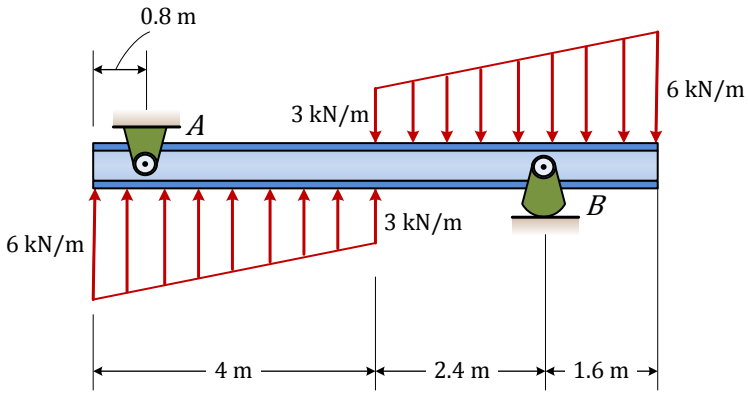
## Question 5.11.

The beam subjected to the two linearly distributed loads, as shown. Calculate the support reactions at $A$ and $B$.




## Solution

$$R_1 = \frac{1}{2}(4)(3) = 6 \text{ kN}$$

$$R_2 = (4)(3) = 12 \text{ kN}$$

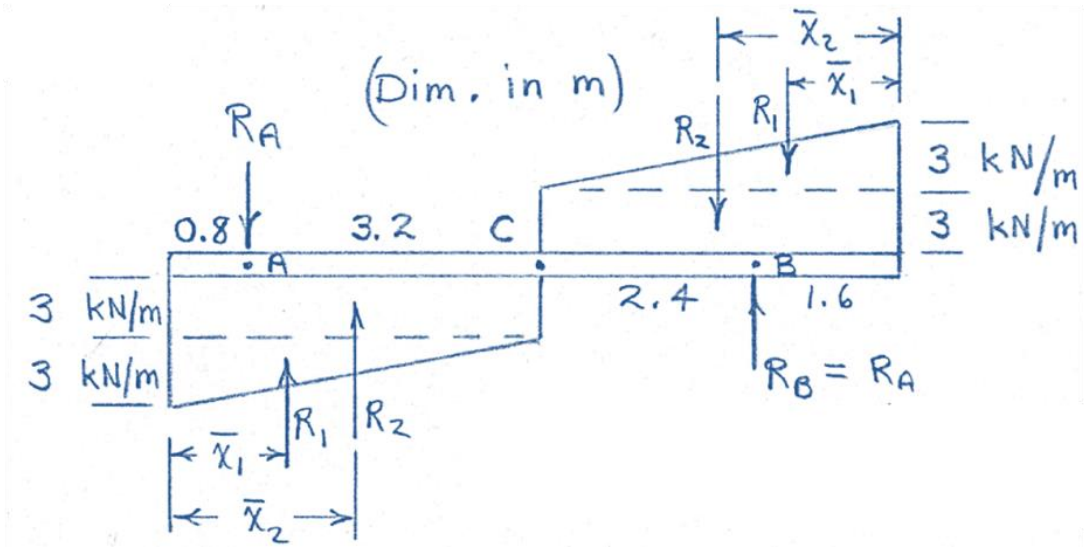
$$\bar{x}_1 = \frac{1}{3}(4) = \frac{4}{3} \text{ m}$$

$$\bar{x}_2 = \frac{1}{2}(4) = 2 \text{ m}$$

$+\circlearrowleft \sum M_B = 0$:

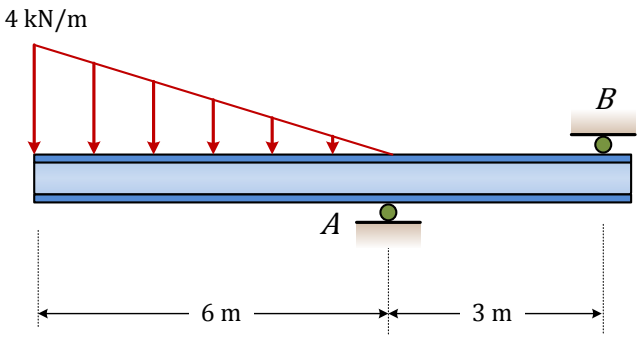
$$R_A(3.2 + 2.4) - 12(2 + 2) - 6\left(4 - \frac{4}{3} + 2.4\right) = 0$$

$R_A = R_B = 14 \text{ kN}$ (Answer)



## Question 5.12.

For the loaded beam shown, draw the shear and moment diagrams. Specify the shear $V$ and moment $M$ at a section 3 $m$ to the left of the support at $A$.

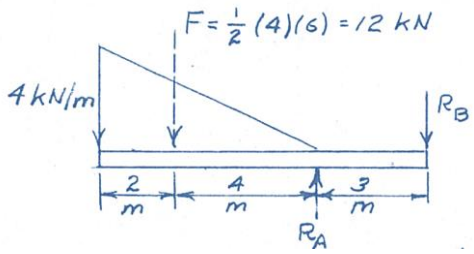


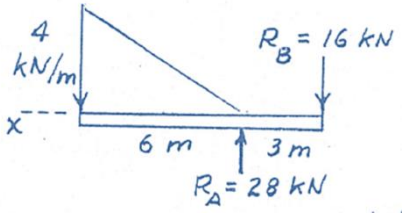

## Solution

$+\circlearrowleft \sum M_A = 0$:

$12(4) - R_B(3) = 0$

$R_B = 16$ kN




$+\circlearrowleft \sum M_B = 0$:

$12(7) - R_A(3) = 0$

$R_A = 28$ kN

*Now taking section cut from* $0 < x < 3$ m

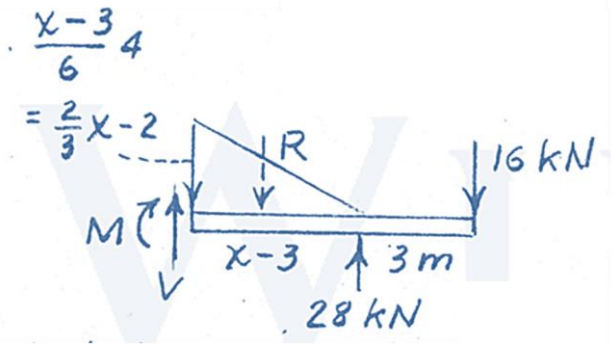
$+\uparrow \sum F_y = 0$:

$V = 16$ kN


$+\circlearrowleft \sum M_C = 0$:

$M = -16x \quad (\text{kN.m})$

*Now taking section cut from* $3 \text{ m} < x < 9$ m




$R = \frac{1}{2}\left(\frac{2x}{3} - 2\right)(x-3) = \frac{1}{3}(x-3)^2$

$+\uparrow \sum F_y = 0$:

$V - 16 + 28 - \frac{1}{3}(x-3)^2 = 0$

$V = \frac{1}{3}(x-3)^2 - 12 \quad (\text{kN})$

$+\circlearrowleft \sum M_C = 0$:

$$M + 16(x) - 28(x-3) + \frac{1}{3}(x-3)^2\left[\frac{1}{3}(x-3)\right] = 0$$

$$M = -\frac{x^3}{9} + x^2 + 9x - 81 \quad (\text{kN.m})$$

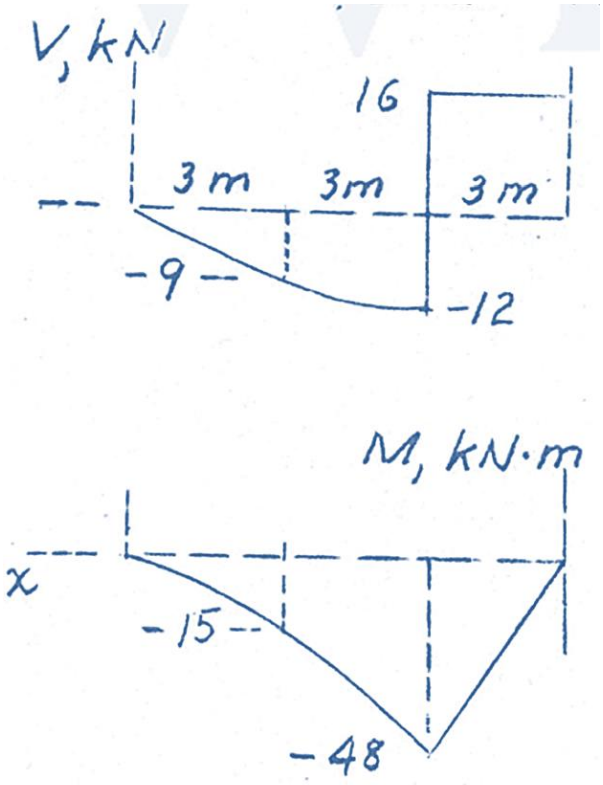
$at\ \ x = 6\ \text{m}$

$$V = \frac{1}{3}(6-3)^2 - 12 \quad (\text{kN})$$

$V = -9\ \text{kN}$ (Answer)

$$M = -\frac{(6)^3}{9} + (6)^2 + 9(6) - 81 \quad (\text{kN.m})$$

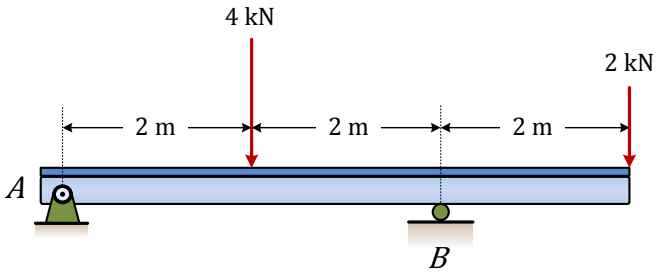
$M = -15\ \ \text{kN.m}$ (Answer)




(Answer)

## Question 5.13.

For the loaded beam shown, draw the shear and moment diagrams. Determine the distance $d$ to the right of $A$ where the moment is zero.

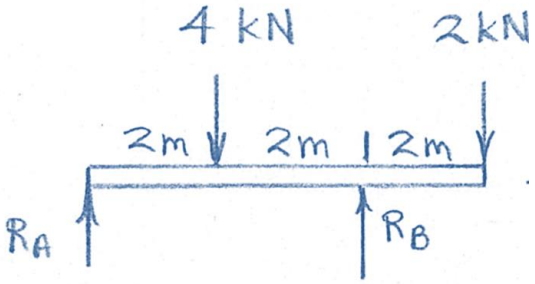



### Solution

$+\circlearrowleft \sum M_A = 0$:

$-4(2) - 2(6) + R_B(4) = 0$

$R_B = 5$ kN

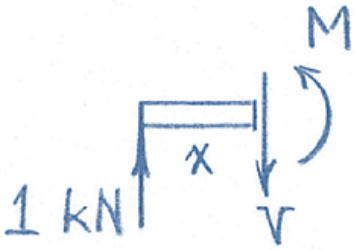



$+\uparrow \sum F_y = 0$:

$R_A - 4 - 2 + R_B = 0$

$R_A = 1$ kN

*Now taking section cut from* $0 < x < 2$ m



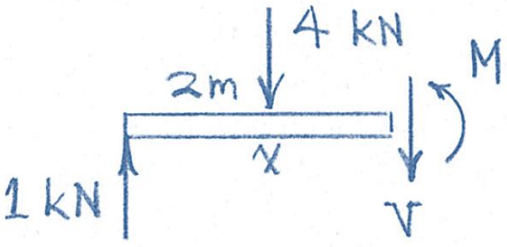

$+\uparrow \sum F_y = 0$:

$V = 1$ kN

$+\circlearrowleft \sum M_C = 0$:

$M = x$ (kN.m)

*Now taking section cut from* $2$ m $< x < 4$ m




$+\uparrow \sum F_y = 0$:

$1 - 4 - V = 0$

$V = -3$ (kN)

$+\circlearrowleft \sum M_C = 0$:

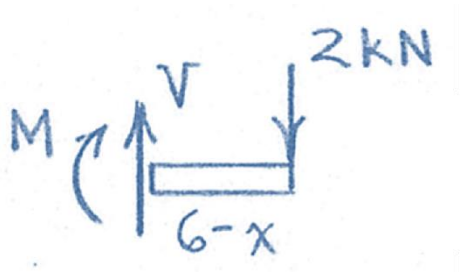
$M - 1(x) + 4(x - 2) = 0$

$M = 8 - 3x \ \ (\text{kN.m})$

*Now taking section cut from* $4\ \text{m} < x < 6\ \text{m}$

$+\uparrow \sum F_y = 0$:

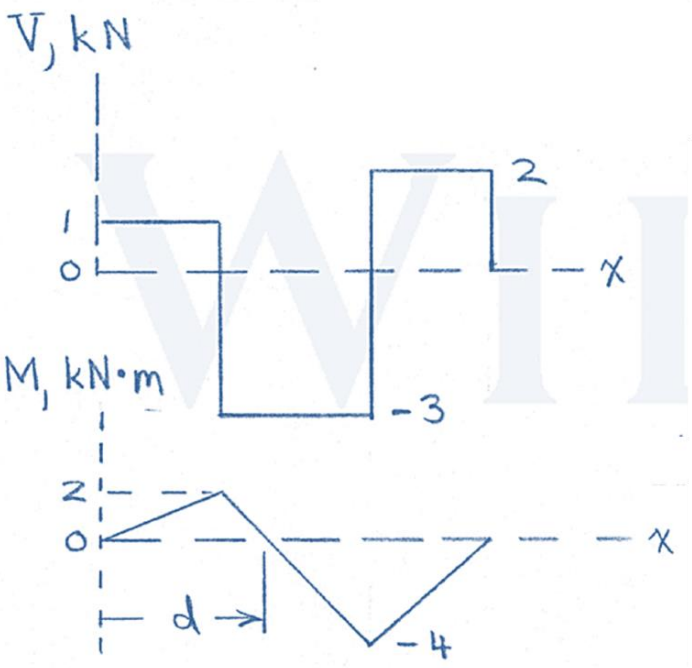
$V = 2 \quad (\text{kN})$




$+\circlearrowleft \sum M_C = 0$:

$-M - 2(6 - x) = 0$

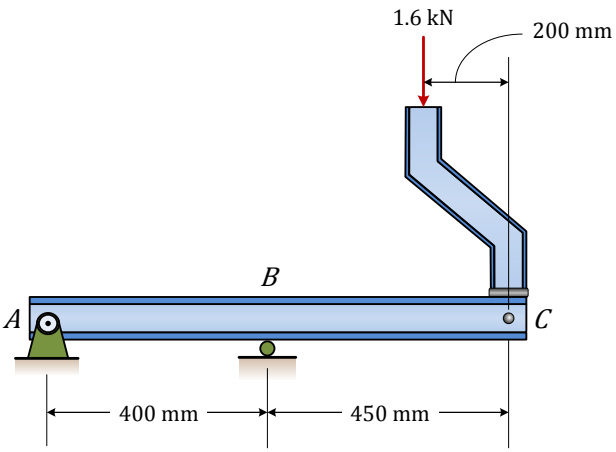
$M = 2x - 12 \ \ (\text{kN.m})$




$d = 2 + \frac{1}{3}(2) = 2.67\ \text{m}$ (Answer)

## Question 5.14.

The angle strut is welded to the end $C$ of the I-beam and supports the 1.6 kN vertical force. Determine the bending moment at $B$ and the distance $x$ to the left of $C$ at which the bending moment is zero. Also construct the moment diagram for the beam.



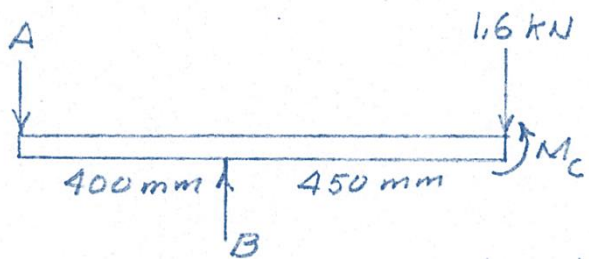

## Solution

$M_c = 1.6(0.2) = 0.32 \text{ kN.m}$

$+\circlearrowleft \sum M_A = 0:$

$B(0.4) - 1.6(0.85) + 0.32 = 0$

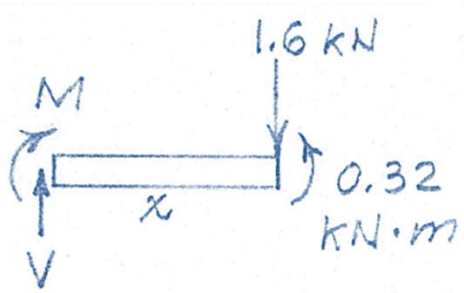
$B = 2.6 \text{ kN}$




$+\uparrow \sum F_y = 0:$

$2.6 - A - 1.6 = 0$

$A = 1 \text{ kN}$

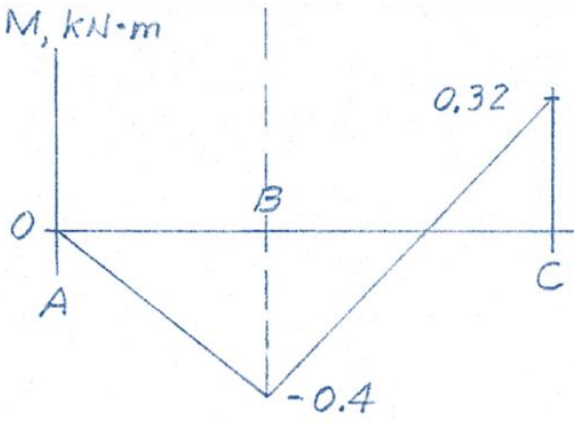



*Now taking section cut*

$+\circlearrowleft \sum M = 0:$

$-M + 0.32 - 1.6(x) = 0$

$M = 0.32 - 1.6x \text{ (kN.m)}$




*at B,* $x = 0.45 \text{ m}$

$M_B = -0.4 \text{ kN.m}$ (Answer)

$M = 0$ *when*

$x = \frac{0.32}{1.6} = 0.2$

(Answer)