New 2018

Civilittee

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تحليل إنشائي

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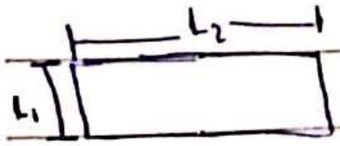
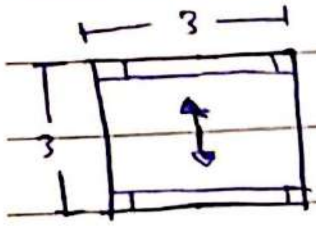
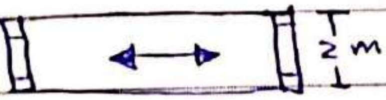


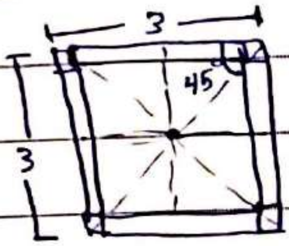
$\frac{L_2}{L_1} \geq 2 \rightarrow$ One way

$\frac{L_2}{L_1} < 2 \rightarrow$ Two way



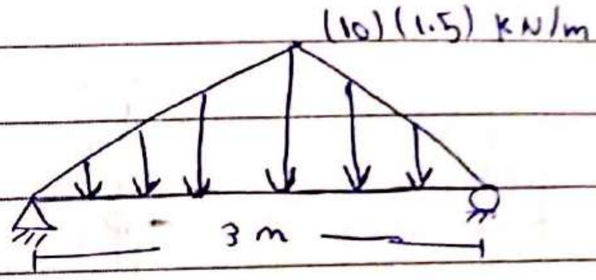


$\boxed{3}$

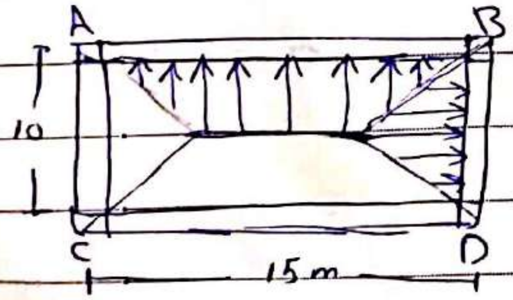


Two way

$w = 10\ kN/m^2$

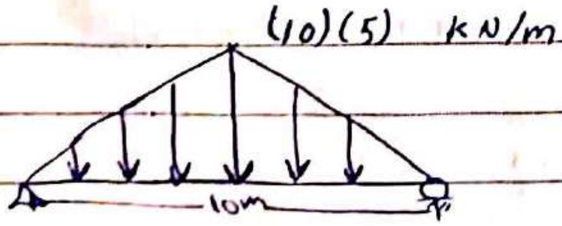


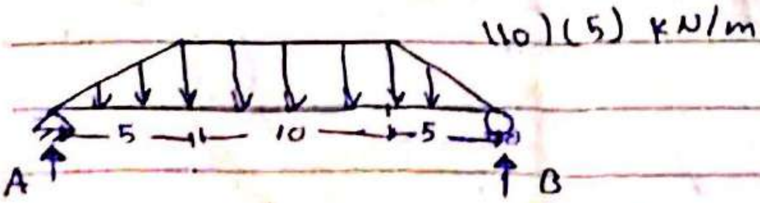
$\boxed{4}$



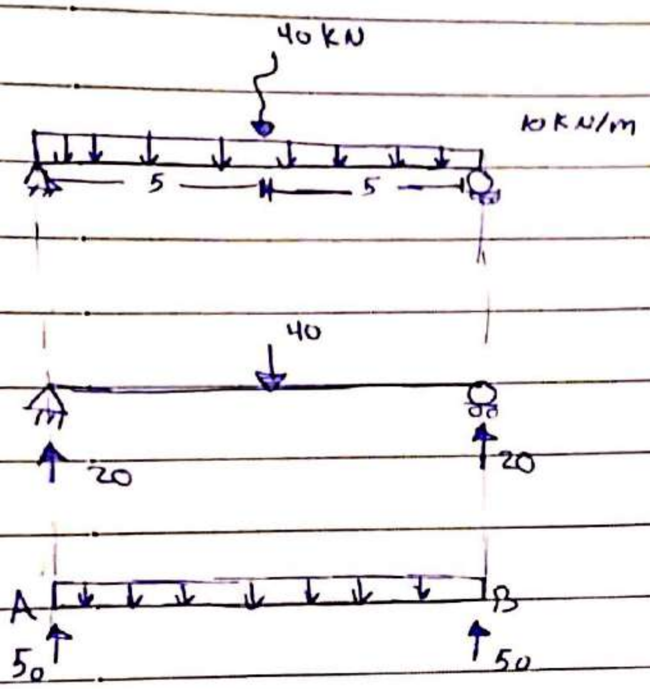
$w = 10\ kN/m^2$

$\frac{15}{10} < 2$ Two way





* 2.2. principle super position :-



* $\sum M_A = 0$

$-40(5) - (100)(5) + B_y(10) = 0$

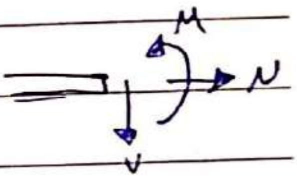
$B_y = 70$

* 2.3. equations of equilbrium

$\sum F_x = 0$

$\sum F_y = 0$

$\sum M = 0$



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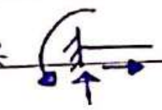

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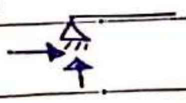

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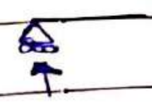
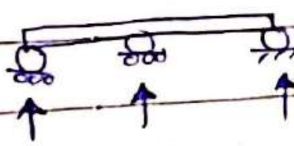
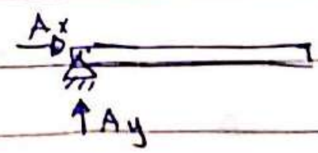


* 2.4 :- Determinancy and stability :-



متوازنات

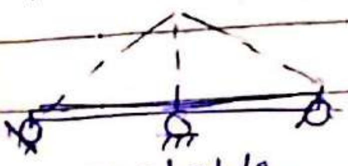
unstable



unkowns < equi

$2 < 3$

unstable

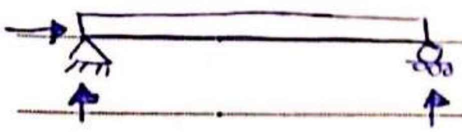


بلتقو في نقطة

unstable

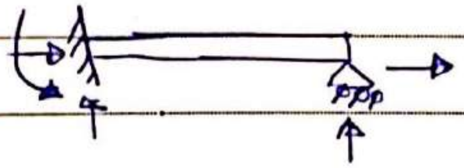
* Determinancy.

3 equ. per mumber



member = 1

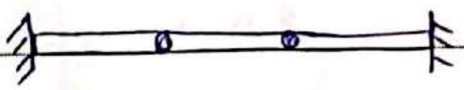
3 = 3 (Determine)

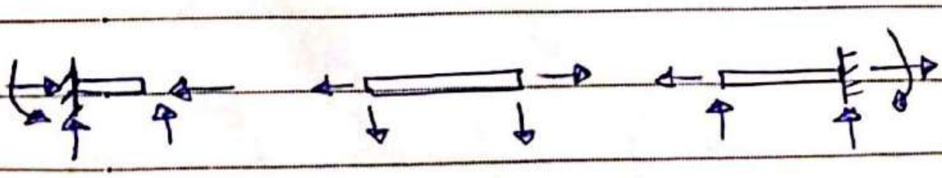


5 > 3 ⟹ 3 equi equ + 2 compatabilite equ

In determenate to 2^{nd} degree

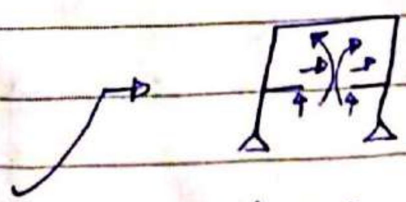
Ex:-





equ = 3 x 3 = 9 / unk = 10

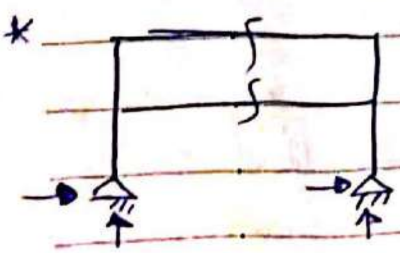
$10 - 9 = 1^{st}$ degree indct



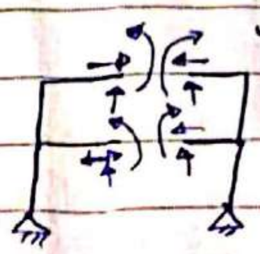
7 - 3 = 4

4^{th} degree

*



⟹



10 unkowns

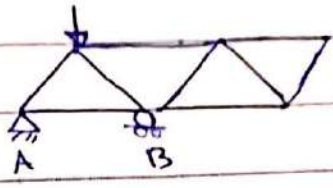
2 x 3 = 6

$10 - 6 = 4^{th}$ degrees

#3 Trusses Determinate

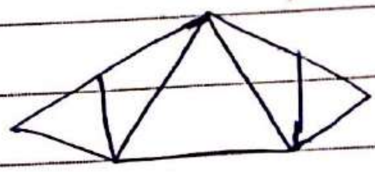
* Type of Trusses :-

[A] simple Truss →

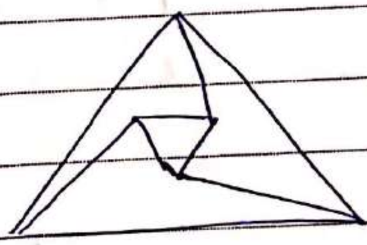


[B] compound Truss

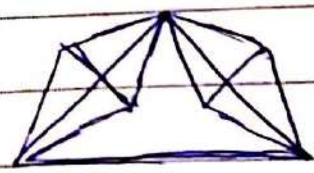
① Type 1 :- Two simple Truss connected by joint and 1 members



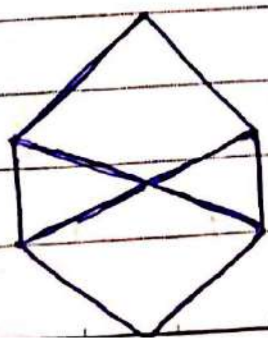
② Type 2 :- simple Trusses connected with 3-members



③ Type 3 :- The member of main truss ⇒ Trusses

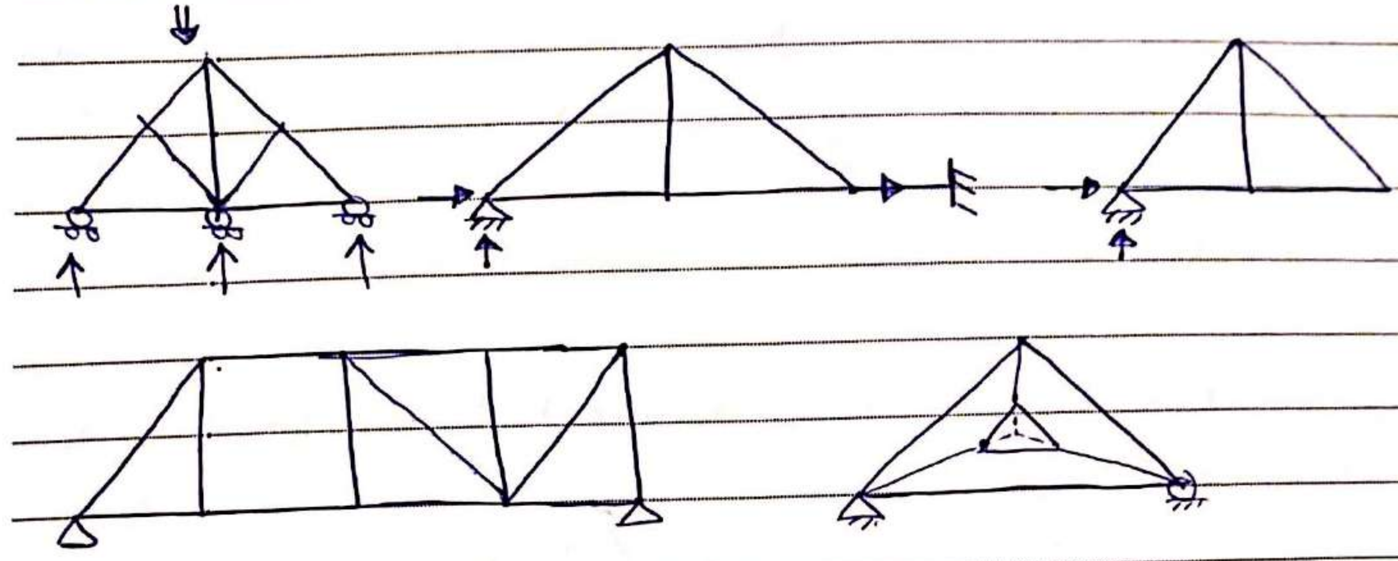


[C] complex Truss



* Stability and determinacy

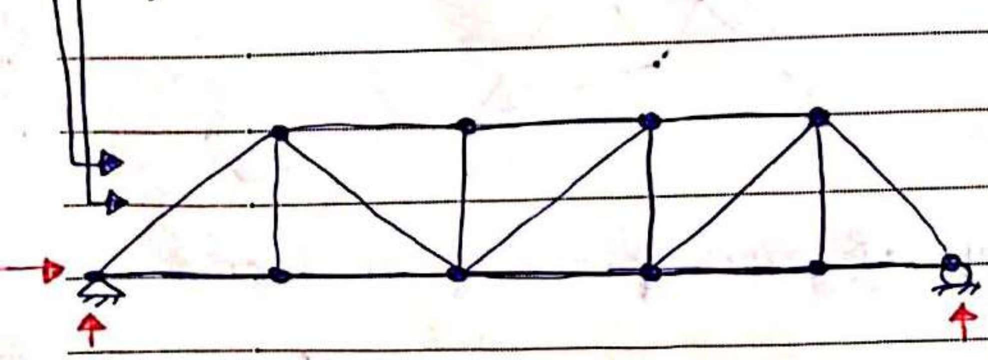
- External and Internal Determinacy.
- Stable Trusses



* Internal Determinacy

unknown = $\overset{R}{\text{Reaction}}$ + $\overset{m}{\text{Number of members}}$ = 20

equations = Number of $\overset{J}{\text{joints}}$ * 2 = 10(2) = 20

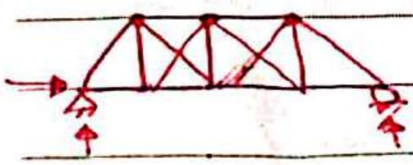


$R + m = 2J$ Determin

$R + m > 2J$ Internal

$R + m < 2J$ unstabl

3 Reaction 3 equation ⇒ Externally Determinate



$3 + 15 = 18$

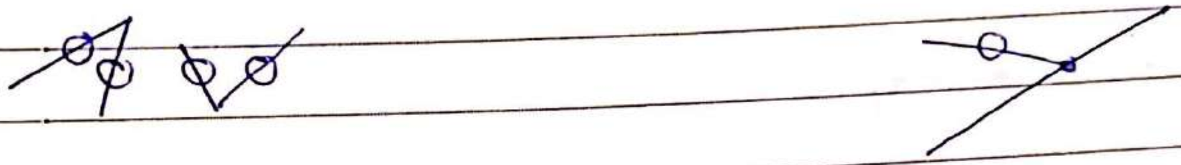
$2(8) = 16$

$18 > 16$ ⇒ Internal

* Zero force members.

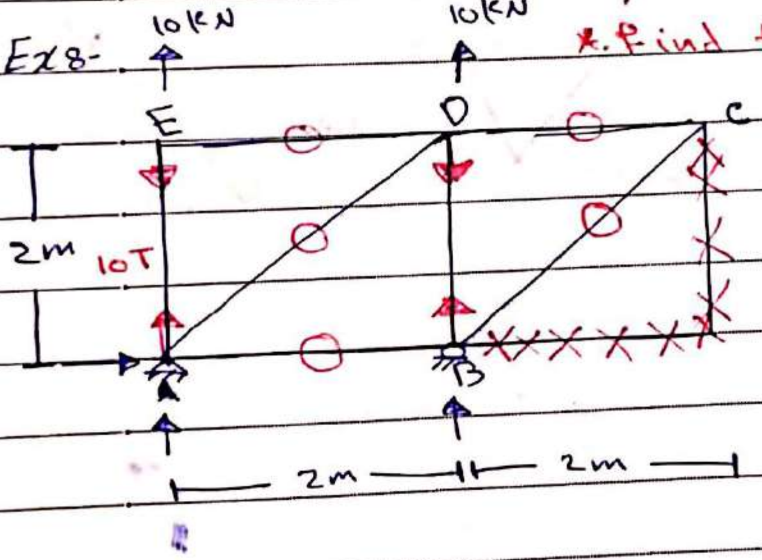
Joints with No load

2 members	Joint with 3 member
not colinear	Two of Them colinear
both Zero	The Third is Zero

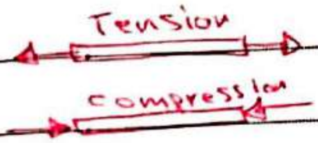


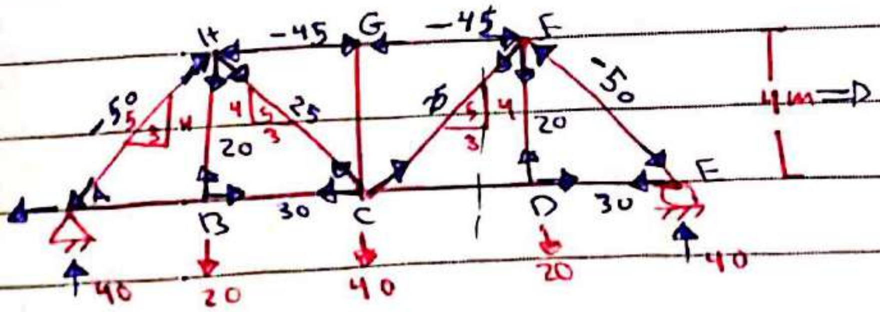
Ex8:-

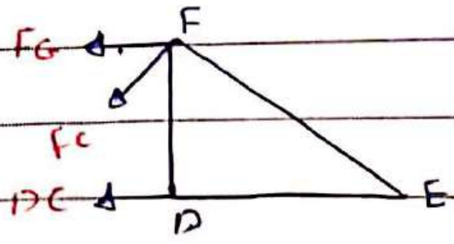
* Find the force in each Member.



* Analysis of Trusses:
to find the force in each Member.
- Joint Method
- section Method







$\Sigma F_y = 0 \quad -20 + 40 - \frac{4}{5} F_C = 0$

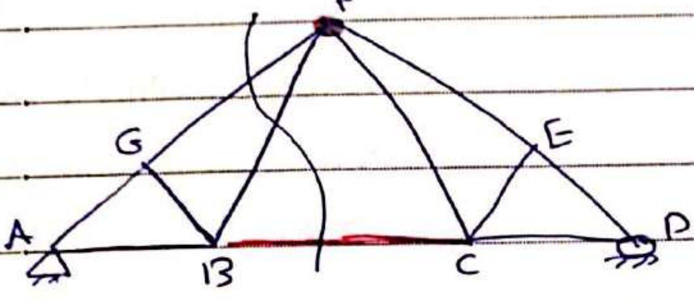
4 @ 3 m

Scanned with CamScanner

* Joint with load

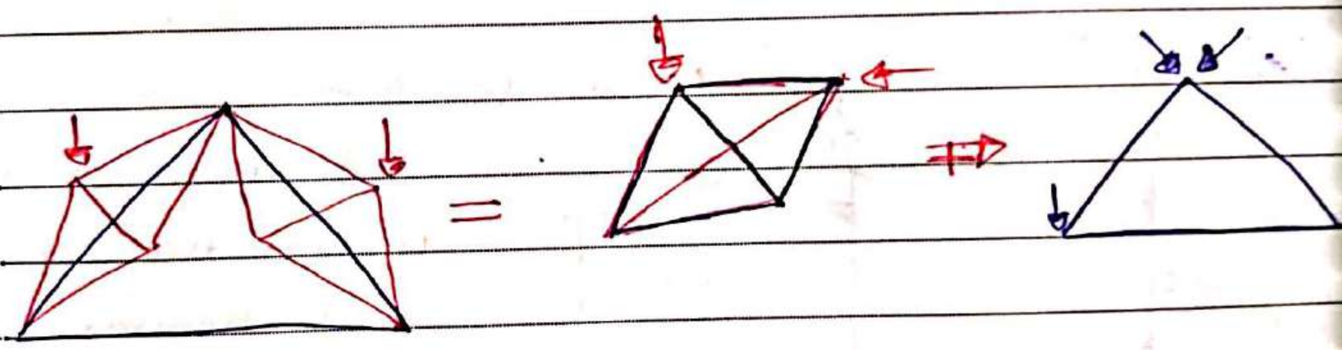
2-member

One of them colinear with load ⇒ the second is zero

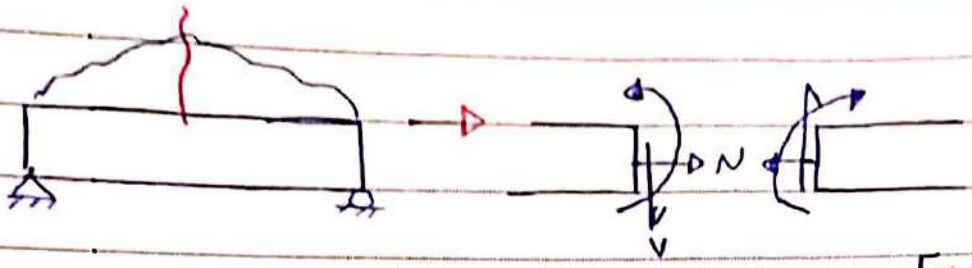


① section → $\Sigma M_F = 0$

#

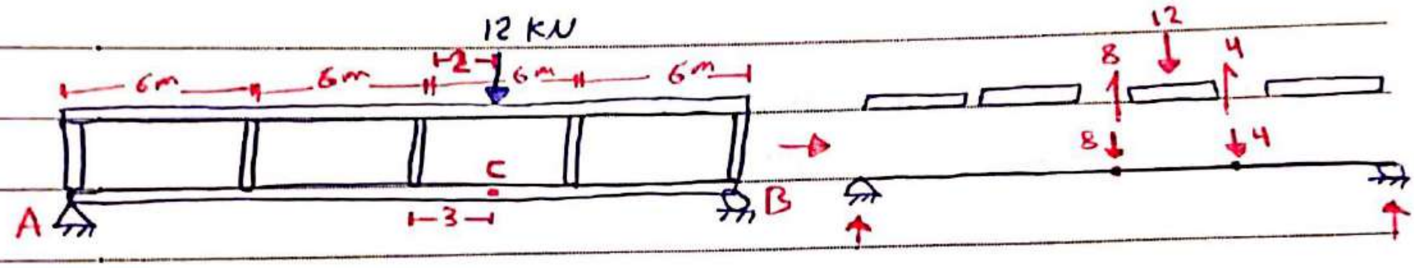


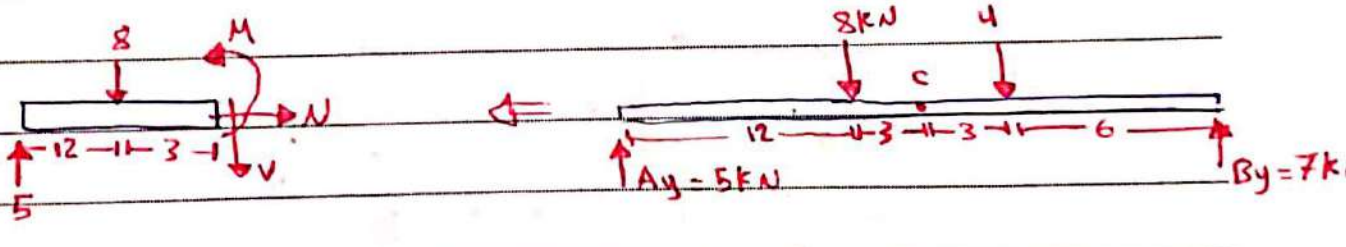
Intarnal force



equilibrium equ $\begin{cases} \Sigma F_x = 0 \\ \Sigma F_y = 0 \\ \Sigma M = 0 \end{cases}$

Ex 8-. Find internal force at C.

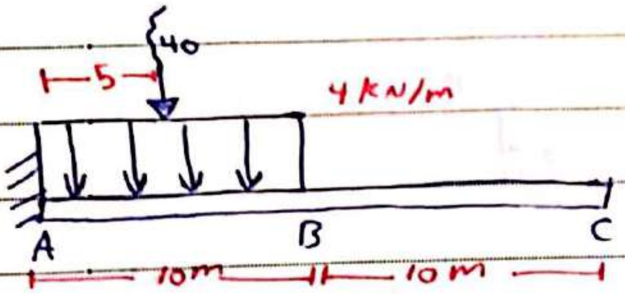




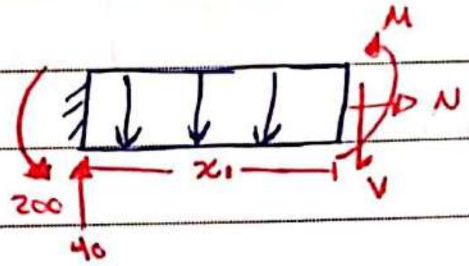
$\Sigma F_y = 0 \quad 5 - 8 - V = 0 \quad V = -3$

$\Sigma M = 0 \quad -5(15) + 8(3) + M = 0 \quad M = 51$

* Find the equation of Moment for the cantilever.



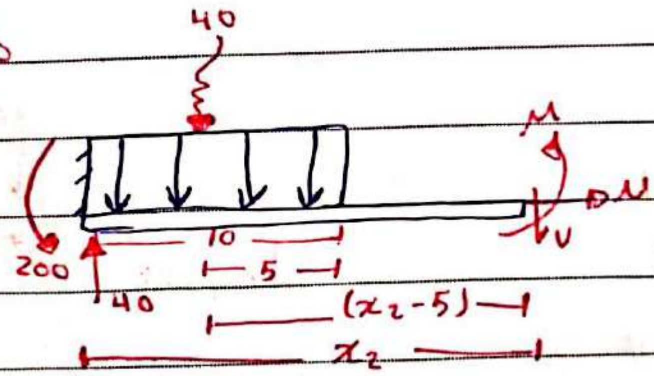
* $0 < x < 10$



$\overset{+}{\circlearrowleft} \sum M = 0$ $\quad 200 + 2x_1 - 40x_1 + M = 0$

$M = -200 - 2x_1^2 + 40x$

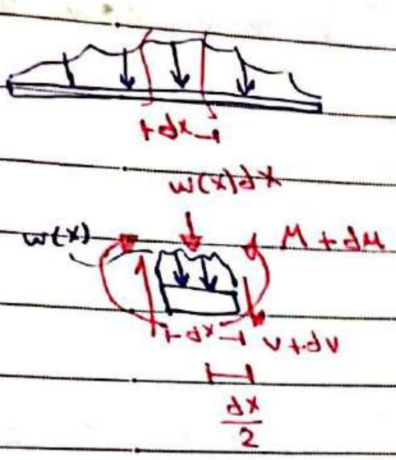
* $10 < x_2 < 20$



$\overset{+}{\circlearrowleft} \sum M = 0$ $\quad 200 + 40(x_2-5) - 40x_2 + M = 0$

$M = 0$

* Relation between load, shear and Moment.



$\boxed{1}$ $+\uparrow \sum F_y = 0$ $\quad V - w(x)dx - (V + dV) = 0$

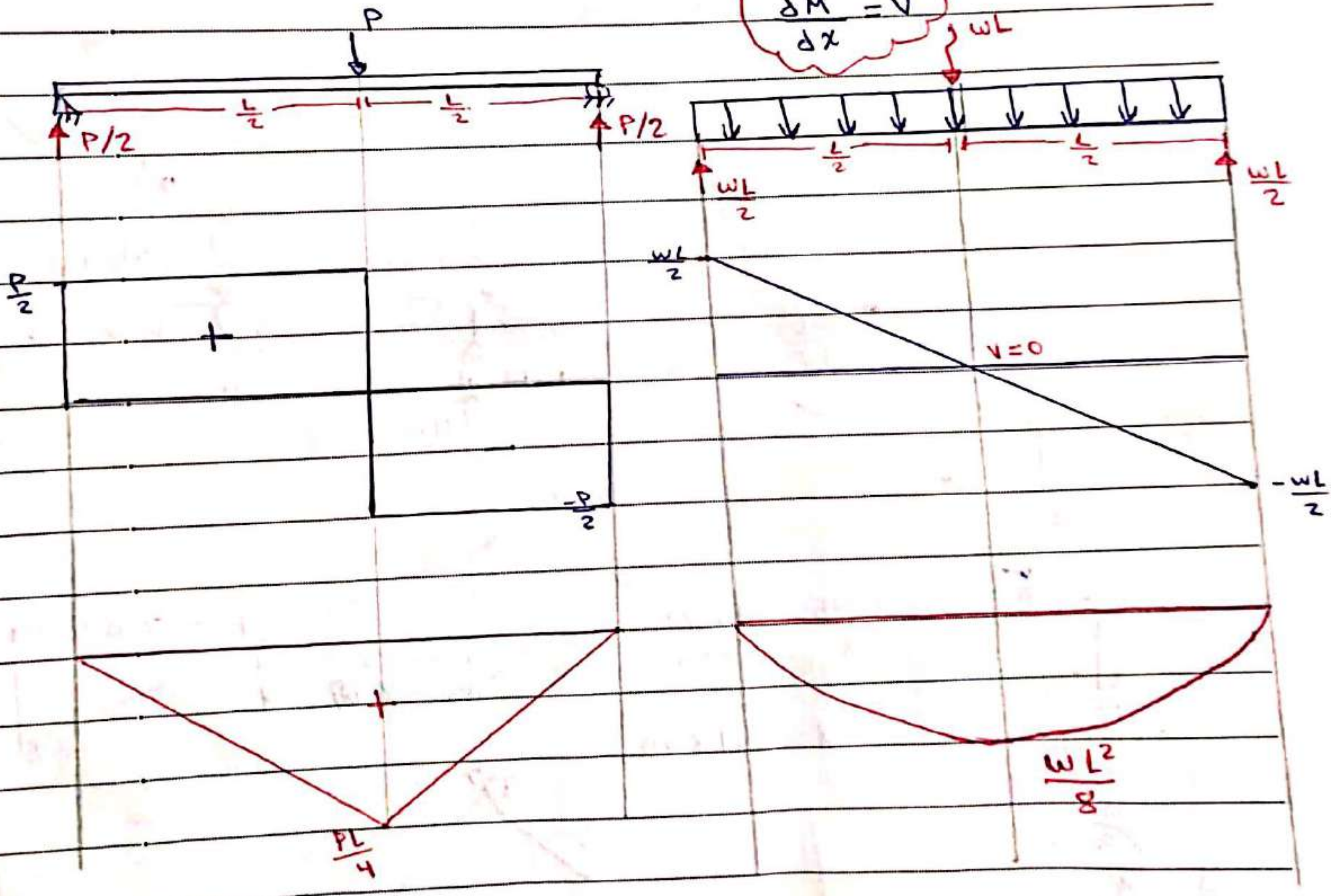
$$-w(x)\,dx = dV$$

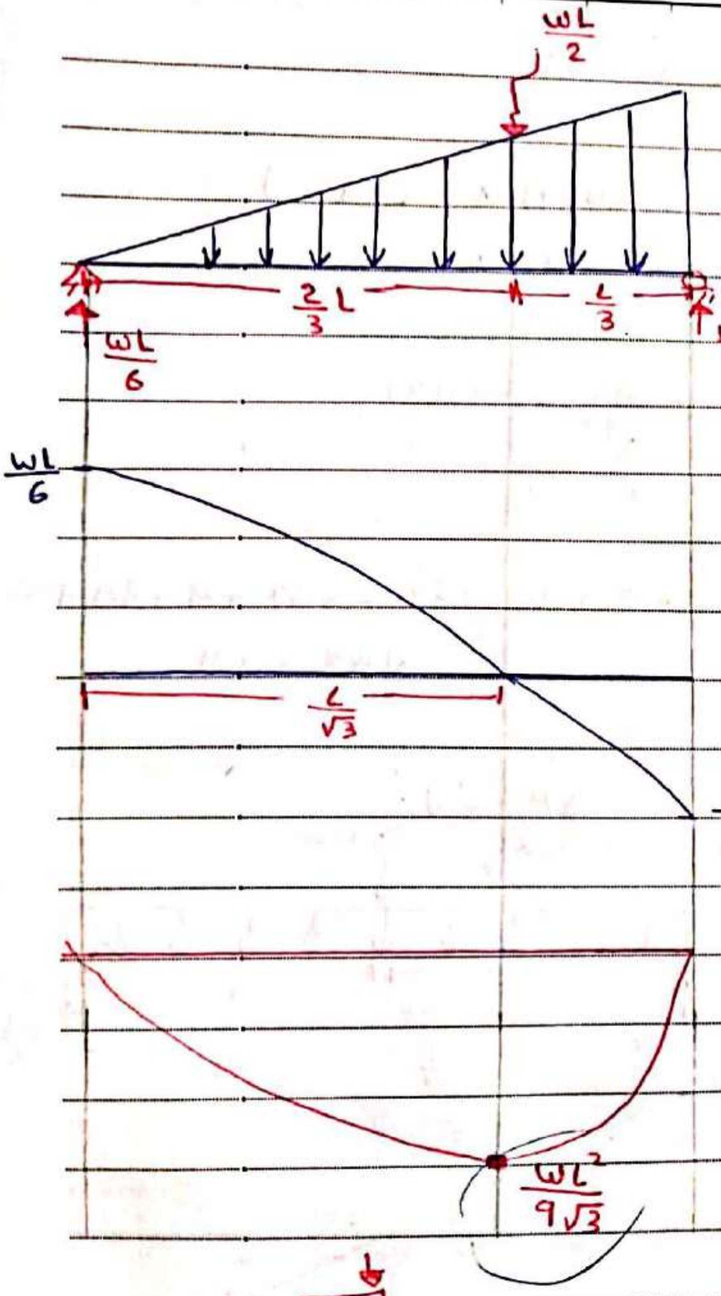
$$\frac{dV}{dx} = -w(x)$$

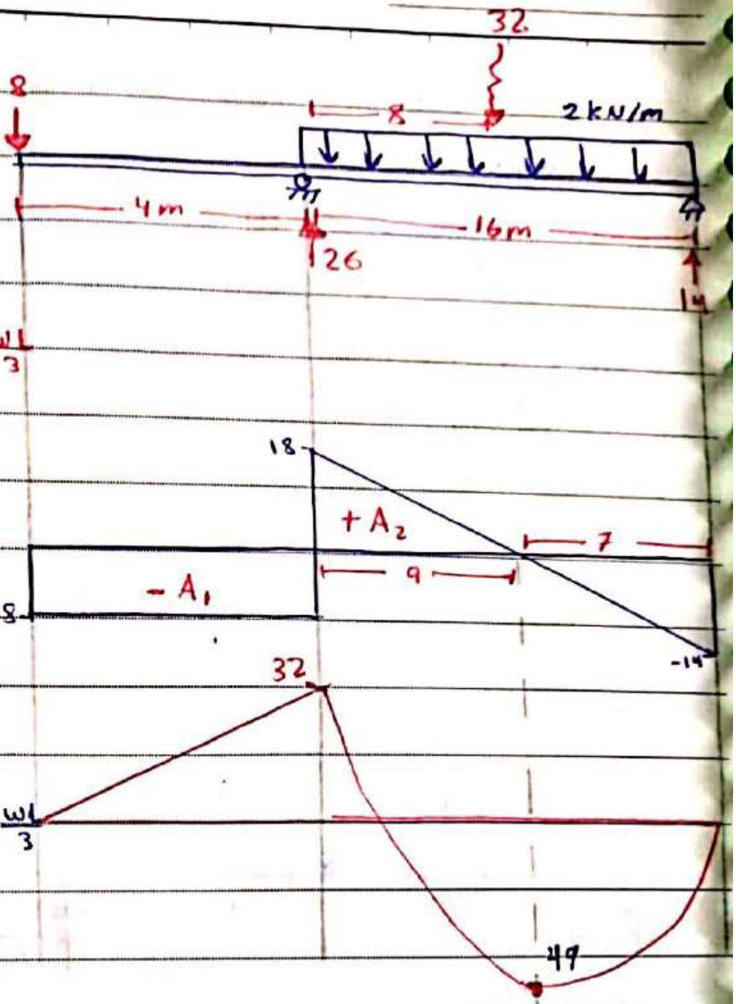
$\boxed{2}$ $\circlearrowleft + \sum M = 0$ $\quad \cancel{-M} + \underbrace{w(x)\frac{dx^2}{2}}_{\simeq 0} - V\,dx + \cancel{M} + dM = 0$

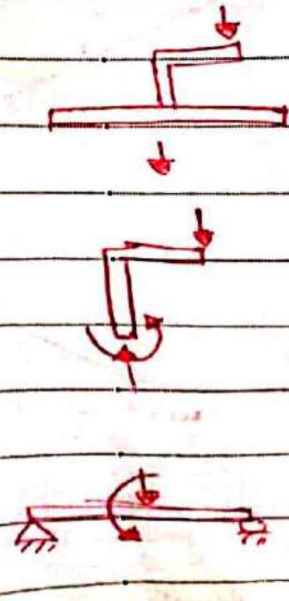
$$V\,dx = dM$$

$$\frac{dM}{dx} = V$$



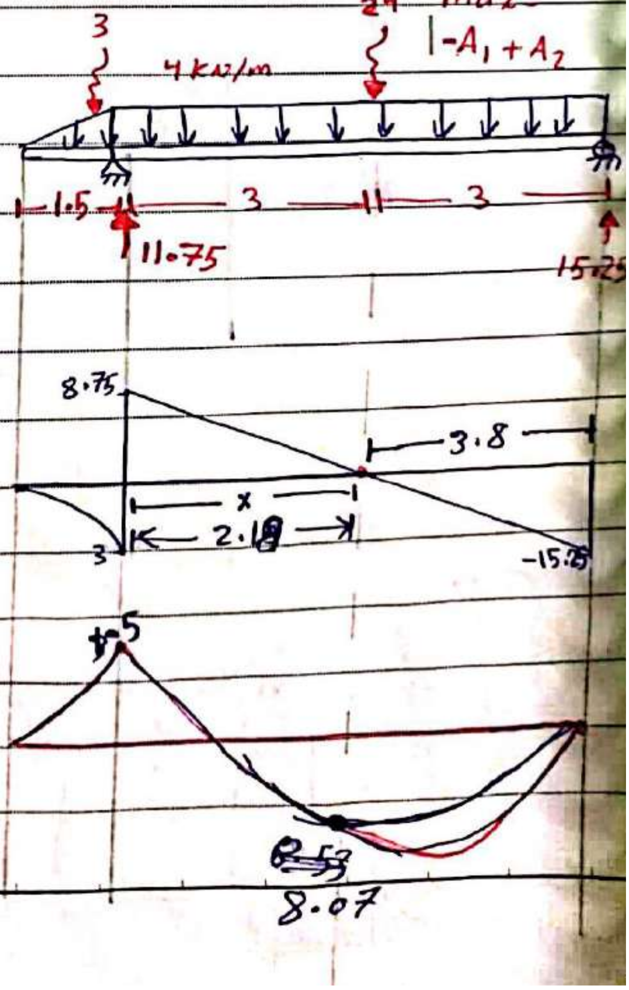




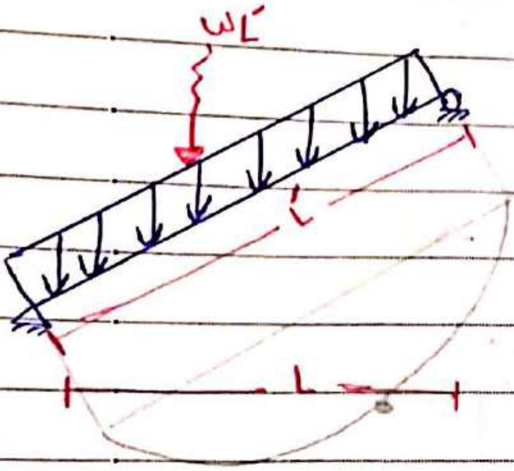


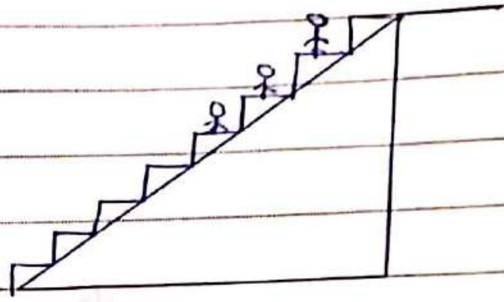
$$\frac{8.75}{x} = \frac{15.25}{6-x}$$

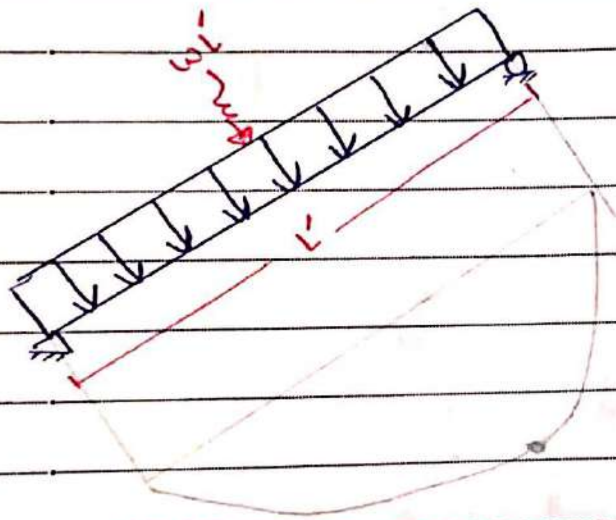
$$x = 2.18 \text{ m}$$

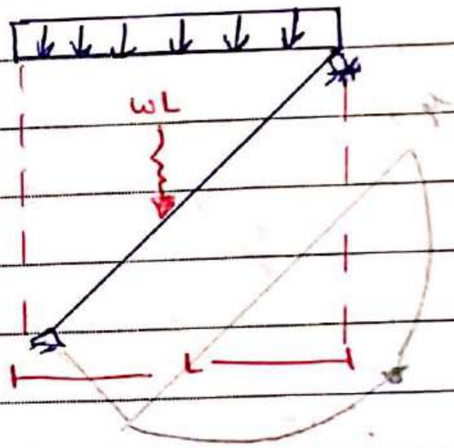


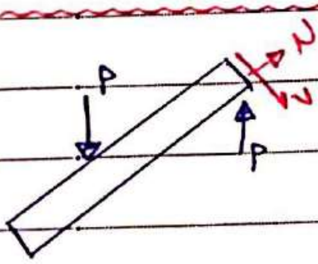
* Inclined Beam

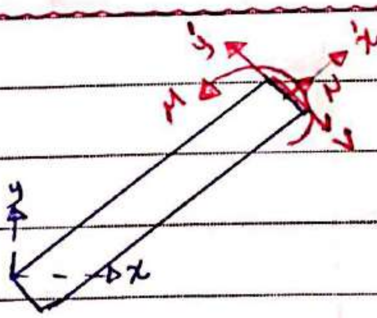


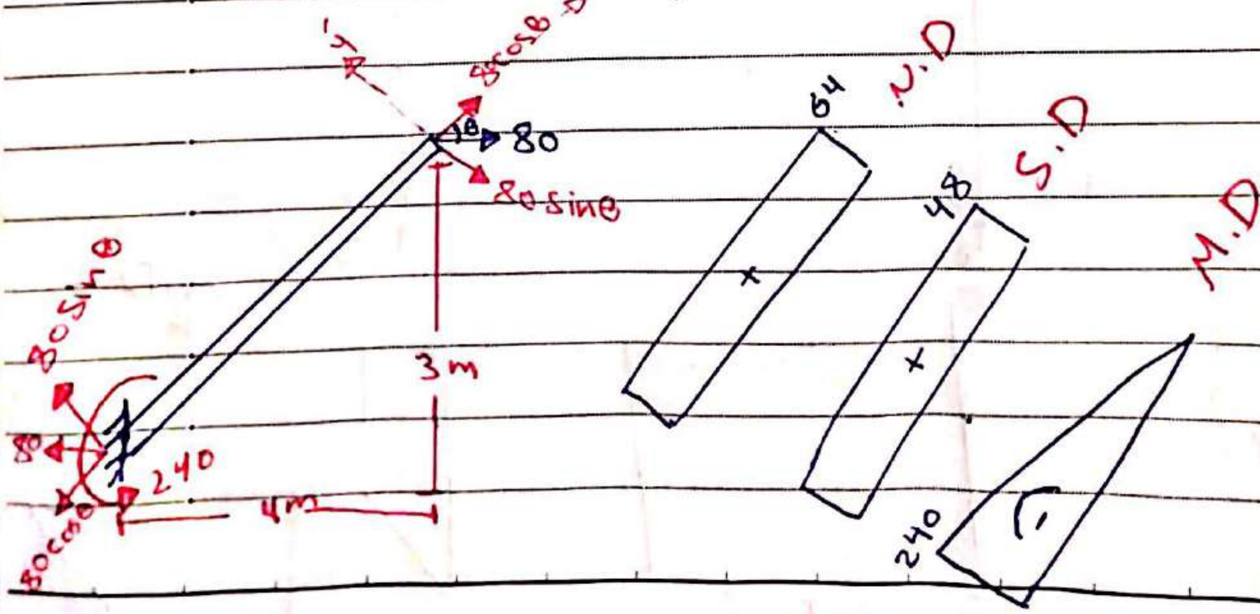






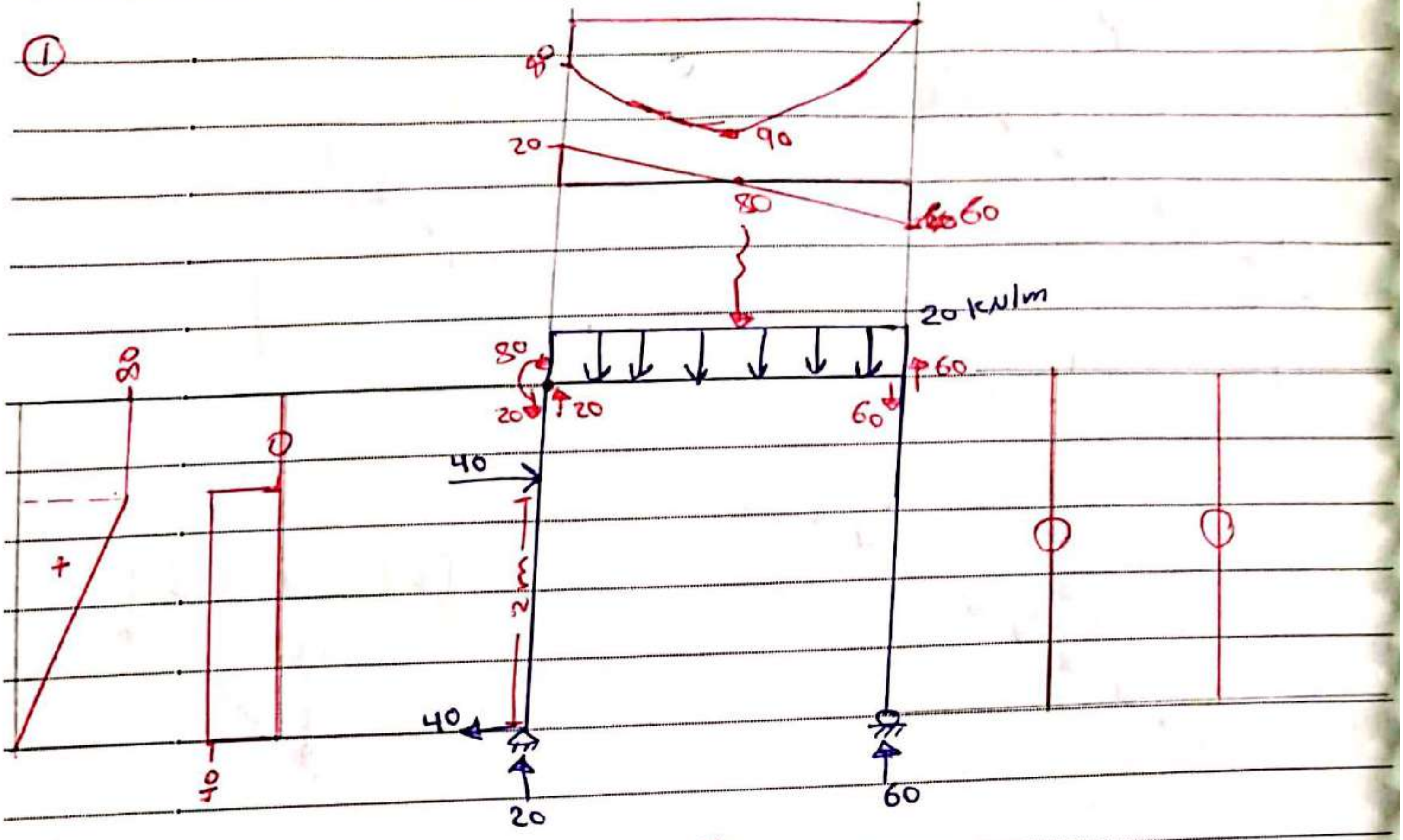


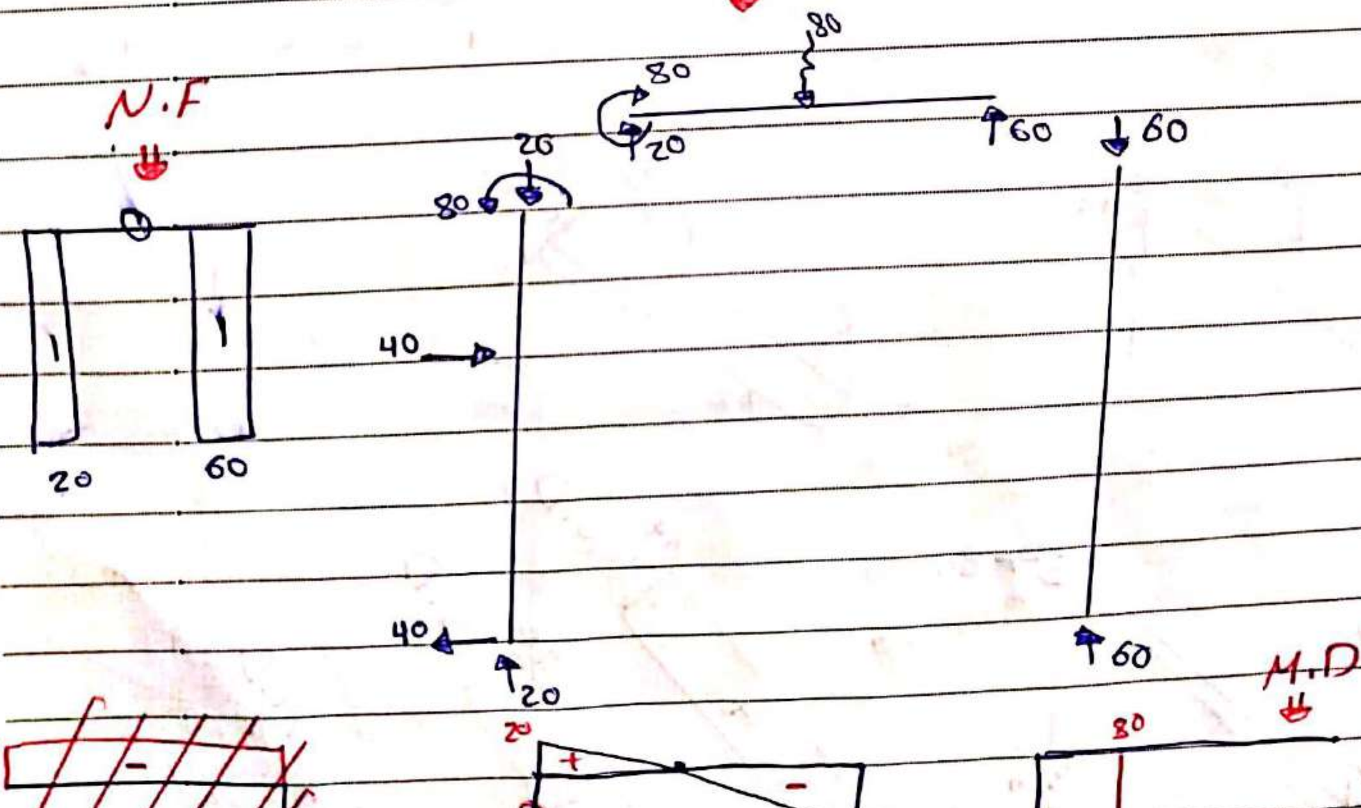


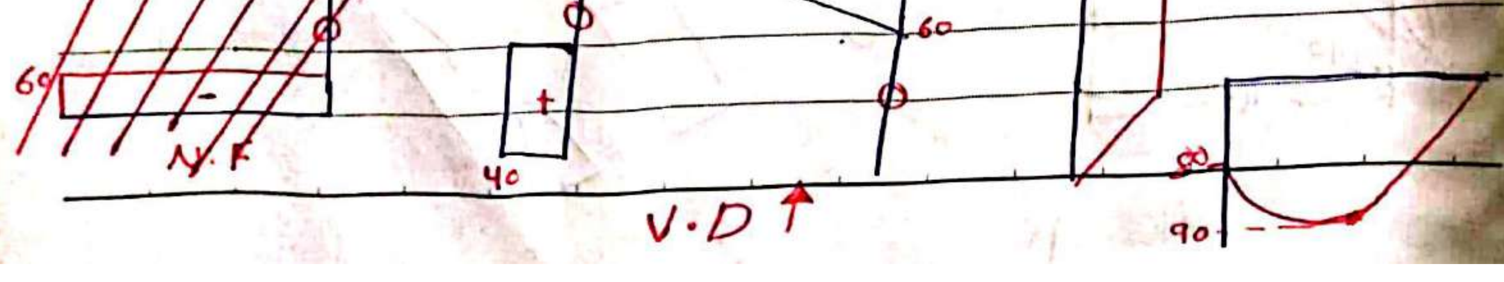


Ex8- Find S.D , M.D of frames.

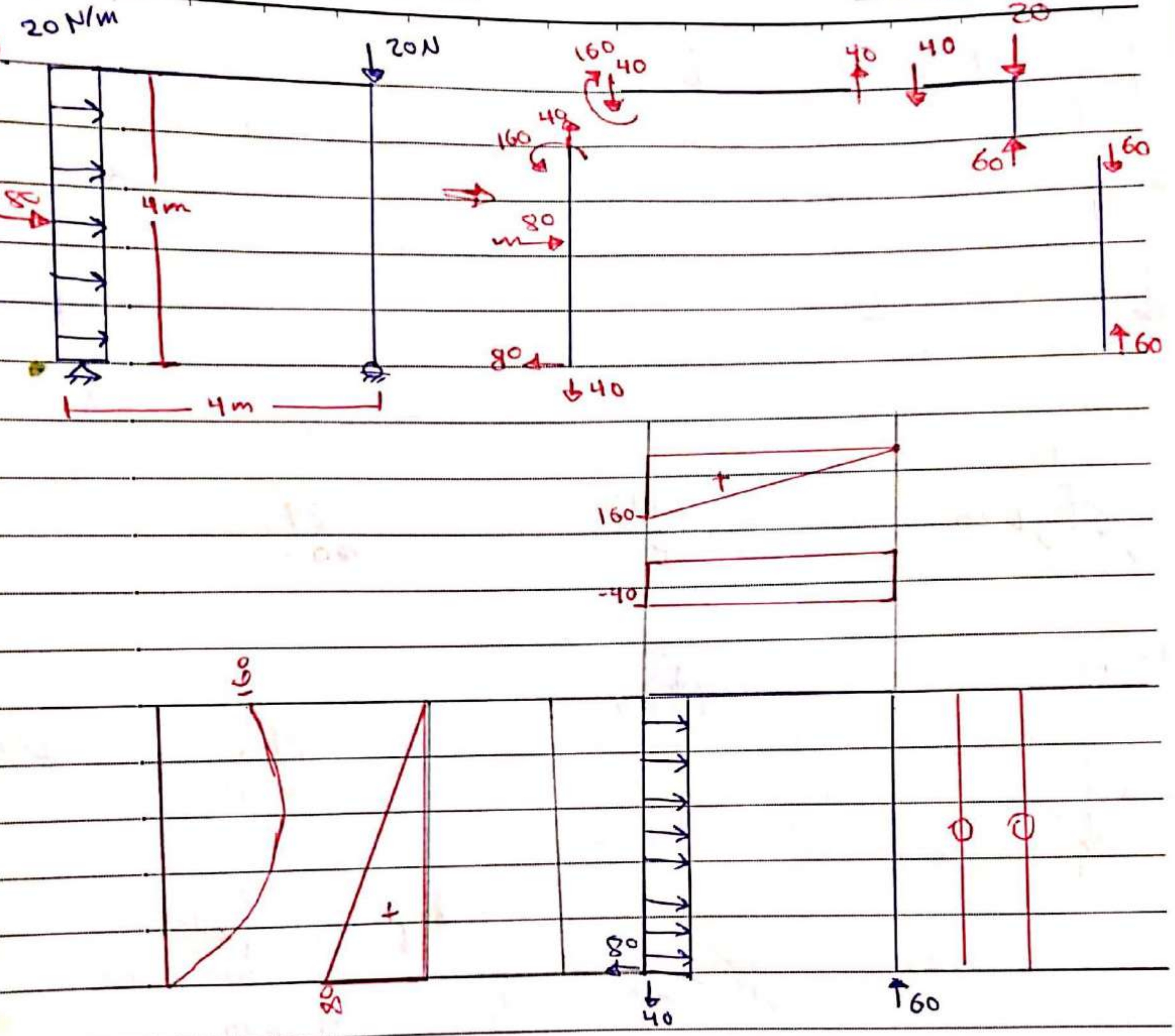
①





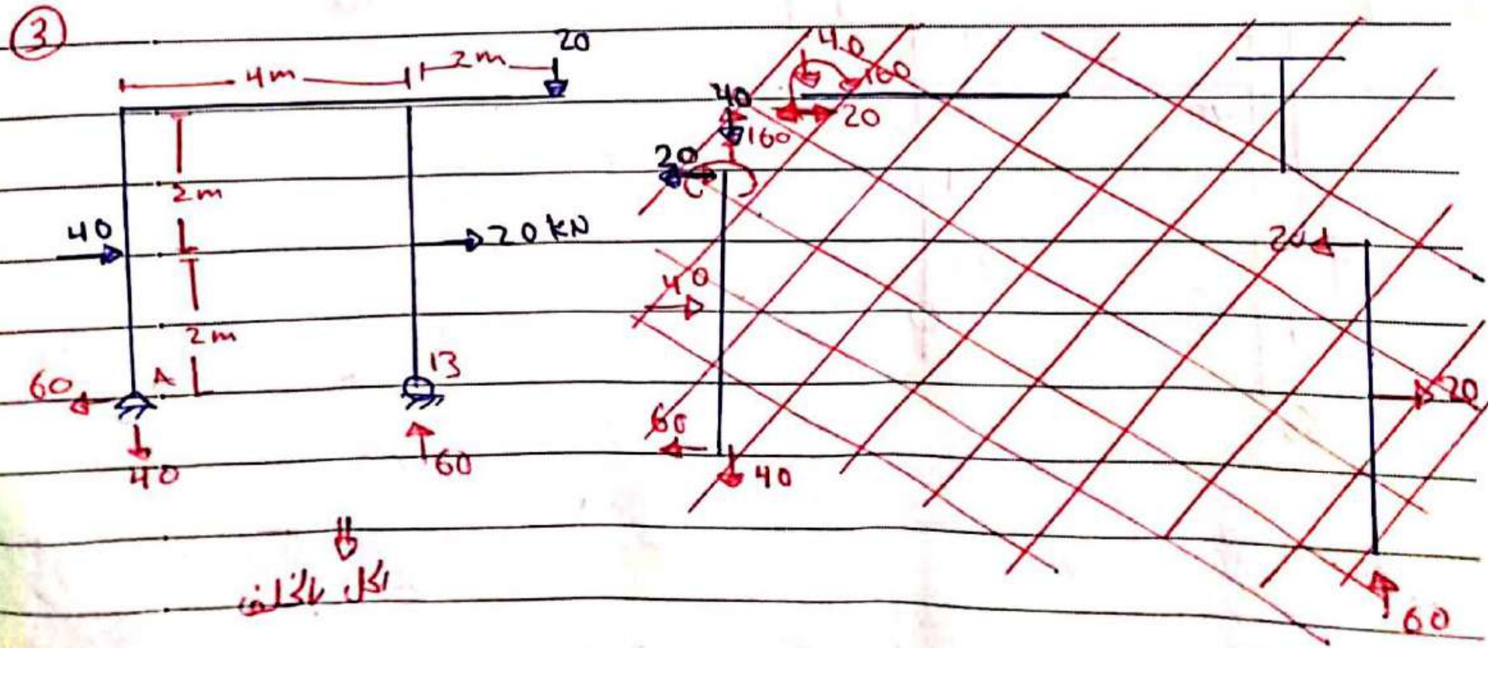


(2)

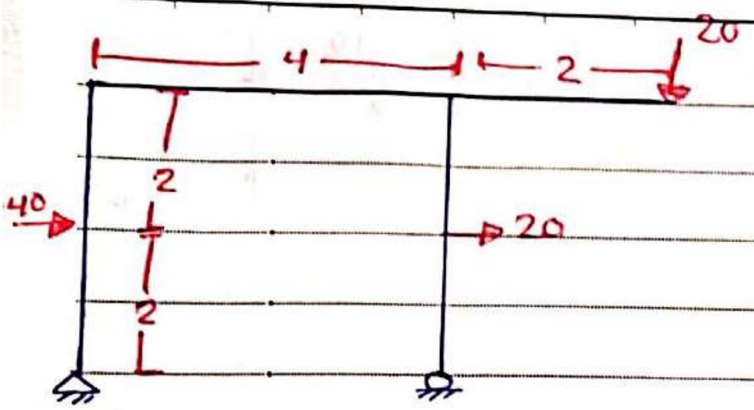


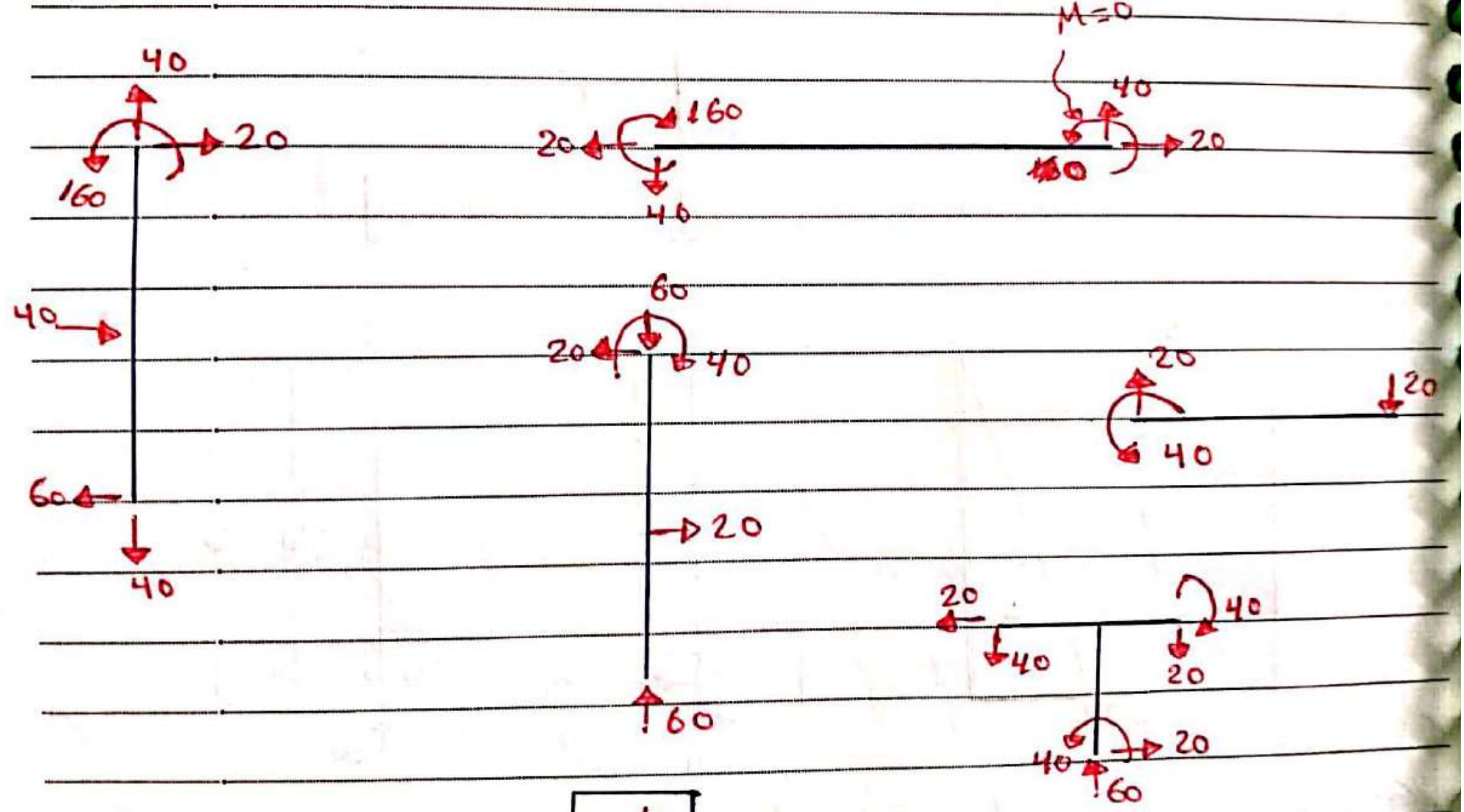
20 N/m
20 N
4m
4m
80
160
40
60
-40

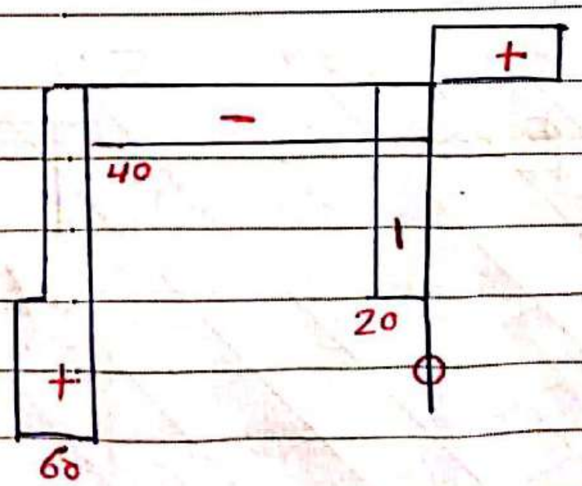
(3)



4m
2m
20
2m
2m
40
20 kN
60
40
60
A
B
160
20


4
2
20
40
2
2
20

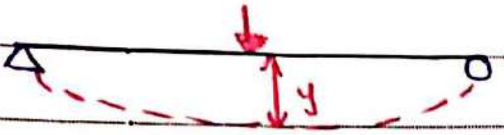

M=0
40
20
160
40
20
160
40
20
160
40
40
60
40
60
20
40
20
20
40
20
60
20
40
40
20
40
20
40
60

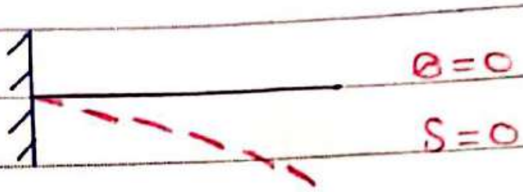

+
-
40
20
+
60

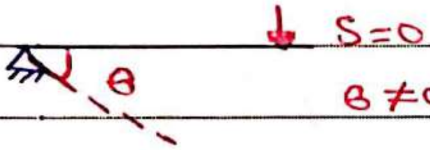
8. Deflection of Beam

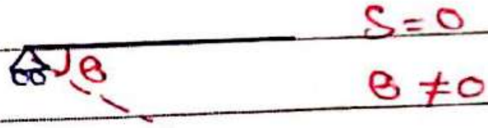
elastic curve : qualitative

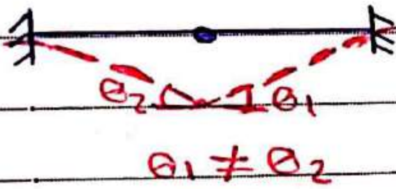
Deflection curve

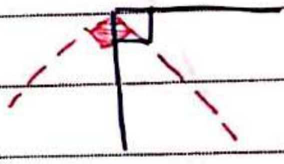




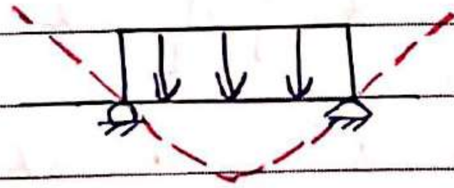


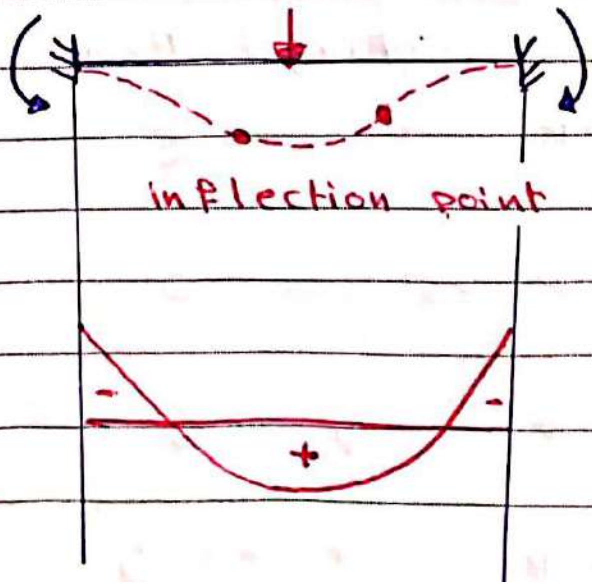


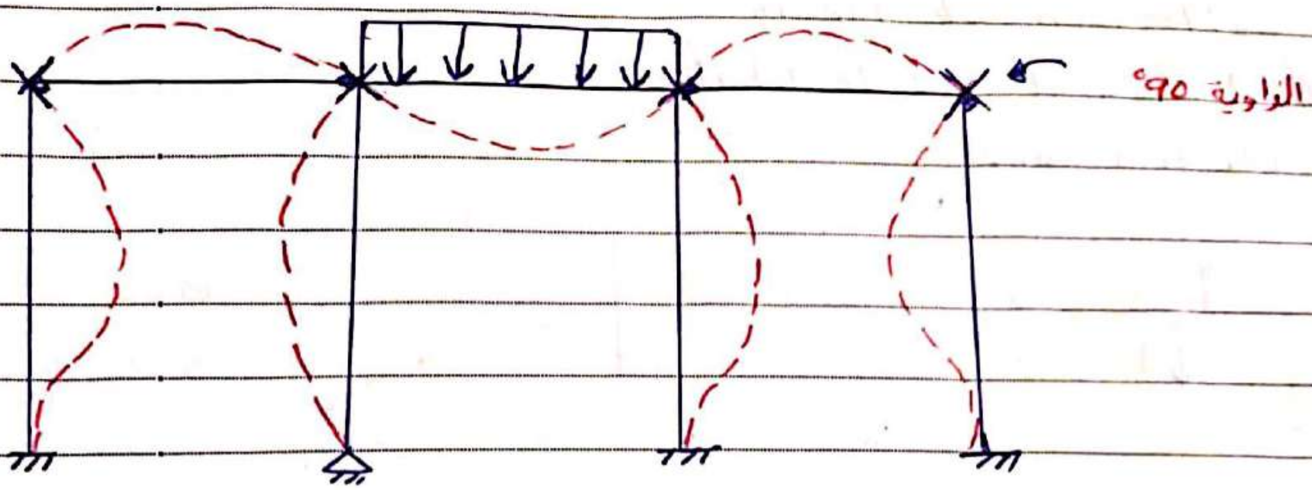


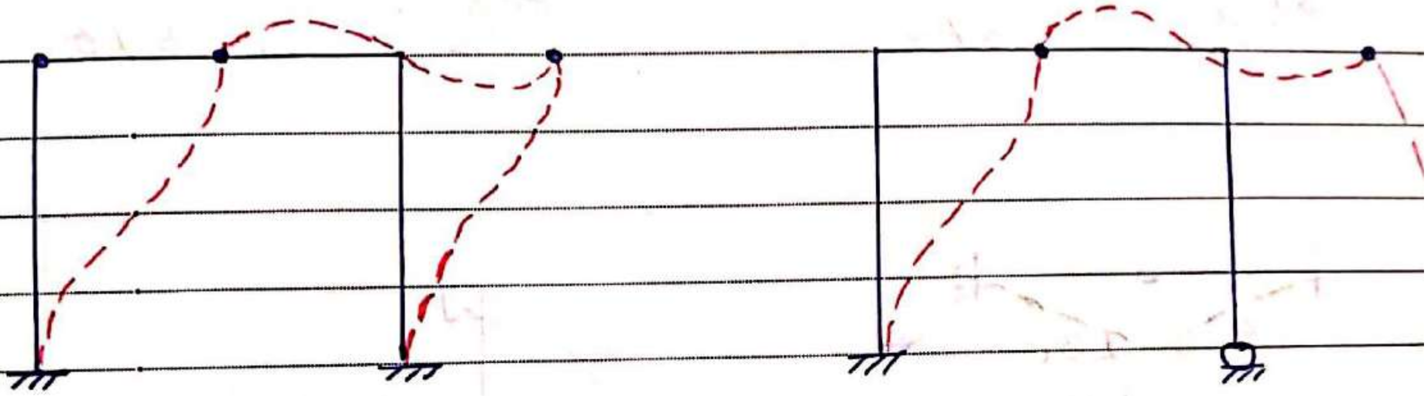


Ex:-

① 

② 



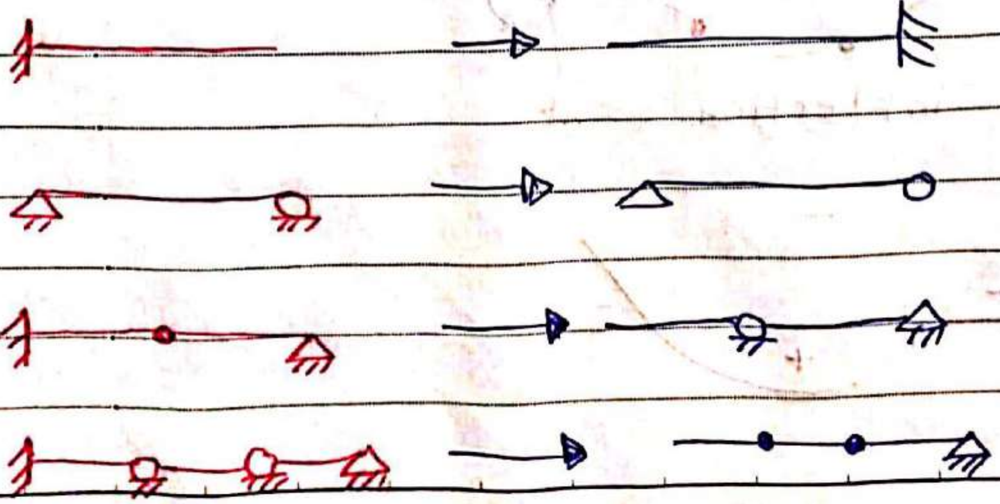


Real Beam | Conjugate Beam

$$V = \int w(x)\,dx \longrightarrow \theta = \int \frac{M}{EI}\,dx$$

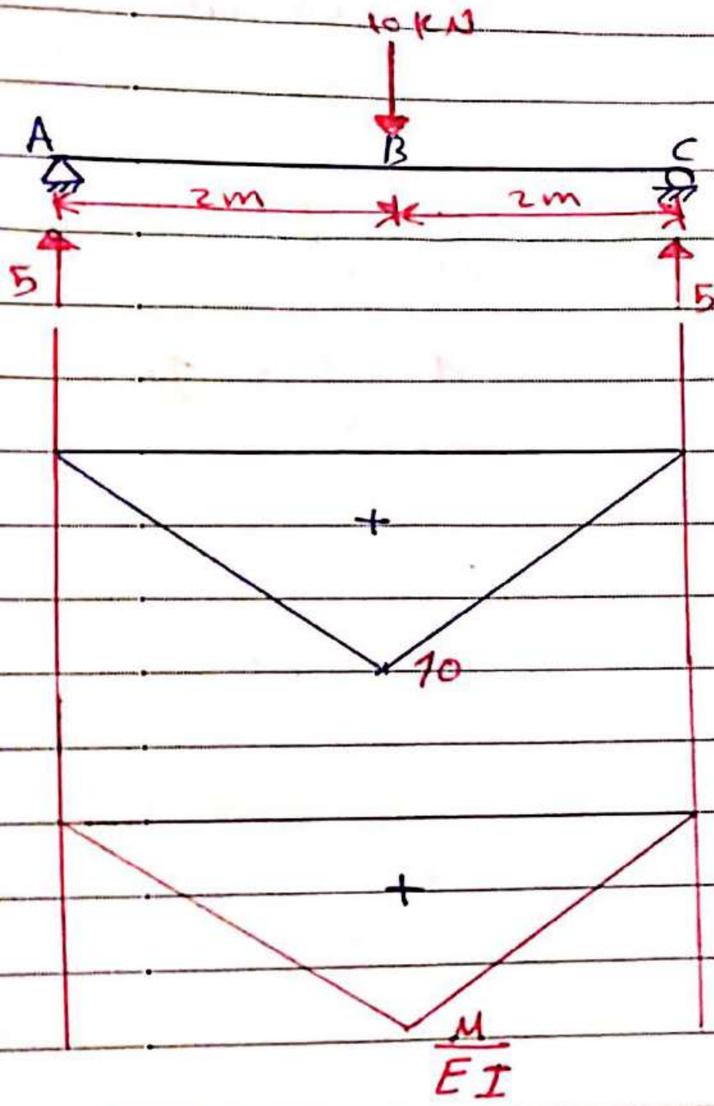
$$M = \iint w(x)\,dx \longrightarrow y = \iint \frac{M}{EI}\,dx$$

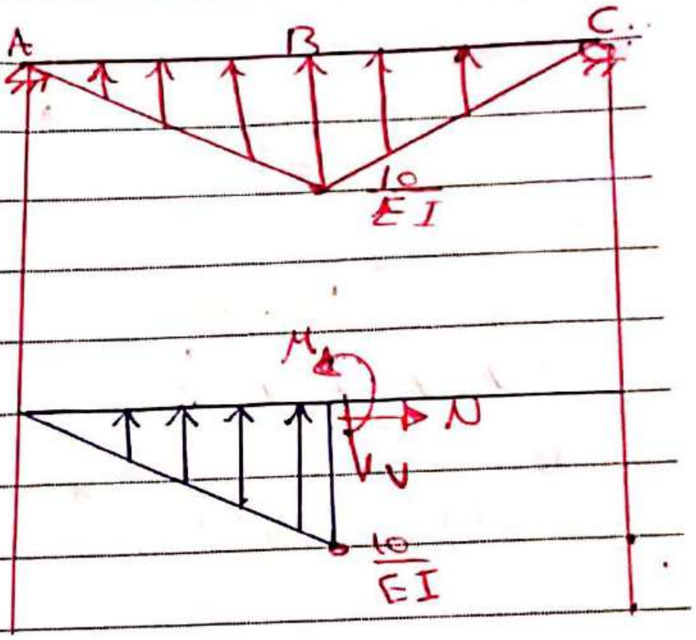
Real Beam | Conjugate Beam



Ex 8- Find deflection at point B. $E = 206\ \text{Gpa}$

$I = 200 * 10^6\ \text{mm}^4$





$\circlearrowleft + \ \Sigma M_B = 0$

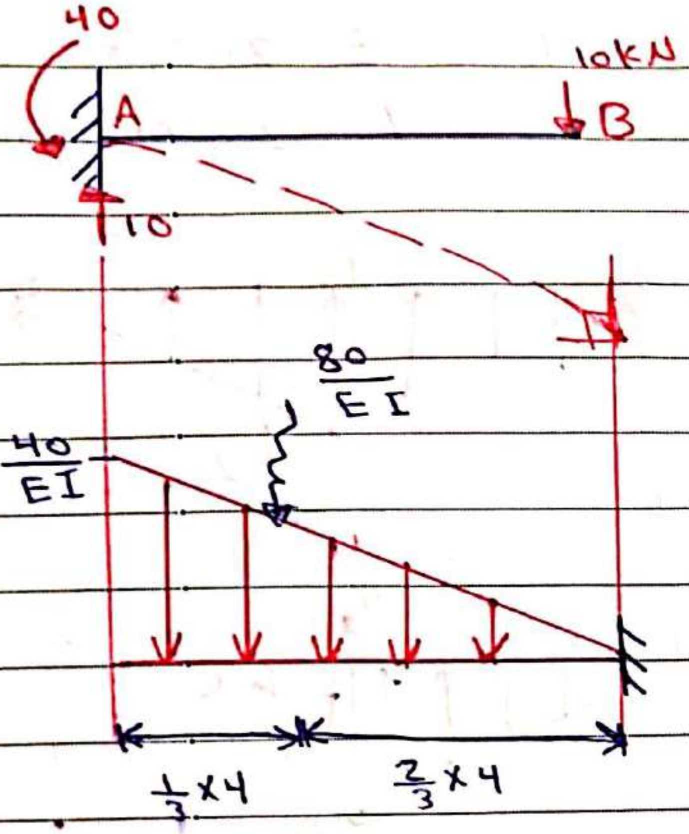
$$\left(\frac{10}{EI}\right)(2) - \left(\frac{10}{EI}\right)\left(\frac{2}{3}\right) + M = 0$$

$$M = \frac{-40}{3EI} = \delta(m)$$

$E = 206 * 10^9$

$I = 200 * 10^{-6}$

* find δ and θ at B



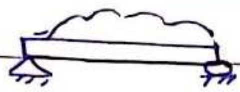
$E = 206\ GPa$

$I = 200 * 10^6\ mm^4$

$\circlearrowleft + \Sigma M_B = 0 \quad \left(\frac{80}{EI}\right)\left(\frac{2}{3}\right)(4) + M = 0$

$M = \frac{-231.32}{EI}$ (1)

conjugate Beam Method [Deflection]

1. Real Beam 

2. Draw M.D for the real Beam.

3. Draw conjugate beam.

4. put the $\frac{M}{EI}$ Diagrame as load on the conjugate beam.

$+M \Rightarrow \uparrow$ load up $-M \Rightarrow \downarrow$ load Down

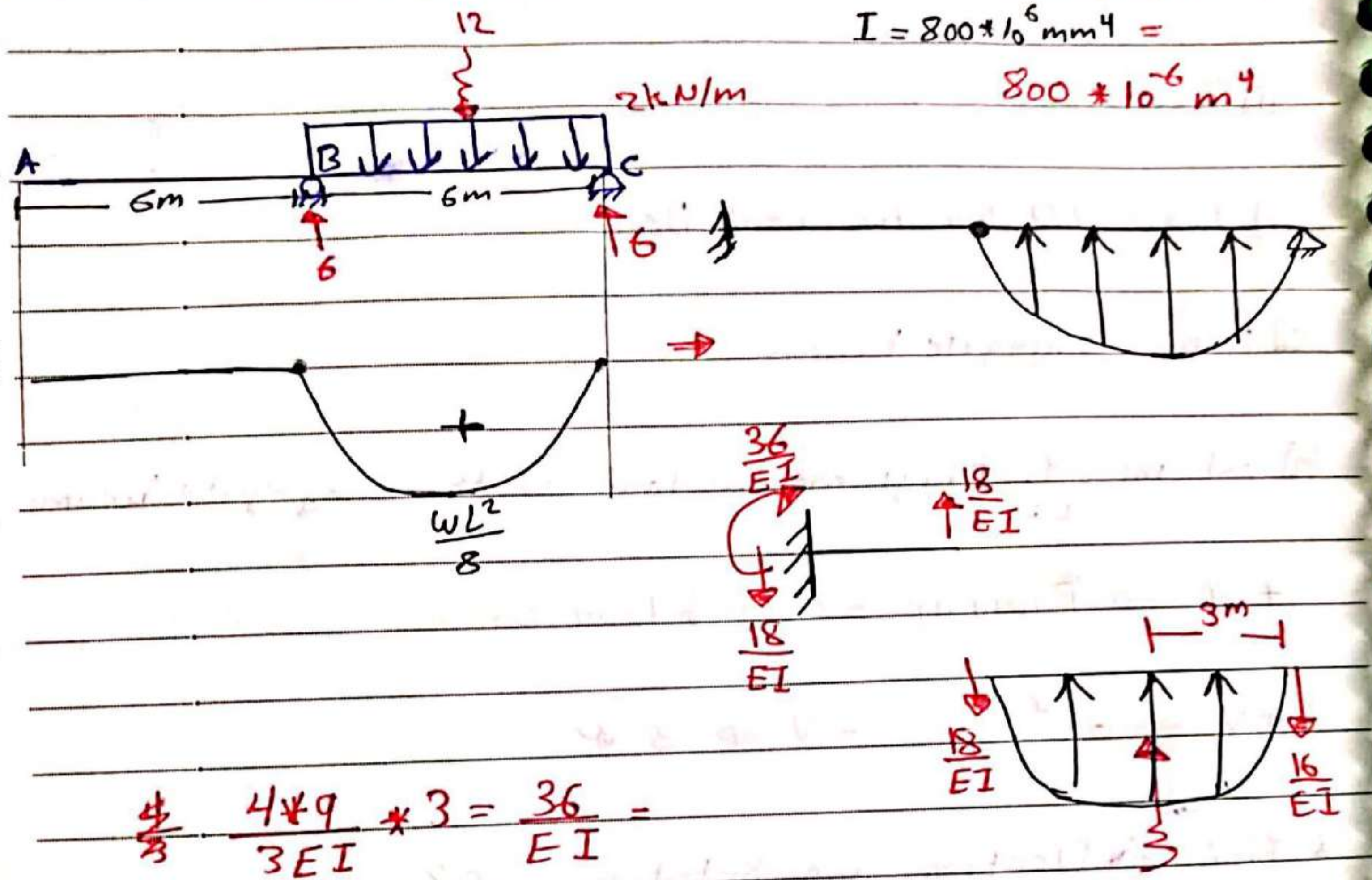
$+V \Rightarrow \theta$ $\quad -V \Rightarrow \theta$

* find θ , δ ⇒ at A

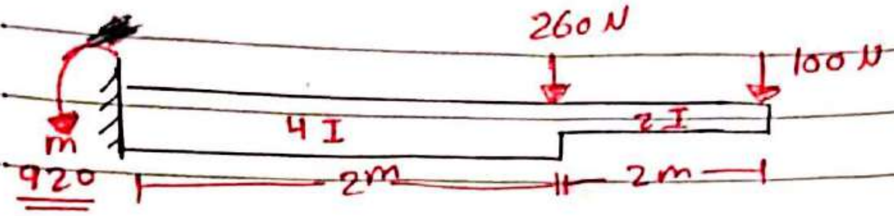
$E = 200$ Gpa $= 200 * 10^6$ KN/m

$I = 800 * 10^6 \, mm^4 =$

$800 * 10^{-6} \, m^4$

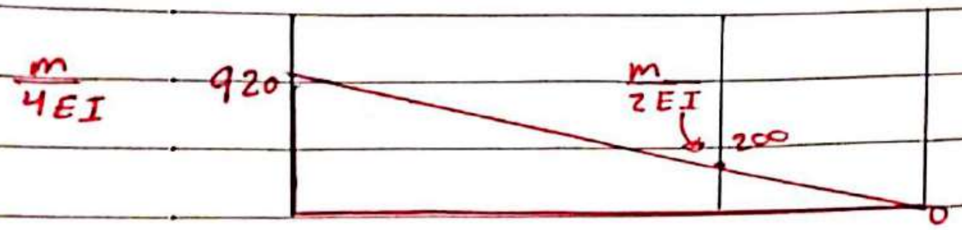


$\frac{4}{3} \cdot \frac{4*9}{3EI} * 3 = \frac{36}{EI} =$

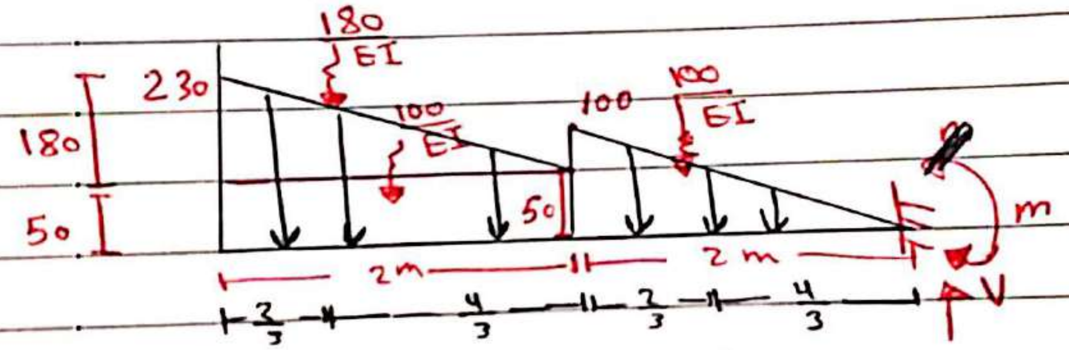


$$\Sigma M = 0 \quad +m - 260(2) - 100(4) = 0 \qquad m = 920$$

نرسم m



$\frac{920}{4} = 230 \qquad \frac{200}{4} = 50 \qquad \frac{200}{2} = 100$



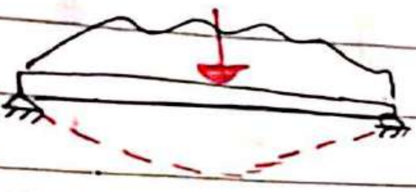
$$\Sigma M = 0 \quad -\frac{m}{EI} + \frac{180}{EI}\left(\frac{10}{3}\right) + \frac{100}{EI}(3) + \frac{100}{EI}\left(\frac{4}{3}\right) = 0$$

$$\frac{m}{EI} = 1033.3 \Rightarrow \Delta$$

$$\Sigma F_y = 0 \quad \frac{-180}{EI} - \frac{100}{EI} - \frac{100}{EI} + V = 0$$

$$V = \frac{380}{EI} \quad \theta$$

* Virtual work method :- [Deflection]

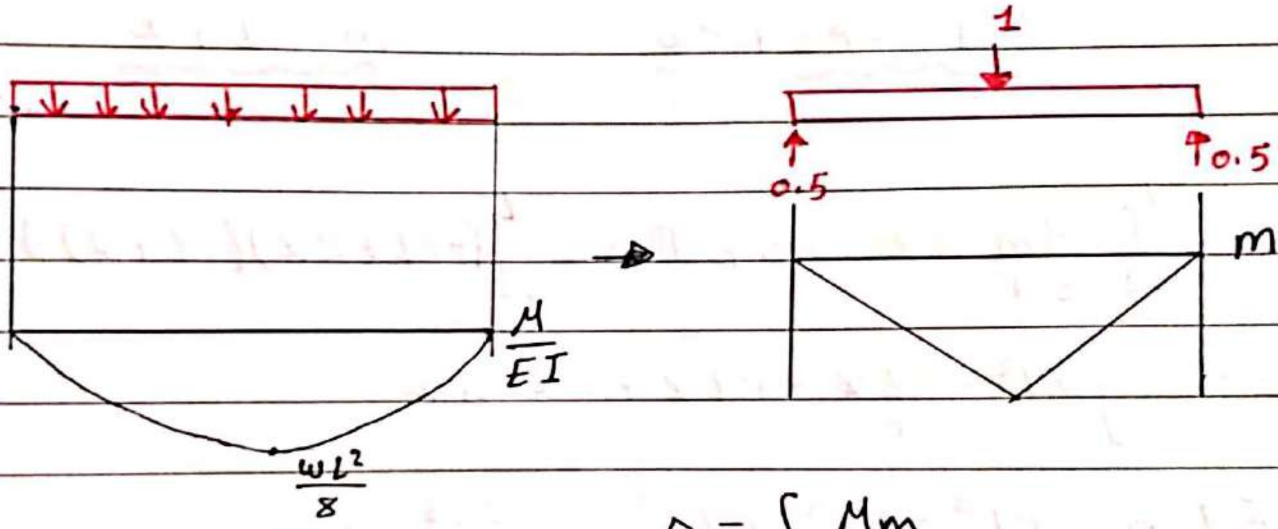


$$\Delta = \int_0^L \frac{Mm}{EI}\, dx$$

M :- moment due to external load

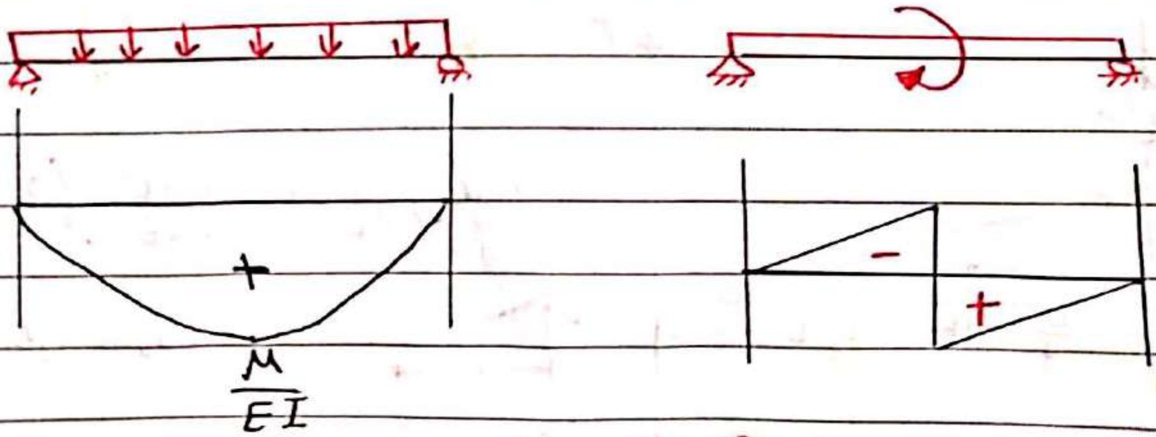
m :- moment for the unit load

Δ :-



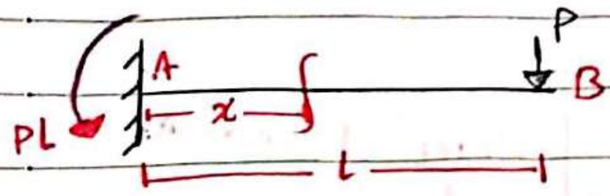
$$\Delta = \int \frac{Mm}{EI}$$

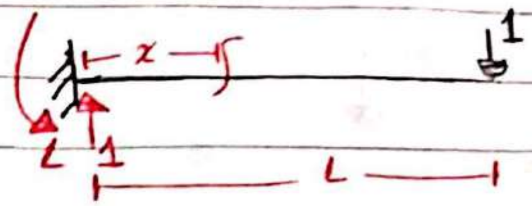
θ :-

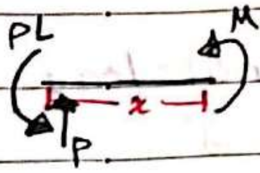


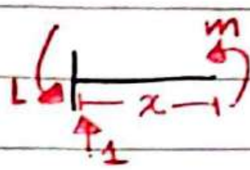
$$\theta = \int \frac{Mm}{EI}\, dx$$

Ex 8- Find Δ_B , θ_B :-









$\Sigma M = 0$ $\qquad$ $PL - Px + M = 0$ $\qquad$ $M = -PL + Px$

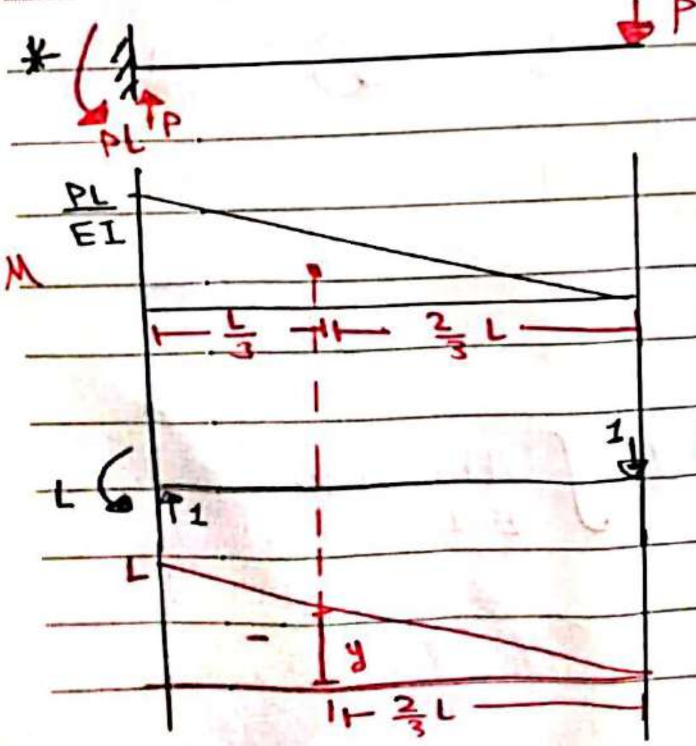
$\Sigma M = 0$ $\qquad$ $L - x + m = 0$ $\qquad$ $m = -L + x$

$$\Delta = \int_0^L \frac{Mm}{EI}\,dx \Rightarrow EI\Delta = \int_0^L (-PL + Px)(-L + x)\,dx$$

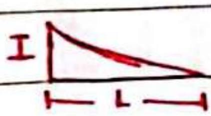
$$EI\Delta = \int_0^L PL^2 - PLx - PLx + Px^2\,dx$$

$$EI\Delta = PL^3 - PL^3 + \frac{PL^3}{3} = \frac{PL^3}{3}$$

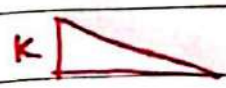
* $\Leftarrow$ [طريقه الجدول]



$$\Delta = \int_0^L \frac{Mm}{EI}\,dx = \left(\frac{PL^2}{2EI}\right)\left(\frac{2}{3}L\right) = \frac{PL^3}{6EI}$$



$\Leftarrow$ من الجدول يلي بالشيت

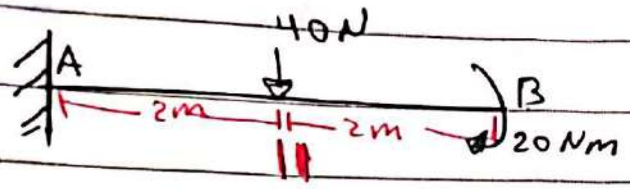


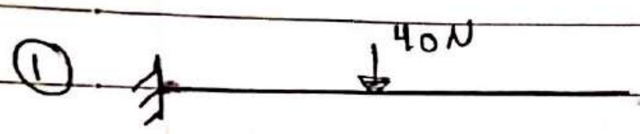
$\frac{1}{3} KIL$

$$\left(\frac{1}{3}\right)\left(\frac{PL}{EI}\right)(L)(L) = \frac{PL^3}{3EI}$$

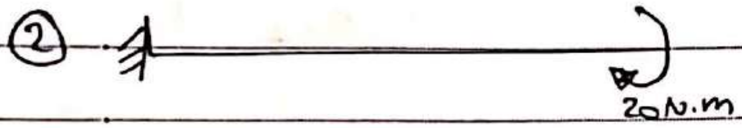
* find ΔB :-

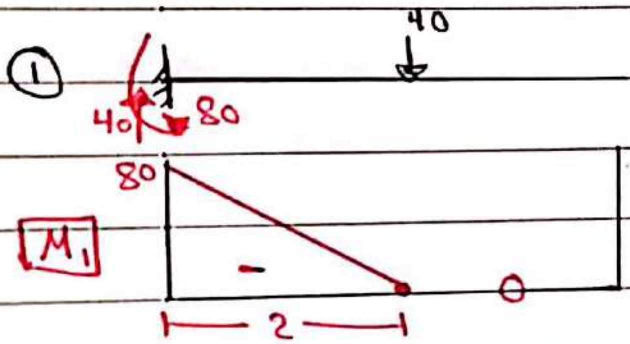
$M = M_1 + M_2$

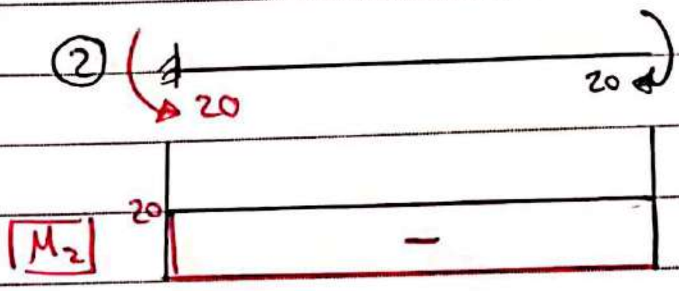


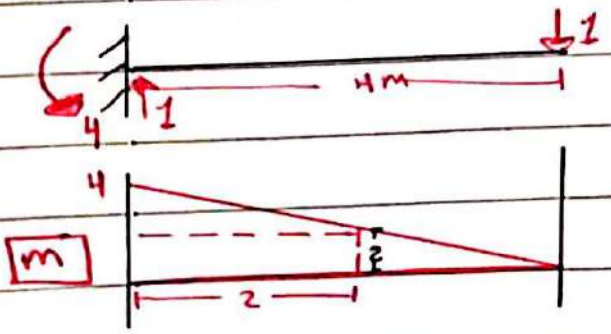


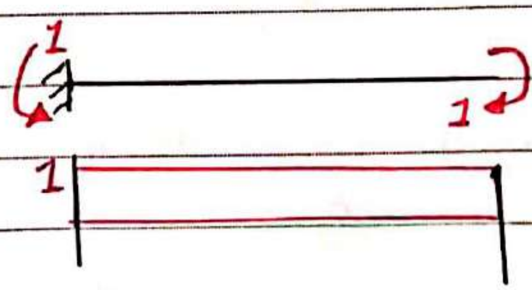
+





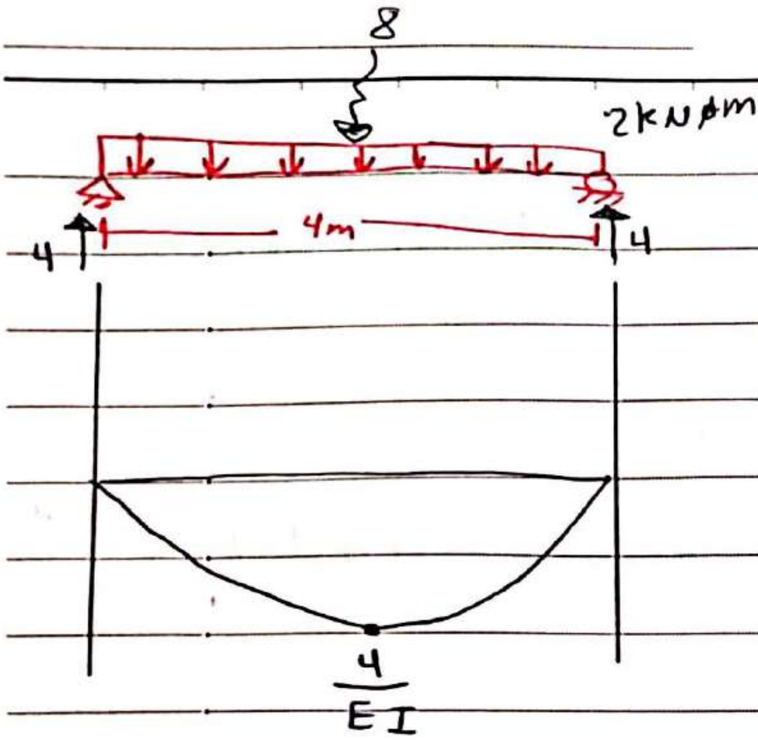


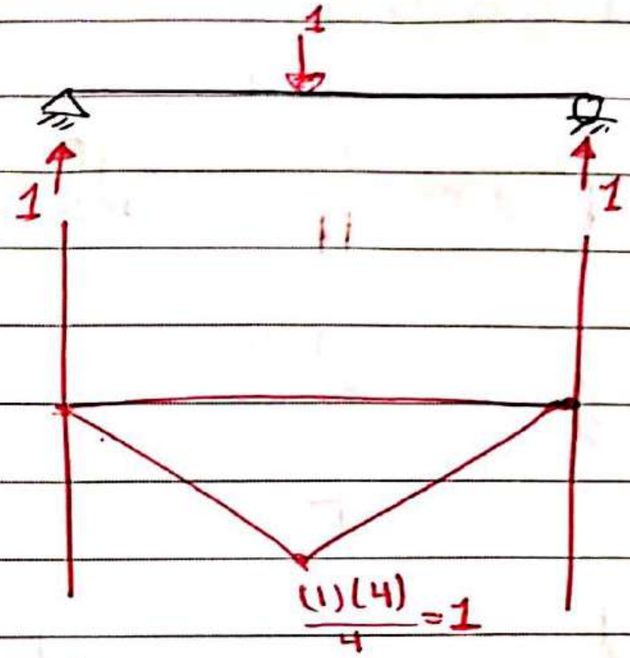




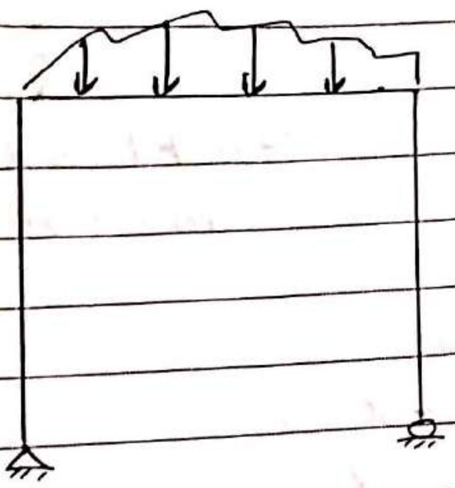
$$\Delta = \left(\frac{1}{3}\right)\left(\frac{80}{EI}\right)(2)(3) + \left(\frac{80}{2EI}\right)(2)(2) + \left(\frac{20}{2EI}\right)(4)(4) =$$

$$\theta = \left(\frac{PL}{2EI}\right)(L)(1) = \frac{PL^2}{2EI}$$


8
2kN/m
4m
4
4
4
EI

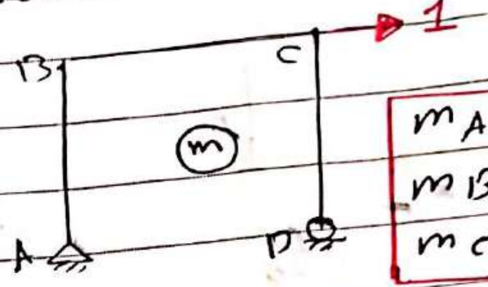

1
1
1
(1)(4)
4
=1

* Virtual work method. (Frames) $E = 200\ GPa$, $I = 235 \times 10^{6}\ m^4$



Real structure $\underline{\underline{M}}$

M_{AB}
M_{BC}
M_{CD}



m_{AB}
m_{BC}
m_{CD}

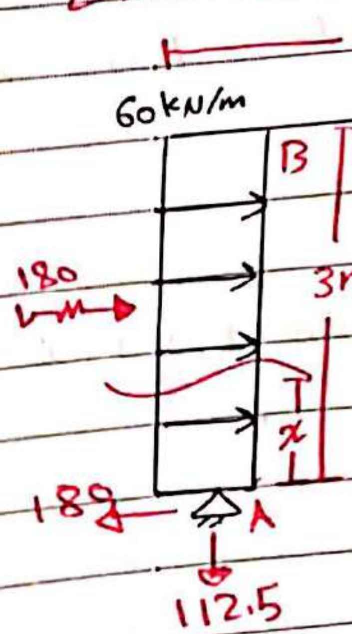
horizontal $\rightarrow 1$

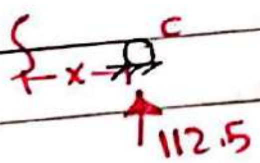
vertical $\downarrow 1$

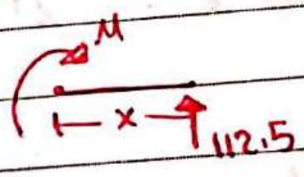
Rotation $\circlearrowright 1$

$\Delta_c = \Delta_{axial} + \Delta_{moment}$

Ex8- find the horizontal displacment at C.

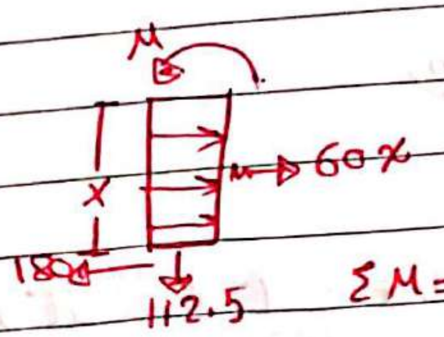






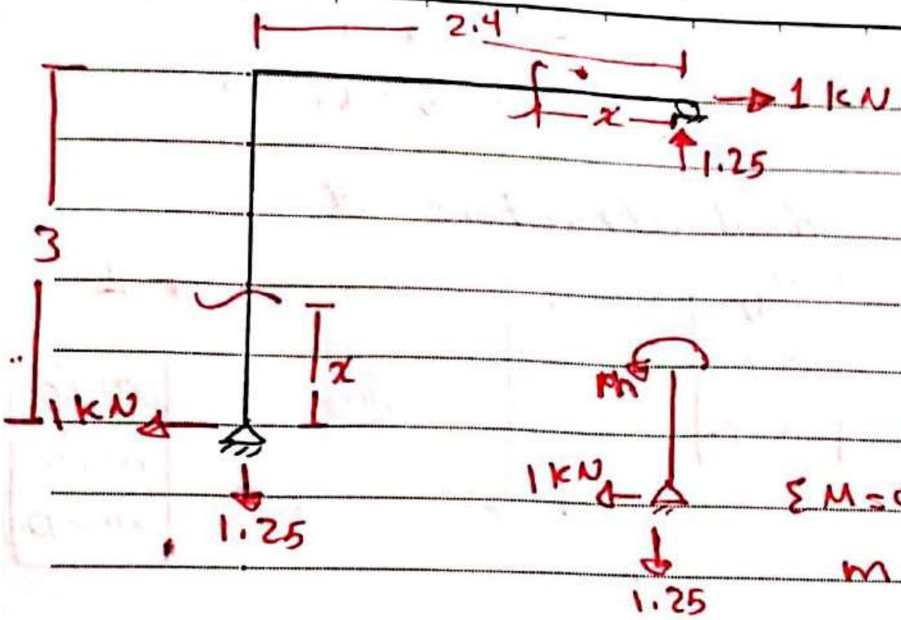
$\Sigma M = 0$

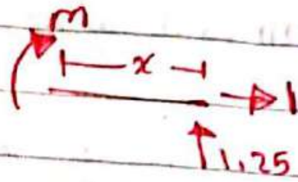
$112.5x - M = 0$ $\boxed{M = 112.5x}$



$\Sigma M = 0$ $M + 60X\left(\frac{X}{2}\right) - 180X = 0$

$M = 180x - 30X^2$





$$-m + 1.25x = 0$$

$$m = 1.25x$$

$$\Sigma M = 0$$

$$m - x = 0$$

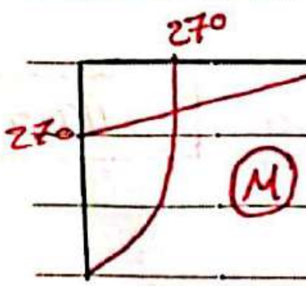
$$m = x$$

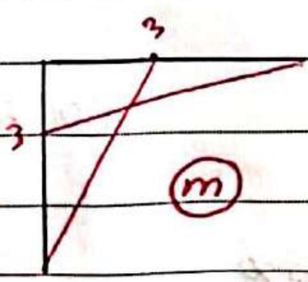
Segment	Origin	limits	M	m	Mm
AB	A	0-3	$180x - 30x^2$	x	$180x^2 - 30x^3$
CB	C	0-2.4	$112.5x$	$1.25x$	$14062.5x^2$

$$EI\Delta = \int_0^3 (180x^2 - 30x^3)\,dx + \int_0^{2.4} (14062.5x^2)\,dx = 1660.5$$

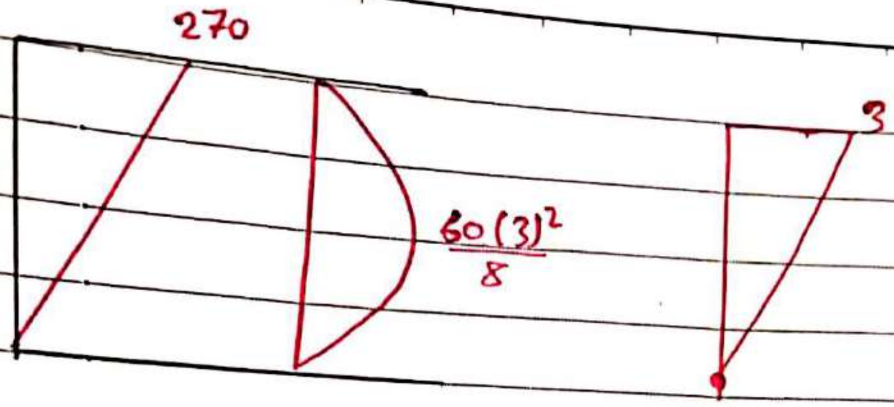
$$\Delta = \frac{1660.5}{(200)(235)} = .0035 \text{ m}$$

* حل السؤال السابق باستخدام الجداول.



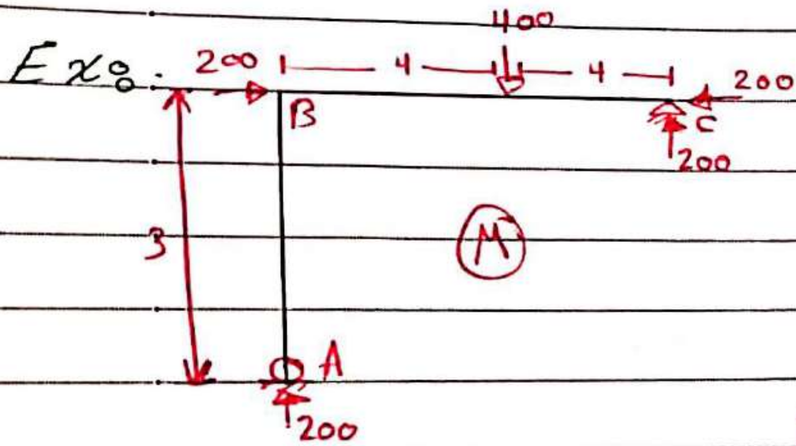


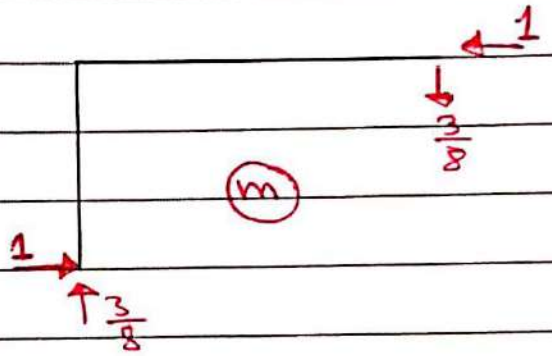
$$EI\Delta = \frac{1}{3}(270)(3)(2.4) + \frac{5}{12}(270)(3)(3) = 1660.5$$

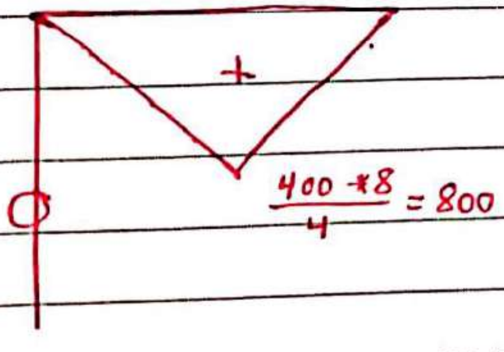


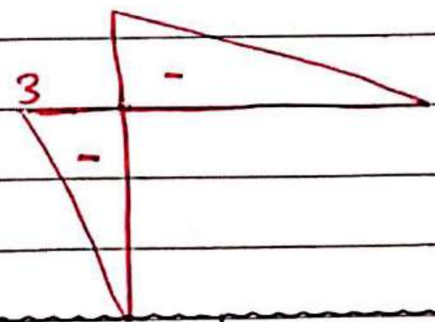
$$\frac{1}{3}(270)(3)(3) + \frac{1}{3}(3)\left(\frac{60\times 3^2}{8}\right)(3) = 1012.5$$

Ex 8 :- * Find ~~dispta~~ horizontal displacement at A :-









Segment	origin	limits	M	m	Mm
AB	A	0-3	0	$-X$	0
BC	B	0-4	$200X$	$-3-\frac{3}{8}X$	$-600X - \frac{600}{8}X^2$
DC	D	0-4	$200X$	$-\frac{3}{8}X$	$-\frac{600X^2}{8}$

$$EI\Delta_A = \int_0^4 -600X - \frac{600}{8}X^2\,dX + \int_0^4 -\frac{600X^2}{8}\,dX = \frac{-4800}{EI}$$