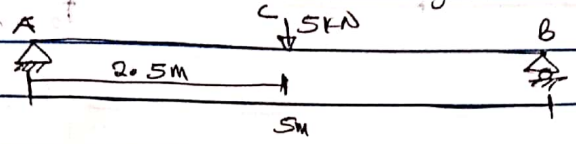
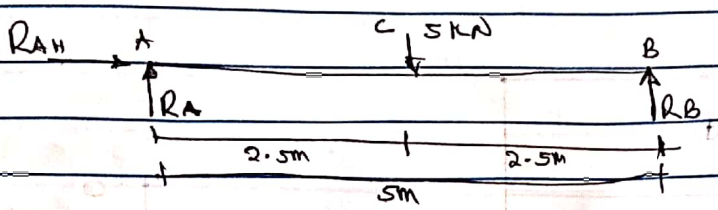
Simply Supported Beam

Example 1: Draw the SF and BM Diagram for the SSB below



Step 1: FBD



Step 2: cal. the support Reaction

$\Sigma F_x = 0 \Rightarrow R_{AH} = 0 KN$

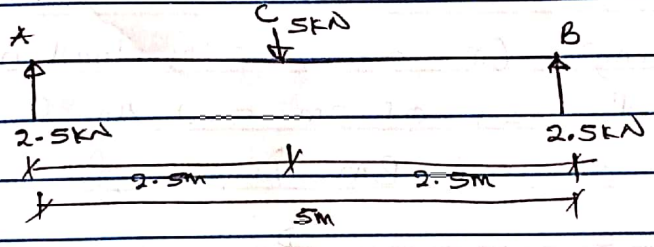
$\Sigma F_y = 0 \Rightarrow R_A + R_B = 5KN$ ——— ①

$\Sigma M_A = 0 \Rightarrow 5 \times 2.5 = R_B \times 5$ ∴ $R_B = 2.5KN$

$\Sigma M_B = 0 \Rightarrow R_A \times 5 = 5 \times 2.5$ ∴ $R_A = 2.5KN$

From eqn ① $R_A + R_B = 5KN$

Step 3: cal. the SF



SF at A = +2.5KN

SF btw A and C = +2.5KN

SF at C = +2.5 − 5 = −2.5KN

SF btw C and B = −2.5KN

SF at B = −2.5 + 2.5 = 0KN (check)

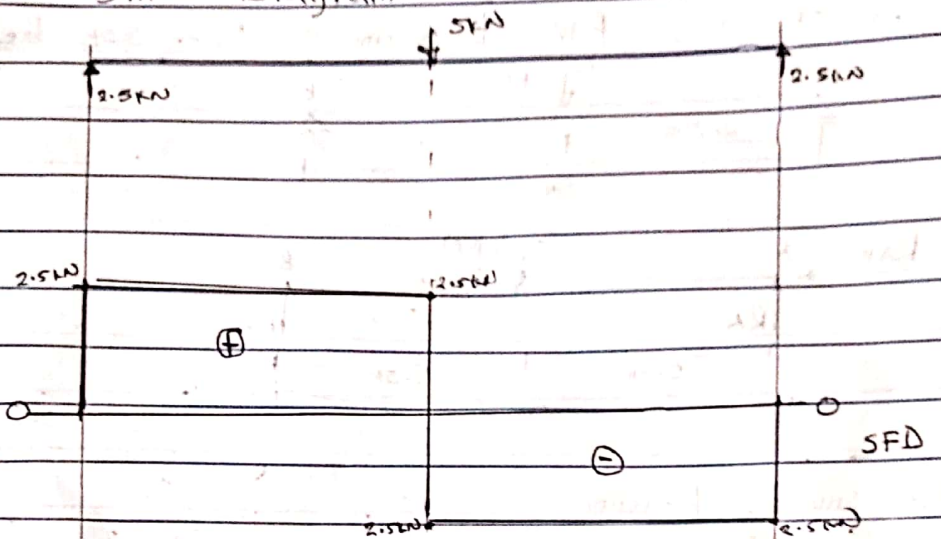
Step 4: Cal. the BM

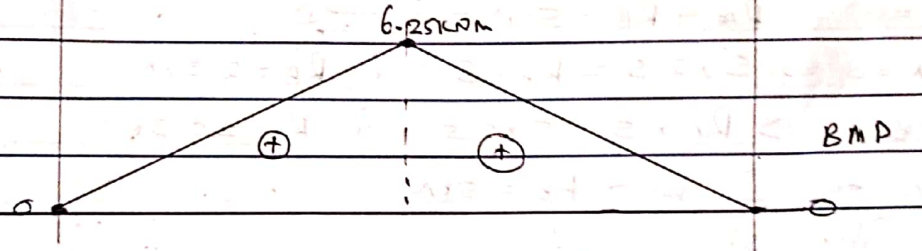
BM at A = 0KNm (Pinned Support)

BM at C = 2.5 × 2.5 = 6.25KNm

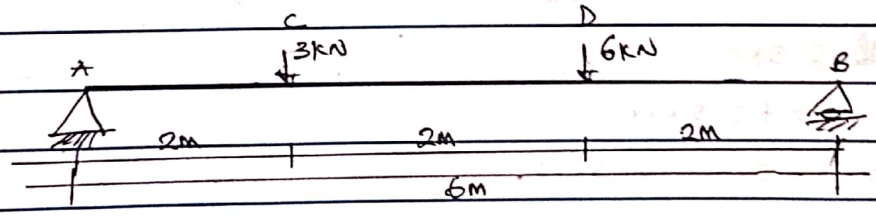
BM at B = 2.5 × 5 − 5 × 2.5 = 0KNm

Step 5: SF and BM Diagram

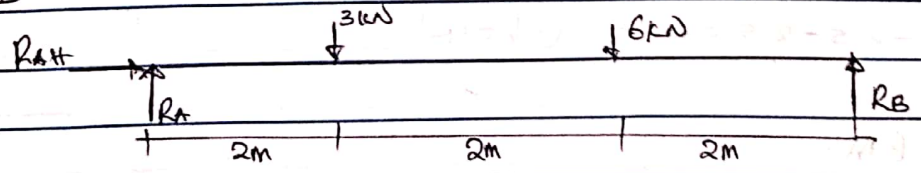




Example 2 : A SSB of length 6m, carries point load of 3KN and 6KN at distances of 2m and 4m from the left end. Draw the SF and BM Diagram for the beam.



Step 1 : FBD



Step 2: cal. the support reactions

$\Sigma F_x = 0 \Rightarrow R_{AH} = 0\,KN$

$\Sigma F_y = 0 \Rightarrow R_A + R_B = 3 + 6$ or $R_A + R_B = 9KN$ — (1)

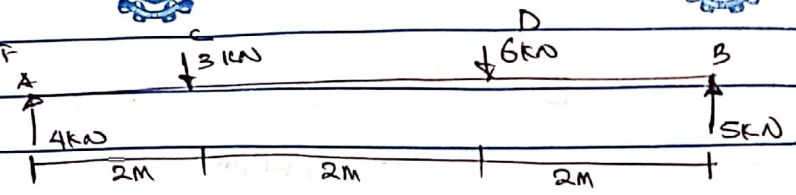
$\Sigma M_A = 0 \Rightarrow 3 \times 2 + 6 \times 4 = 6R_B$ i.e. $R_B = 5KN$

$\Sigma M_B = 0 \Rightarrow 6R_A = 3 \times 4 + 6 \times 2$ i.e. $R_A = 4KN$

QUESTION.....
Write on both sides of the paper.

Do not write in this margin

Step 3: cal. the SF



SF at A = +4 KN

SF btw A and C = +4 KN

SF at C = +4 - 3 = +1 KN

SF btw C and D = +1 KN

SF at D = +1 - 6 = - 5 KN

SF btw D and B = - 5 KN

SF at B = - 5 KN + 5 KN = 0 KN

Step 4: cal. The BM.

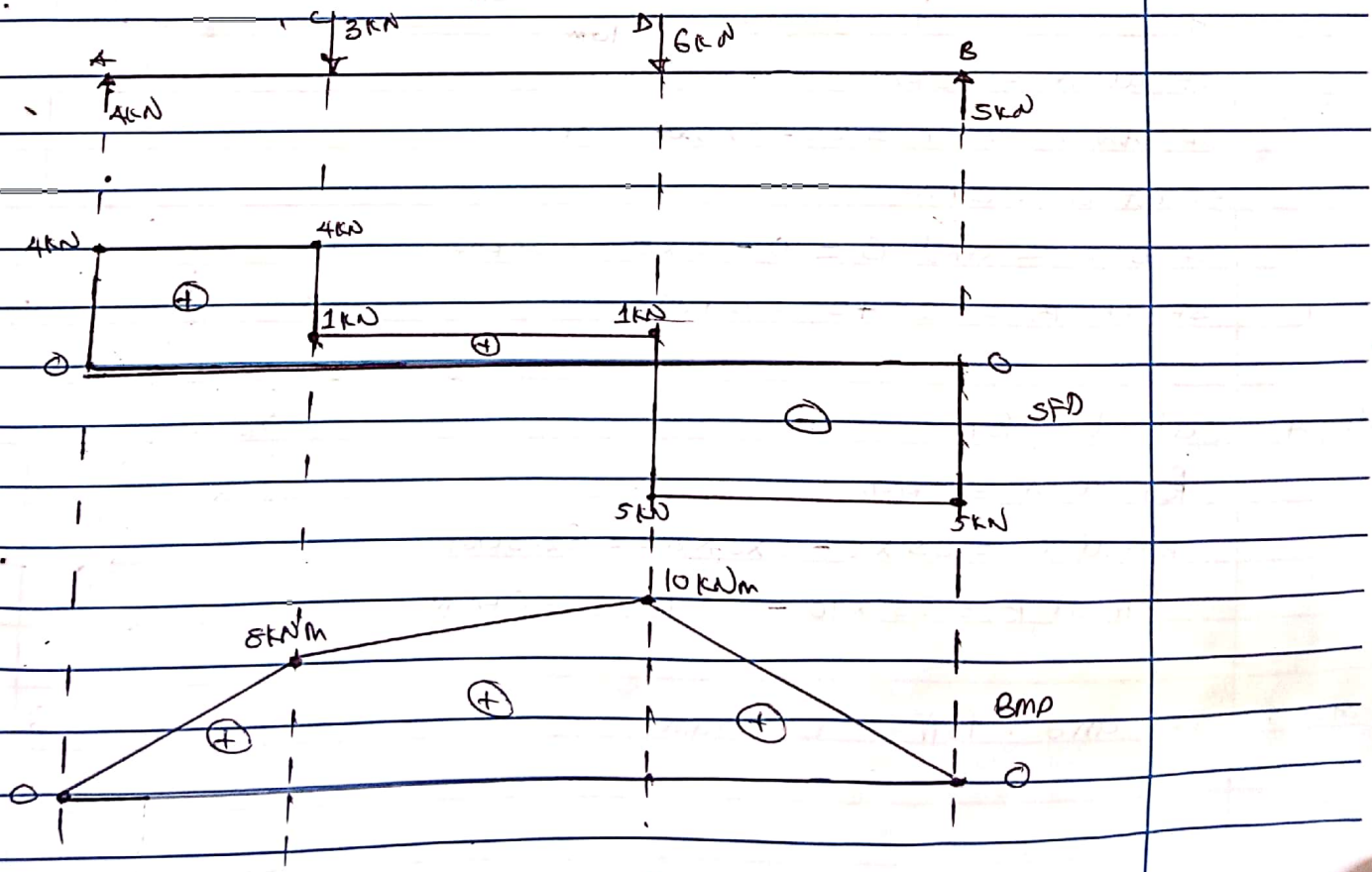
BM at A = 0 KNM

BM at C = 4 X 2 = 8 KNM

BM at D = 4 X 4 - 3 X 2 = 10 KNM

BM at B = 4 X 6 - 3 X 4 - 6 X 2 = 0 KNM

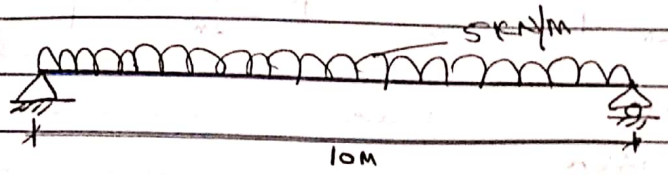
Step 5: SF and BM Diagram



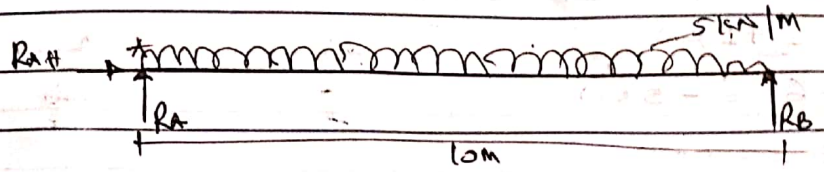
QUESTION.....
Write on both sides of the paper.

Do not write in this margin

Example 3: Draw the SF and BM Diagram for the SSB below



Step 1: FBD



Step 2: cal. the support Reactions

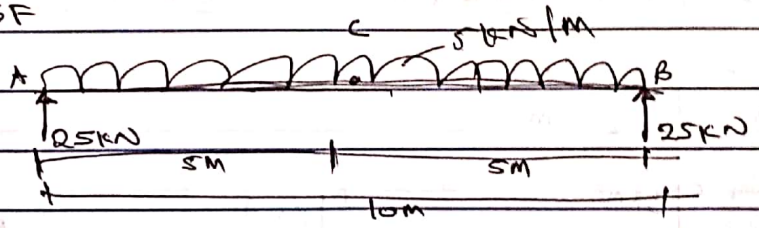
$\Sigma F_x = 0 \Rightarrow R_{AH} = 0KN$

$\Sigma F_y = 0 \Rightarrow R_A + R_B = 5 \times 10$ i.e. $R_A + R_B = 50KN$ ——— (1)

$\Sigma M_A = 0 \Rightarrow 5 \times 10 \times 5 = 10 R_B$ i.e. $R_B = 25KN$

$\Sigma M_B = 0 \Rightarrow 10 R_A = 5 \times 10 \times 5$ i.e. $R_A = 25KN$

Step 3: cal. the SF



JF

JF at A = +25KN

SF btw A and C = $25 - 5 \times 5 = 0KN$

SF at C = 0KN

SF btw C and B = $0 - 5 \times 5 = -25KN$

SF at B = $-25 + 25 = 0KN$

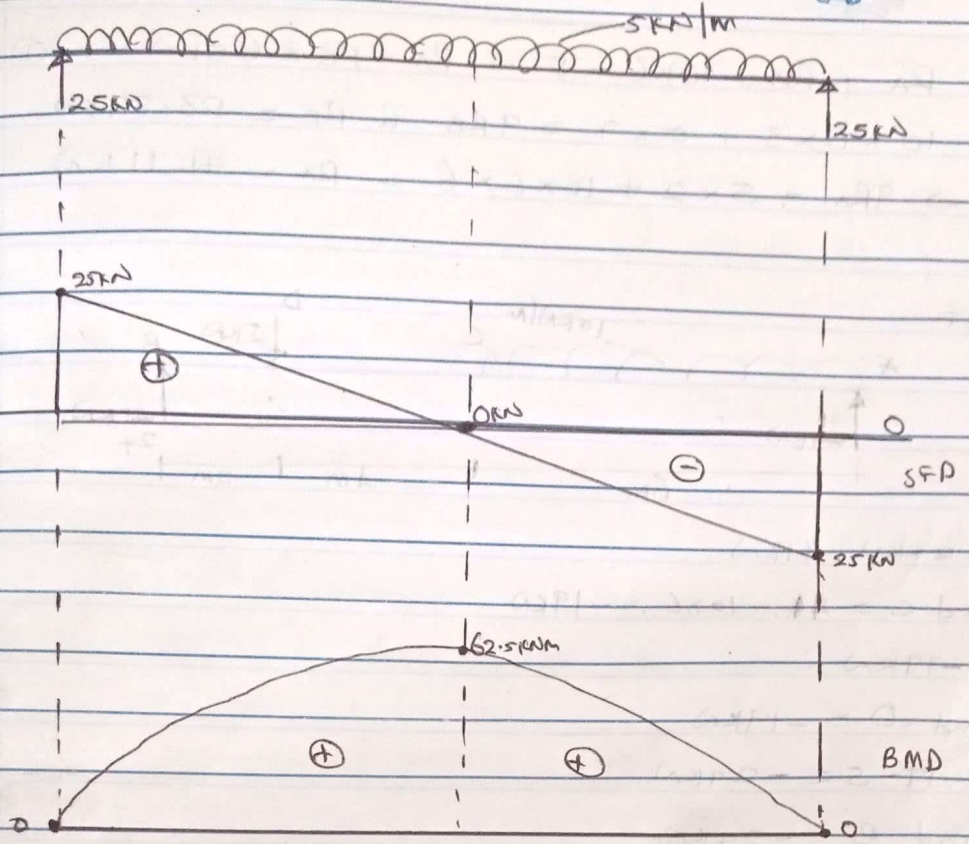
Step 4: cal. the BM

BM at A = 0KNM

BM at C = $25 \times 5 - 5 \times 5 \times 2.5 = 62.5KNM$

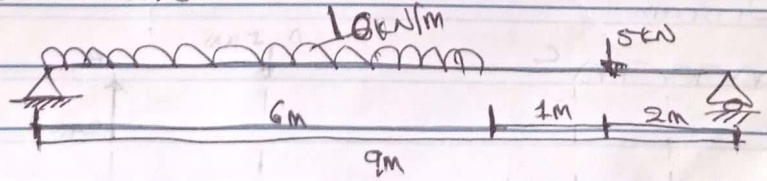
BM at B = $25 \times 10 - 5 \times 10 \times 5 = 0KNM$

Step 5: SF and BM Diagram

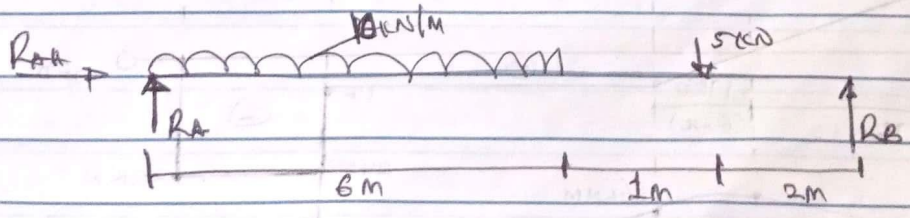


Max. BM is the BM at a pnt where SF changes sign. or where the SF becomes zero.

Example 4: Draw the SF and BM Diagram for a simply supported beam of length 9m and carrying a UDL of 10KN/m for a dist of 6m from the left end, and a pnt load of 5KN at a dist of 7m from the left. Also cal. the max BM of the section.



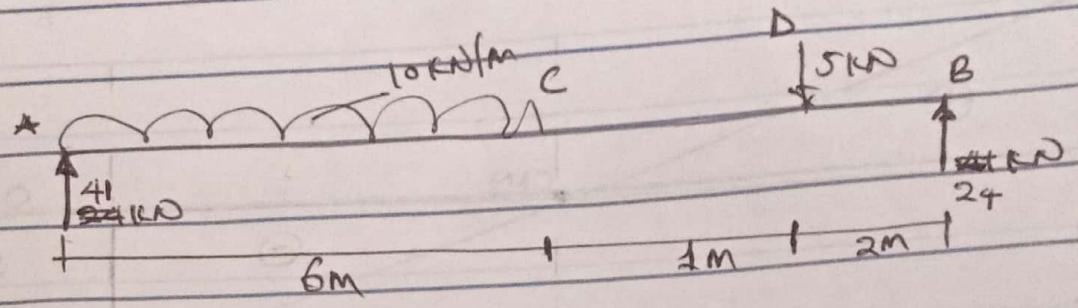
Step 1: FBD



Step 2: cal. the support Reactions

$\Rightarrow \sum F_x = 0 \Rightarrow R_{AH} = 0$ KN.

cal. The SF



SF at A = ~~24KN~~ 41KN

SF btw A and C = 41 - 10x6 = -19KN

SF at C = -19KN

SF btw C and D = -19KN

SF at D = -19-5 = -24KN

SF btw D and B = -24KN

SF at B = -24+24 = 0KN

cal. The BM

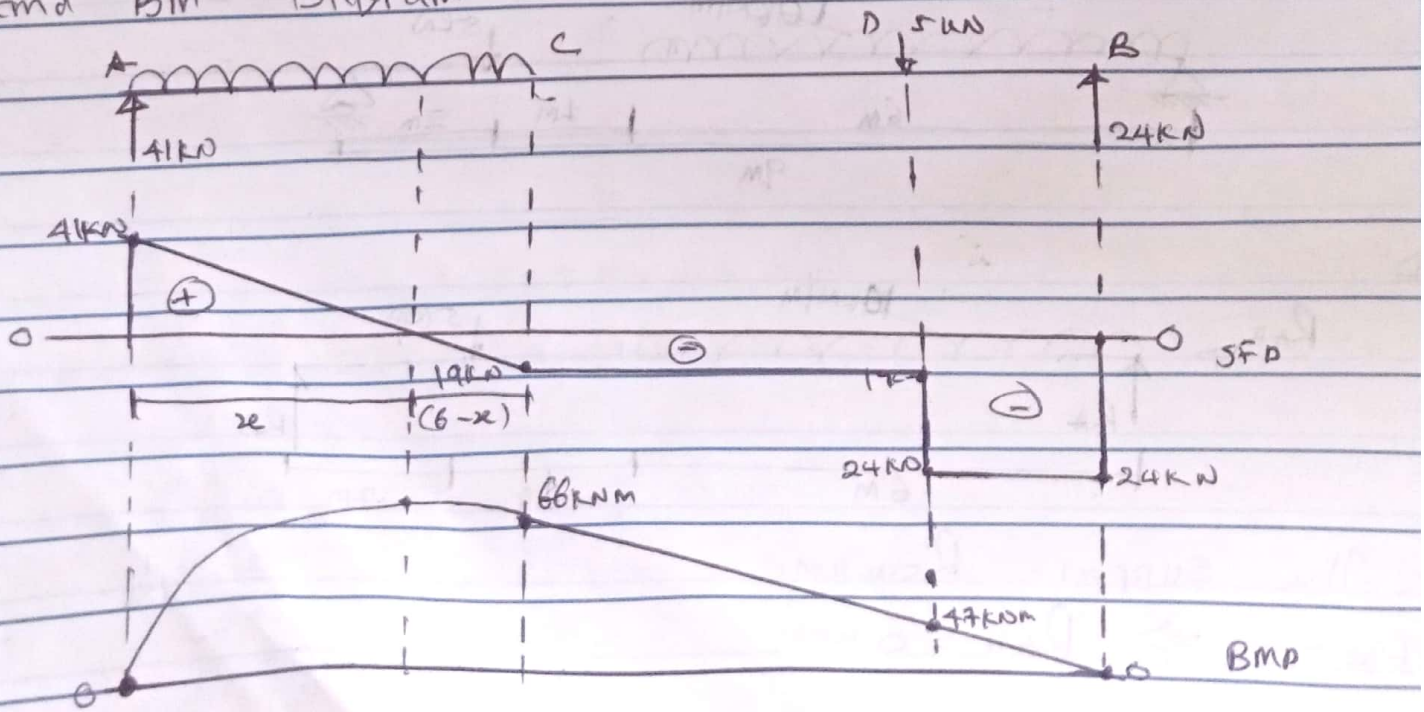
Bm at A = 0KNM

Bm at C = 41x6 - 10x6x3 = 66KNM

Bm at D = 41x7 - 10x6x4 = 47KNM

Bm at B = 41x9 - 10x6x6 - 5x2 ≈ 0KNM

SF and BM Diagram



$\frac{41}{x} = \frac{19}{6-x}$ $\Rightarrow x = 4.1\text{m}$

$246 - 41x = 19x$

Max. Moment occurs at a dist of 4.1m from Support A

Max BM = ~~41x 41.1~~ ~~41x 4.1 - 10x4.1x~~

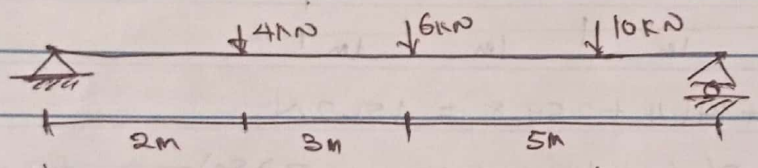
$= 41x - 10x\,x\,\frac{x}{2}$

$= 77.9\text{KNm} = 80\text{KNm}$

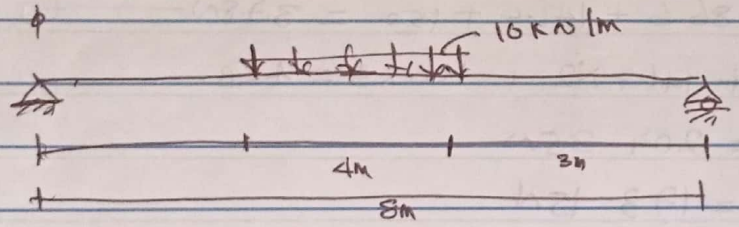
Assignment.

① Draw the SF and BM for the SSBs shown below

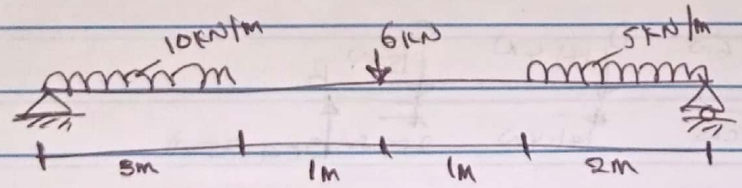
(a)



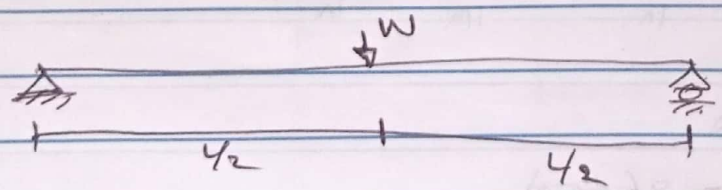
(b)



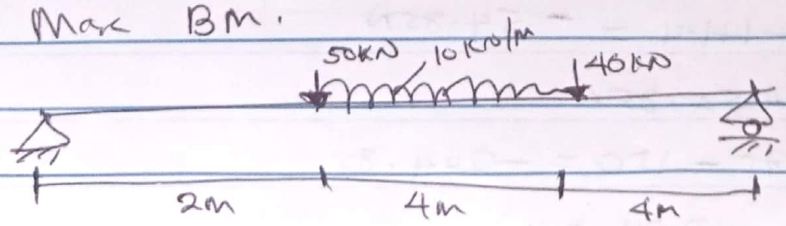
(c)



(d)



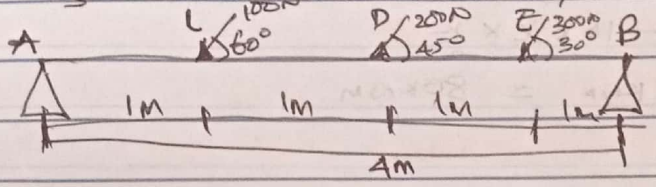
② Draw the SF and BM Diagram for the beam below. Also cal. the Max BM.



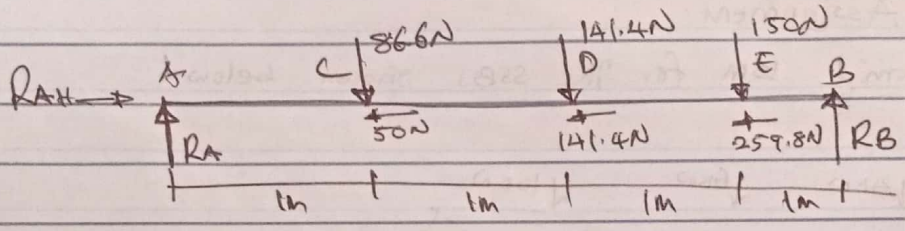
Over-Hanging Beam

Beam Carrying an Inclined Load

Example: A horizontal beam AB of length 4m is hinged at A and supported on roller at B. The beam carries an inclined Loads of 100N, 200N and 300N inclined at 60°, 45° and 30° to the horizontal as shown below. Draw the SF and BM Diagram.



Step 1: FBD



$\Sigma F_x = 0 \Rightarrow R_{AH} = 50 + 141.4 + 259.8 = 451.2N$

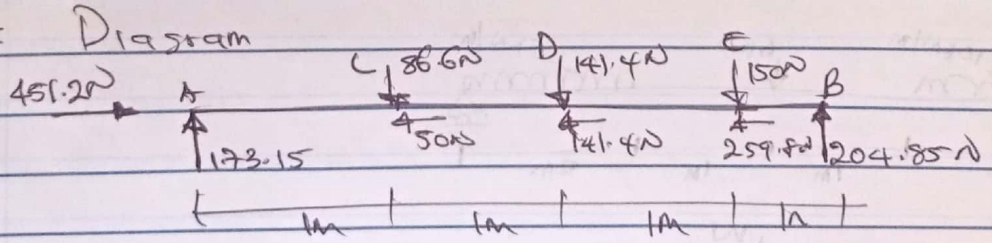
$\Sigma F_y = 0 \Rightarrow R_A + R_B = 86.6 + 141.4 + 150 = 378N$ ——— (1)

$\Sigma M_A = 0 \Rightarrow 86.6 \times 1 + 141.4 \times 2 + 150 \times 3 = 4R_B$

$\therefore R_B = 204.85N$

$R_A = 173.15N$

Step 2: SF Diagram



SF at A = 173.15N

SF b/w A and C = 173.15N

SF at C = 173.15 − 86.6 = 86.55N

SF b/w C and D = 86.55N

SF at D = 86.55 − 141.4 = −54.85N

SF b/w D and E = −54.85N

SF at E = −54.85 − 150 = −204.85

SF b/w E and B = −204.85N

SF at B = −204.85 + 204.85 = 0N

Steps: Trust Diagram

TR at A = RAH = 451.2N

TR bN A and C = 451.2N

TR at C = 451.2 − 50 = 401.2N

TR btw C and D = 401.2N

TR at D = 401.2 − 141.4 = 259.8N

TR bN D and E = 259.8N

TR at E = 259.8 − 259.8 = 0N

TR bN E and B = 0N

TR at B = 0N

Step 4: BM Diagram

BM at A = 0KNm

BM at C = 173.15 × 1 = 173.15KNm

BM at D = 173.15 × 2 − 86.6 × 1 = 259.7KNm

BM at E = 173.15 × 3 − 86.6 × 2 − 141.4 × 1 = 204.85KNm

BM at B = 173.15 × 4 − 86.6 × 3 − 141.4 × 2 − 150 × 1 = 0KNm