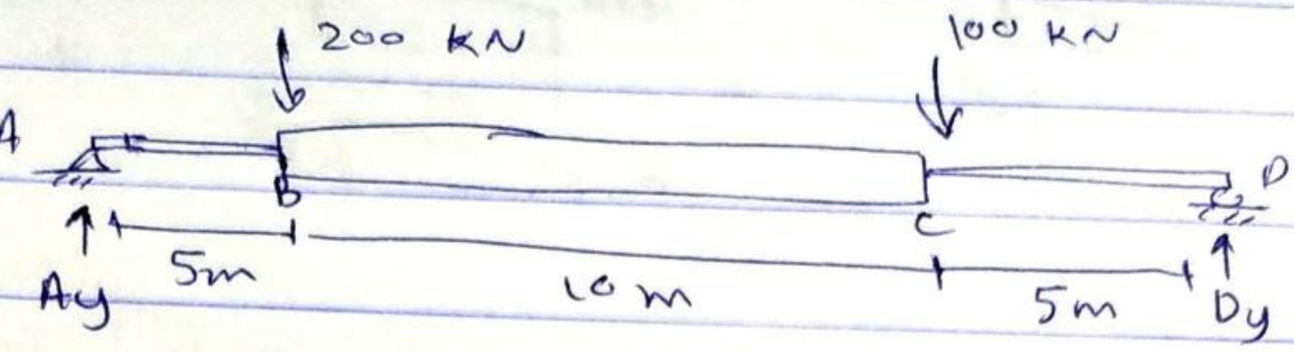
$E = 200\,GPa$

$$\frac{L}{360} = \frac{35PL^3}{162EI}$$

$$\frac{6}{360} = \frac{35\,(120\times10^3)\,(6)^3}{162\,(200\times10^9)I}$$

$$\Rightarrow \boxed{I = 1.68\times10^9\ mm^4}$$

(b) • Rotation at B:

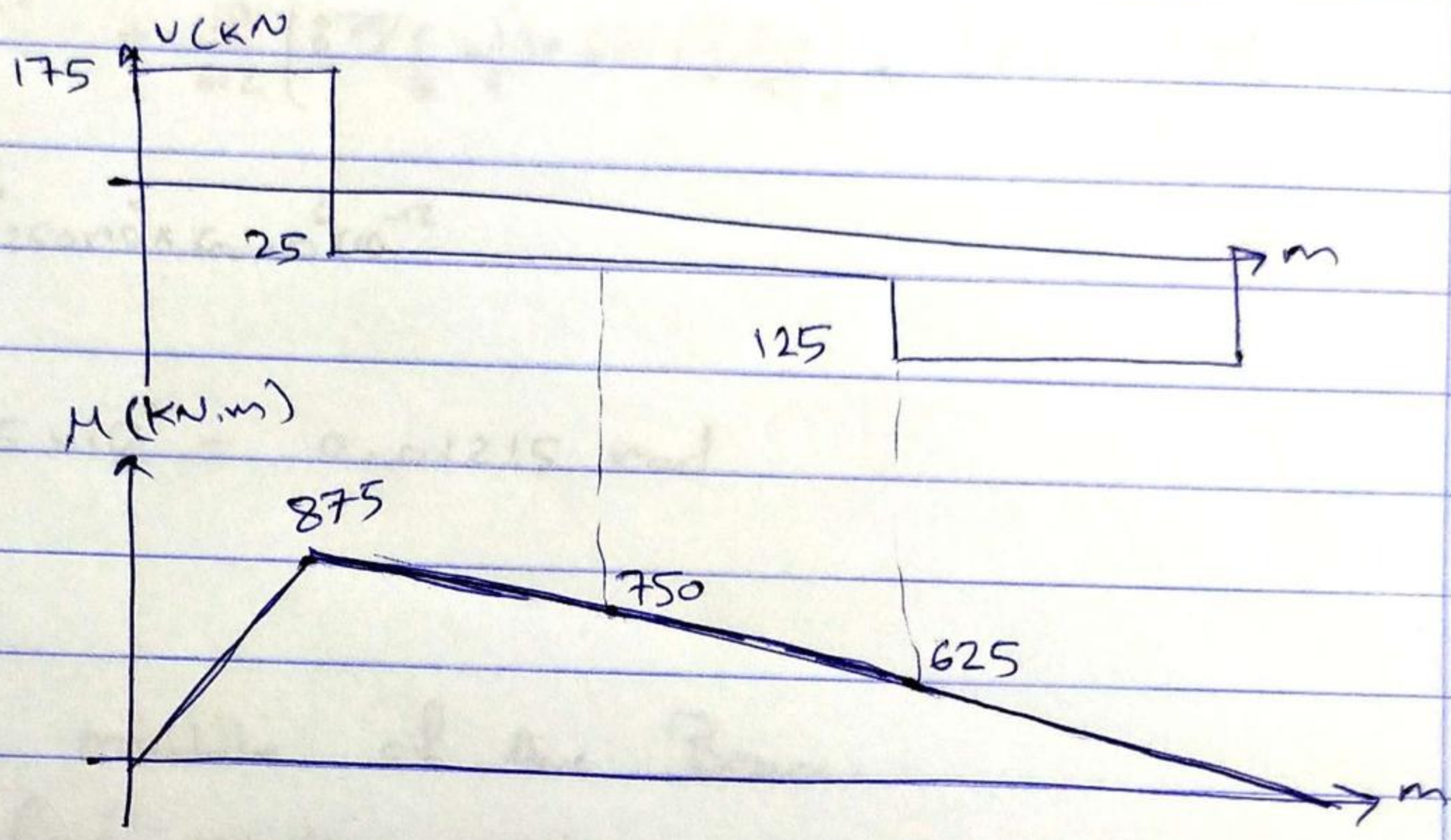


$\circlearrowleft \Sigma M_A = 0$

$200(5) + 100(15) = Dy(20)$

$Dy = 125\ kN \uparrow$

$Ay = 175 kN \uparrow$



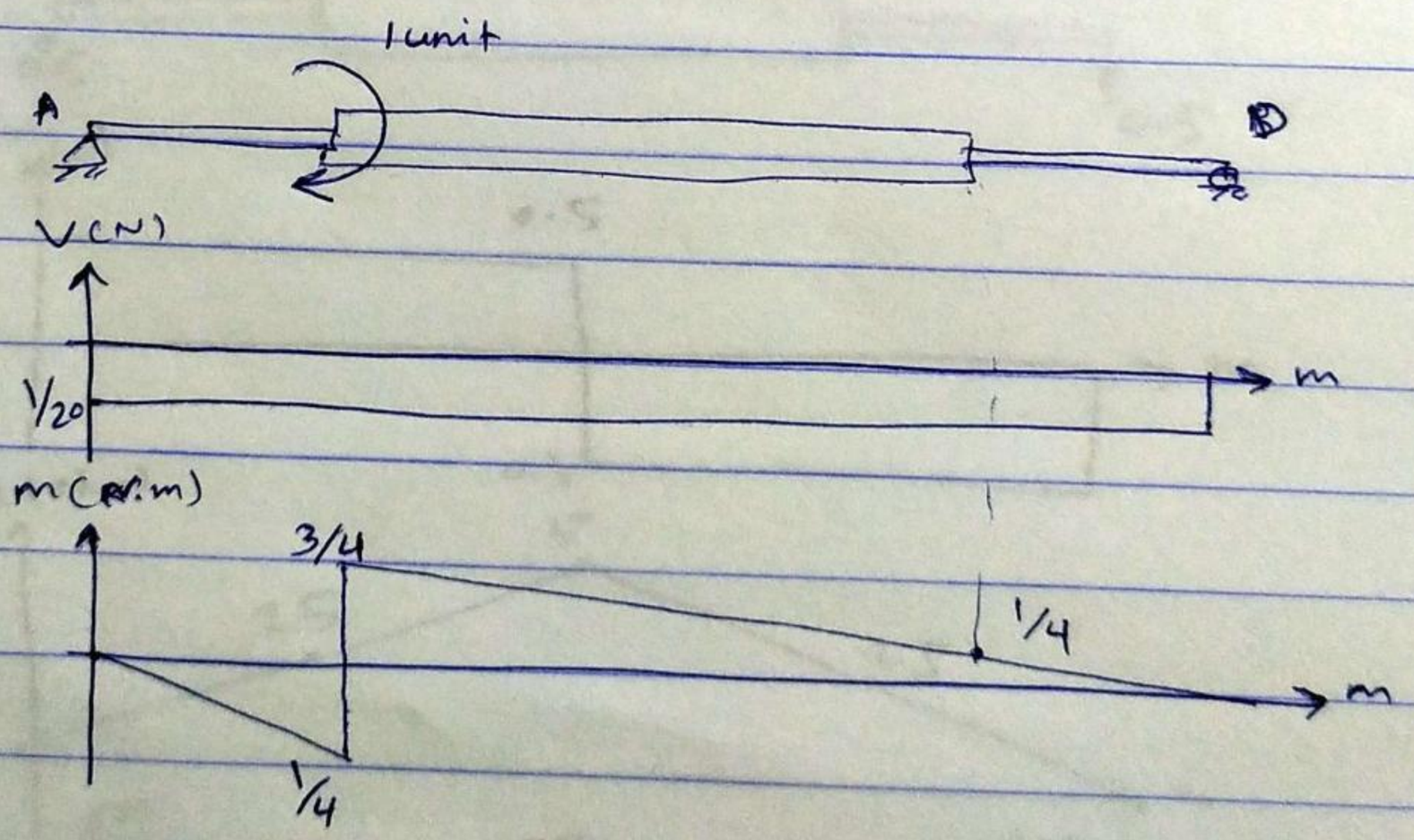
• Assume 1 unit moment at B:-

$\circlearrowleft \Sigma M_A = 0$

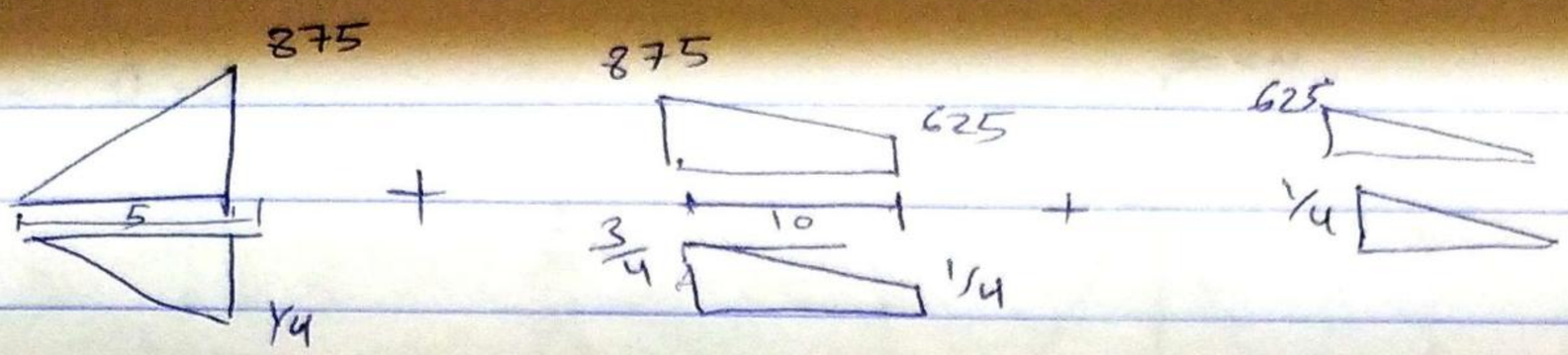
$1 = Dy(20)$

$Dy = \frac{1}{20} N \uparrow$

$Ay = 1/20\ N \downarrow$



θ_B =



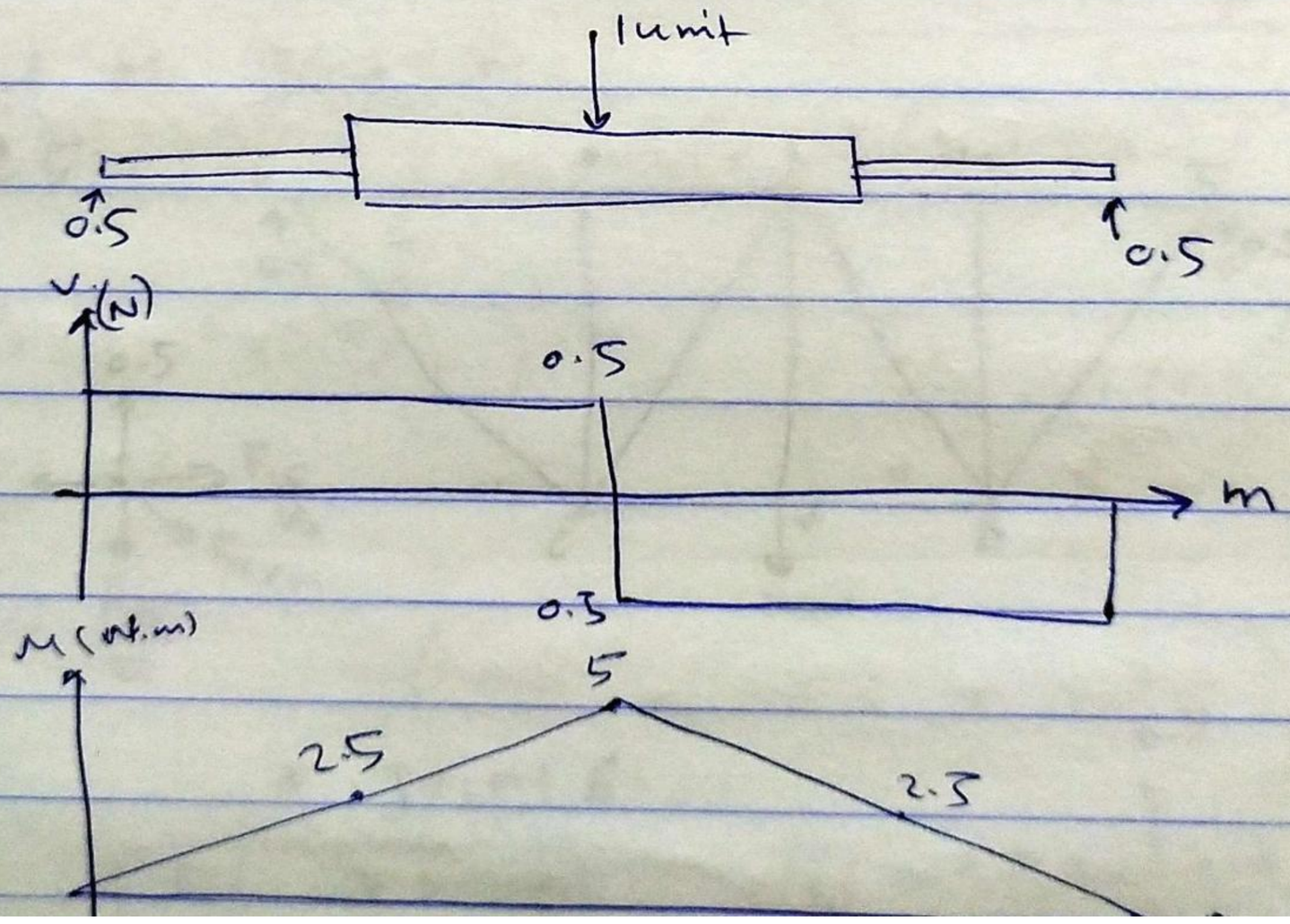
$$= \left(\frac{(5)(875)(-\frac{1}{4})}{3} + \frac{10}{6\times2}\left(875\left(\frac{6}{4}+\frac{1}{4}\right)+625\left(\frac{2}{4}+\frac{3}{4}\right)\right) + \left(\frac{1}{4}\right)\frac{(5)(625)}{3} \right) / EI$$

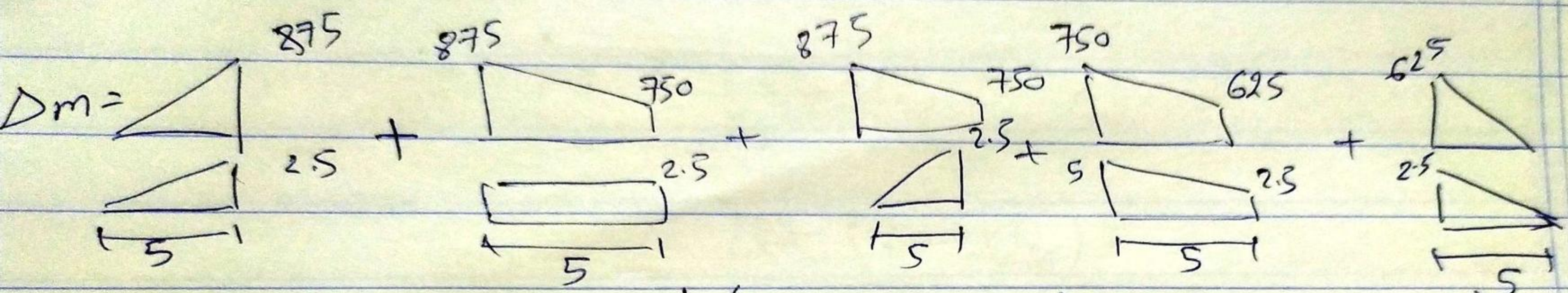
$$= 1822.9\times10^{3} / 250\times10^{9}\times600\times10^{6}\times10^{-12}$$

$$= 0.01215\times10^{0} = 0.01215 \text{ rad}$$

- Deflection at the middle of the Beam.
- Assum 1unit load at the middle.

- $\Theta y = Py = 0.5 \uparrow$ Because of summetry.



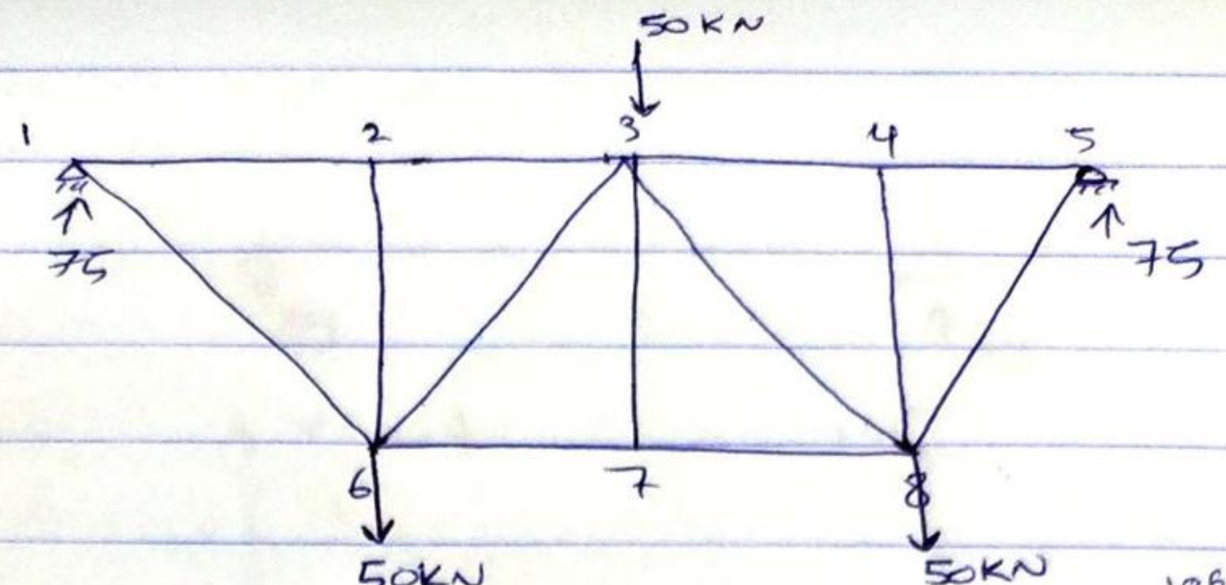
$\Delta m =$ 

$$= \left(\frac{(875)(2.5)(5)}{3}\right) + \left(\frac{(5)(2.5)}{2}(875+750)\right) + \left(\frac{5)(2.5)}{6}(875+2(25)\right) + \frac{(5)}{6}\left(750(10+2.5)+625(10)\right) + \frac{(2.5)(625)(5)}{3}$$

$$= 3645.8 + \left(\frac{10,156.25 + 1833.3 + 13020.833}{2}\right) + 2604.166 = 18755.1575/EI$$

$$\Delta m = \frac{18755.1575 \times 10^3}{250 \times 10^9 \times 600 \times 10^6 \times 10^{-12}} = 0.125 \text{ m}$$

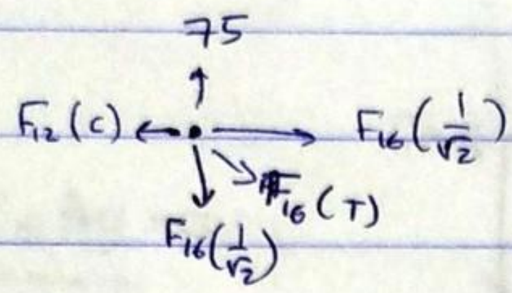
✱ Question 2 :-



- Reaction at 1 & 5
  $= 75_{KN} \uparrow$

Because of Symmetry.

✱ Joint 1 :-

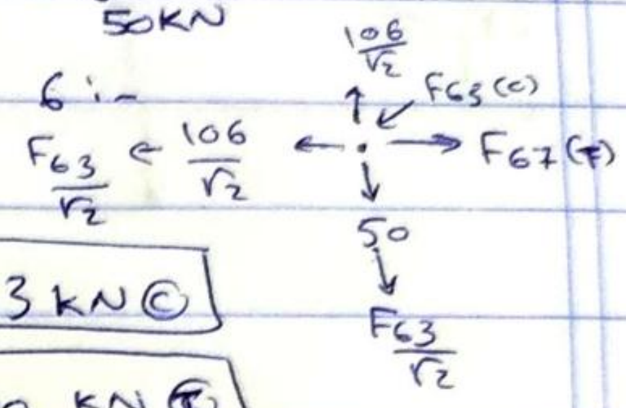


$F_{16} = 106$ KN (T)

$F_{12} = 75$ KN (C)

$F_{23} = 75$ KN (C)

✱ Joint 6 :-



$F_{63} = 35.3$ KN (C)

$F_{67} = 100$ KN (T)

$F_{78} = 100$ KN (T)

$F_{34} = 75$ KN (C)

$F_{83} = 35.3$ KN (C)

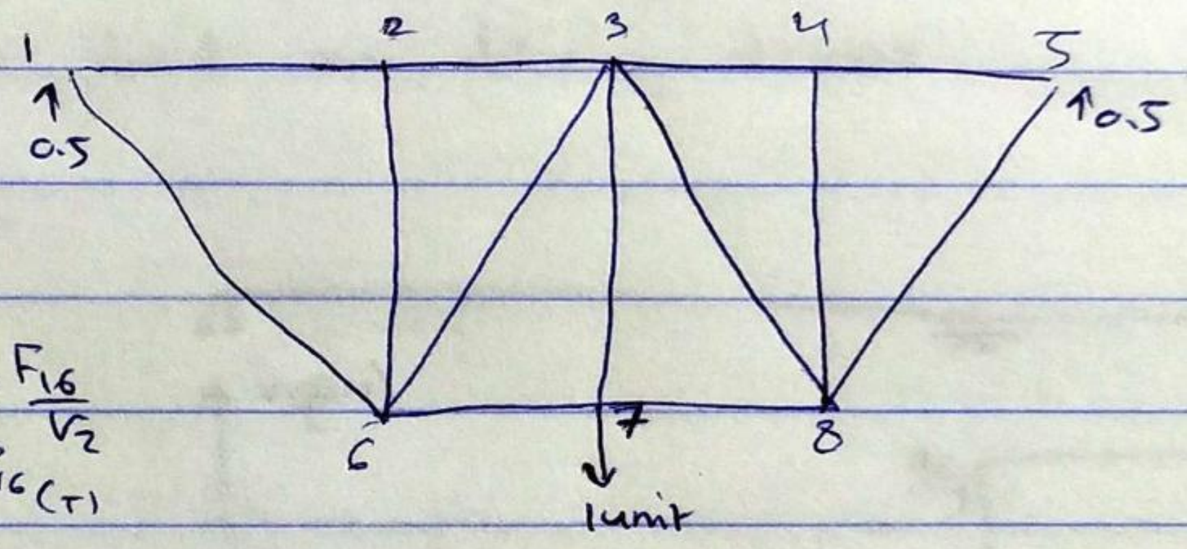
$F_{45} = 75$ KN (C)

$F_{85} = 106$ KN (C)

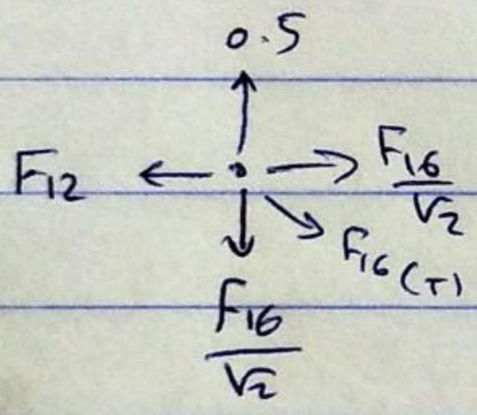
- Assume 1 unit load at Joint 7 :-

Reaction at 1 & 5

$= 0.5$ KN ↑



✱ Joint 1 :-



$F_{16} = 0.7$ KN (T)

$F_{12} = 0.5$ KN (C)

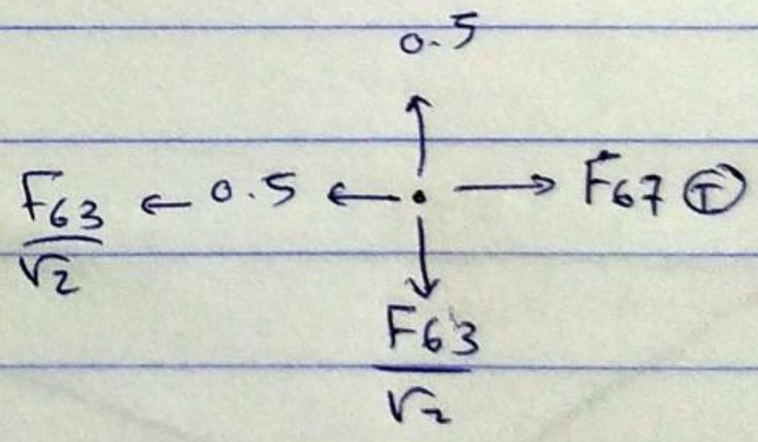
$F_{23} = 0.5$ KN (C)

$F_{34} = 0.5$ KN (C)

$F_{45} = 0.5$ KN (C)

$F_{58} = 0.7$ KN (T)

✱ Joint 6 :-



$F_{63} = 0.7$ KN (T)

$F_{38} = 0.7$ KN (T)

$F_{67} = 1.2$ KN (T)

$F_{78} = 1.2$ KN (T)

* for the Beam :-

$\circlearrowleft \Sigma M_A = 0$

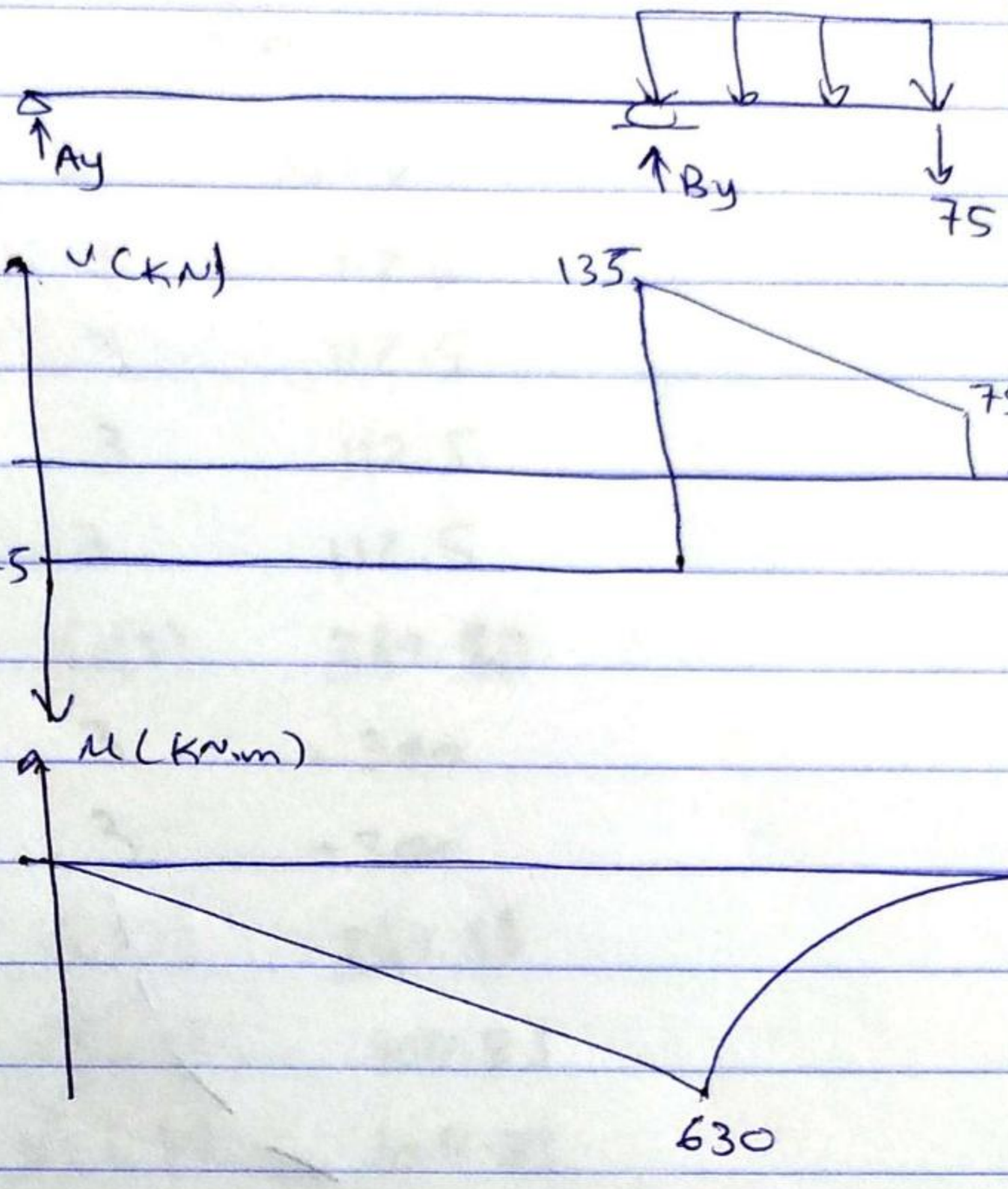
$By(12) = 60 \times 15 + 75(18)$

$\boxed{By = 187.5\ KN\uparrow}$

$\Sigma F_y = 0$

$-60 - 75 + 187.5 + Ay = 0$

$\boxed{Ay = 52.5\ KN\downarrow}$



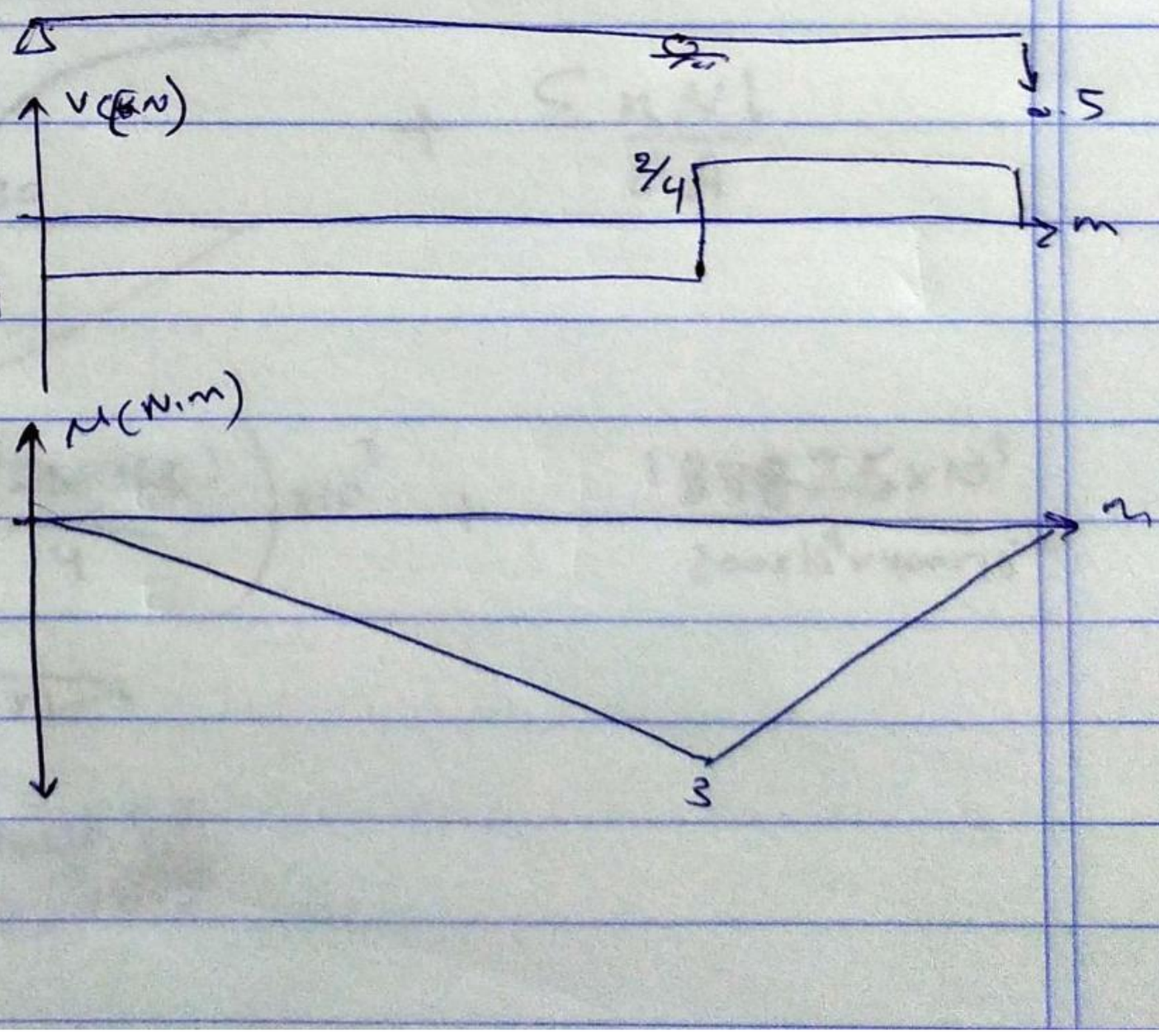
. when Assume a 1unit load on the trusse.

$\circlearrowleft \Sigma M_A = 0$

$RBy = 0.5 \times 18$

$By = \frac{3}{4}\uparrow$

$Ay = \frac{1}{4}\downarrow$

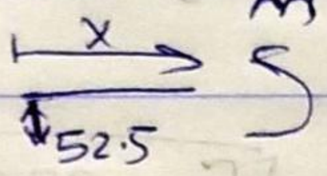


$$\Delta_{Joint} = \int_0^{18} \frac{mM}{EI}\,dx + \sum \frac{nNL}{EA}$$

✱	n	N	L	N × n × L
✓ F_{12}	-0.5	-75	3	112.5
✓ F_{23}	-0.5	-75	3	112.5
✓ F_{34}	-0.5	-75	3	112.5
✓ F_{45}	-0.5	-75	3	112.5
✓ F_{16}	0.7	106	$\sqrt{2}(3)$	349.80
✓ $\rightarrow F_{67}$	1	+100	3	+300
✓ $\rightarrow F_{78}$	1	+100	3	+300
✓ F_{85}	0.7	106	$\sqrt{2}(3)$	349.80
F_{63}	+0.7	-35.3	$\sqrt{2}(3)$	+104.83
F_{83}	+0.7	-35.3	$\sqrt{2}(3)$	104.83

$\Rightarrow \Sigma = 1899.26$

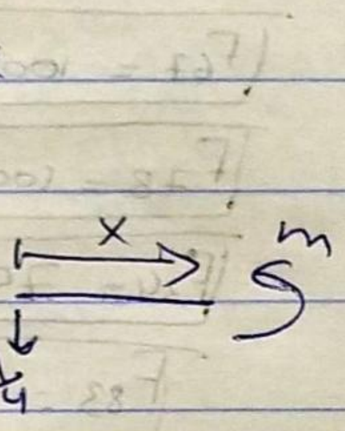
Bending :- AB



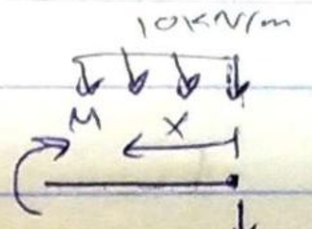
Real :

$M = -52.5x$

virtual



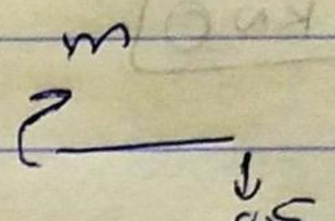
$m = -\frac{1}{4}x$



Real: $M + 75x + 10\left(\frac{x^2}{2}\right) = 0$

$M = -75x - 5x^2$

virtual :-



$m = -0.5x$

$$\Delta_{beam} = \frac{1}{EI}\left(\int_0^{12} (-52.5x)\left(-\tfrac{1}{4}x\right) dx + \int_0^{6} (-75x - 5x^2)(-0.5x)\, dx \right)$$

$$= \frac{1}{EI}\left(\left(\frac{13.125x^3}{3} \Big|_0^{12} \right) + \int_0^{6} (37.5x^2 + 2.5x^3)\, dx \right)$$

$$\hookrightarrow \frac{37.5x^3}{3} + \frac{2.5x^4}{4} \Big|_0^{6}$$

$$= \frac{1}{EI}(7560 + 2700 + 810)$$

$$= \frac{1}{EI}(11070) = \frac{11070 \times 10^3}{25 \times 10^9 \times 8 \times 10^9 \times 10^{-12}} = 55.35 \times 10^{-3}$$

$$\Delta_{joint\,7} = \int_0^{18}{}_{beam} \frac{m(M)}{EI} dx + \sum n \frac{\Delta L N}{AE}$$

$$= 55.35 \times 10^{-3} + \frac{1899.26 \times 10^3}{200 \times 10^9 \times 400 \times 10^6 \times 10^{-6}}$$

$$= 0.05535 + 0.02374 = 0.079\,m \downarrow$$