NAME :- Malik. M. Afnan

ID :- 7839

Section :- "B"

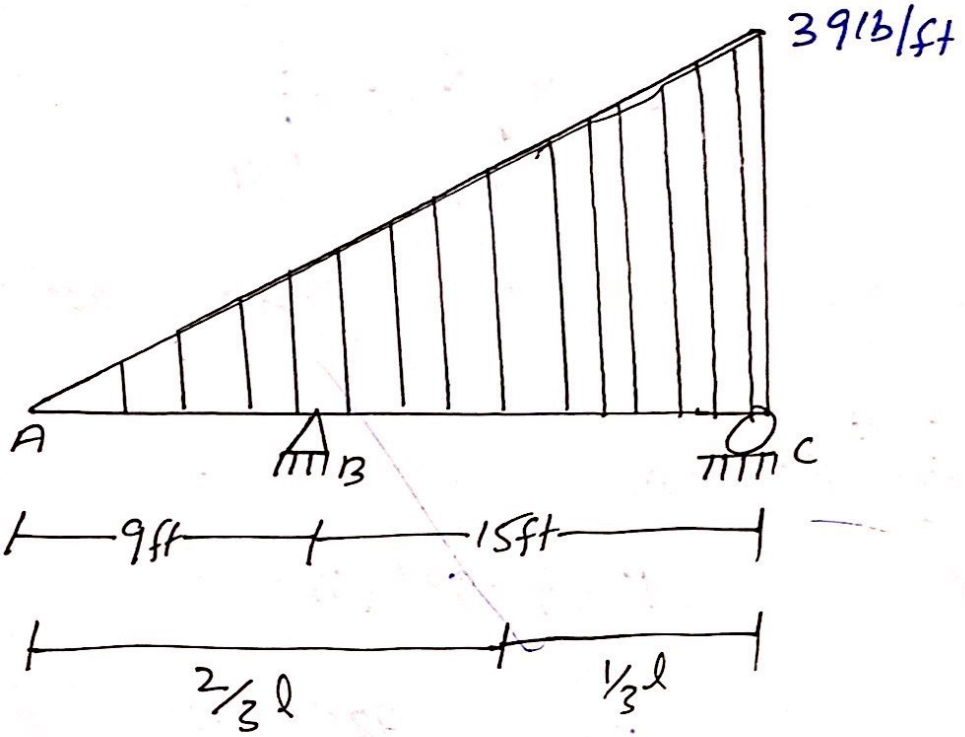
Subject :- Structural Analysis - I

Date :- 26/09/2020

Department :- Civil Engineering

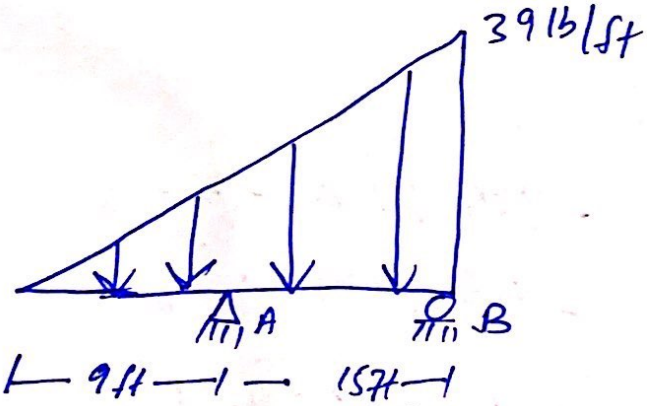
Submitted to :- Engr Muhammad Saqib

Problem # 01

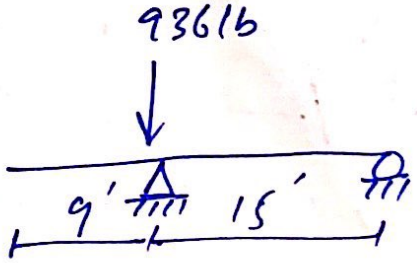


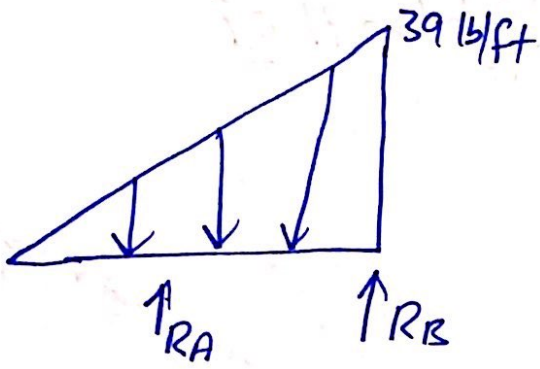
Sol:- To find Shear force and Bending moment Diagram

F.B.D



To find at the point load at uniform varing load.





To find out the support reactions

$(-ive \circlearrowleft)^{+ive} \quad \Sigma M_B = 0$

$$-15R_A + 936(16) = 0$$

$$R_A = \frac{936)\ (16)}{15}$$

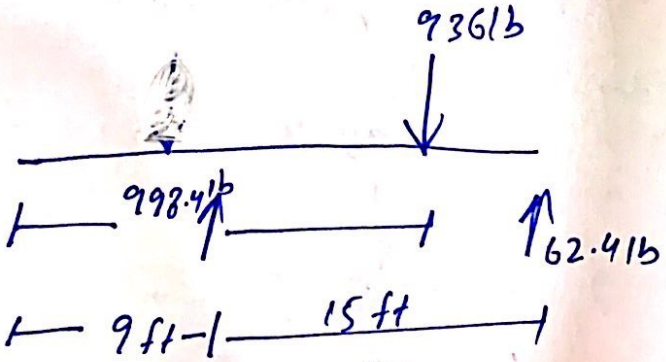
$$\boxed{R_A = 998.4 lb}$$

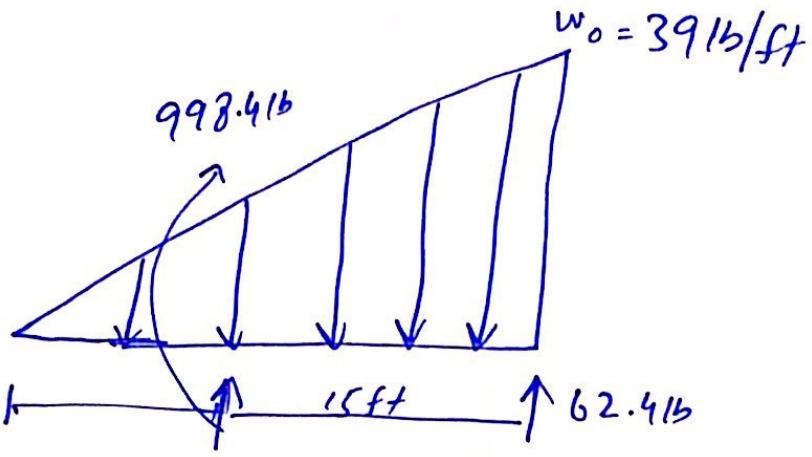
$-\downarrow\uparrow^{+} \quad \Sigma f_y = 0$

$$-936 + R_A + R_B = 0$$

$$-936 + 998.4 + R_B = 0$$

$$\boxed{\Rightarrow R_B = 62.4 lb}$$





Now the applicable loads is be

$$\frac{w_o l}{4} - \frac{1}{2}\left(\frac{w_o x}{l}\right)(x) = 0$$

$$234 - \frac{1}{2}\frac{39x^2}{l}$$

$$19.5\frac{x^2}{l} - 234 = 0$$

$$0.812x^2 - 234 = 0$$

$$\sqrt{x^2} = \sqrt{234}$$

$$\boxed{x = 15.29}$$

$(-ive \quad +ive) \quad \Sigma m = 0$

$$m + \frac{1}{2}\left(\frac{w_o x}{l}\right)x\left(\frac{x}{3}\right) - \frac{w_o l}{4}\left(x - \frac{l}{3}\right) = 0$$

$$m = -\frac{1}{2}\left(\frac{39 \times 15.29}{24}\right)(15.29)\left(\frac{15.29}{3}\right) - \left(\frac{39 \times 24}{4}\right)\left(15.29 - \frac{24}{3}\right)$$

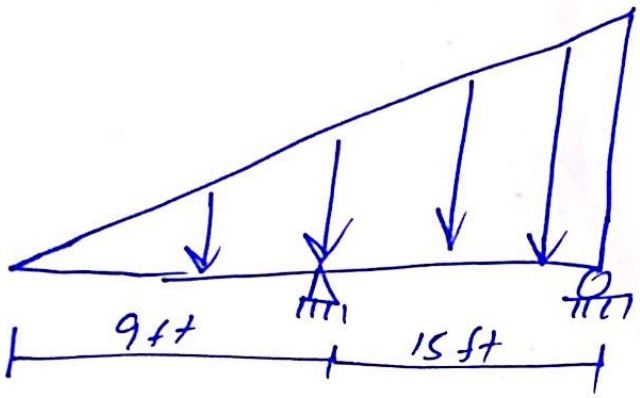
$$(\quad)\left(x - \frac{l}{3}\right) = 0$$

$m = 967.7 + 1705.8$

$m = 2,673.5 \text{ lb-ft}$

The -ive sign show that the moment reaction is in clock-wise direction

Now a section



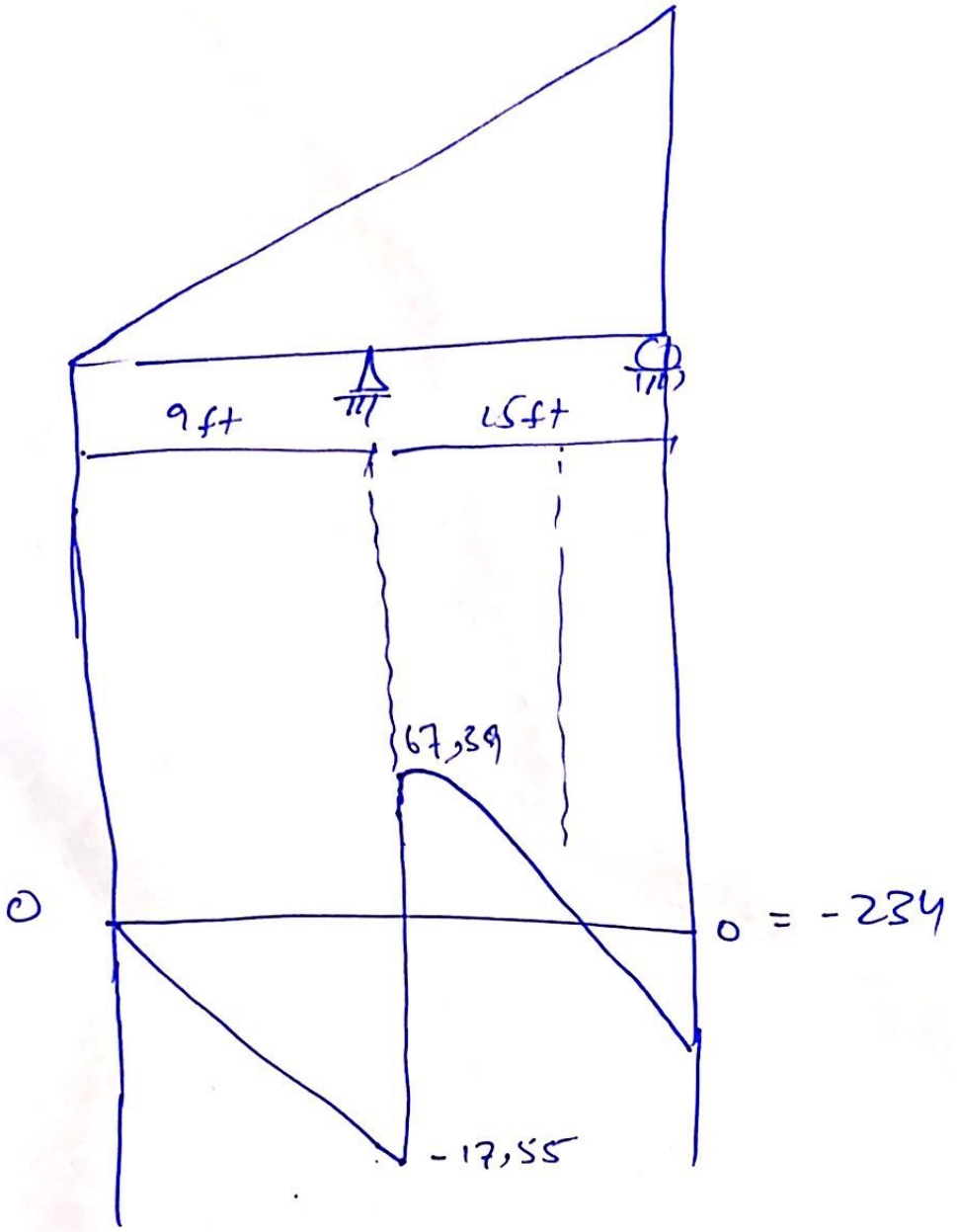
$\frac{1}{2}\left(\frac{39 \times 15.29}{24}\right)(15.29)$

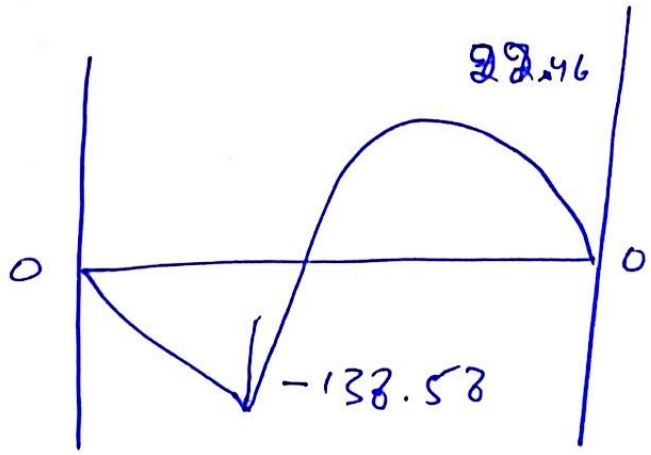
$= 139.94 \text{ lb}$

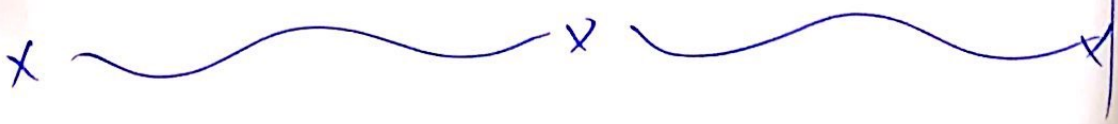
$\frac{w_0}{l} x = \frac{39}{24}(15.29)$

$= 24.84 \text{ lb/ft}$

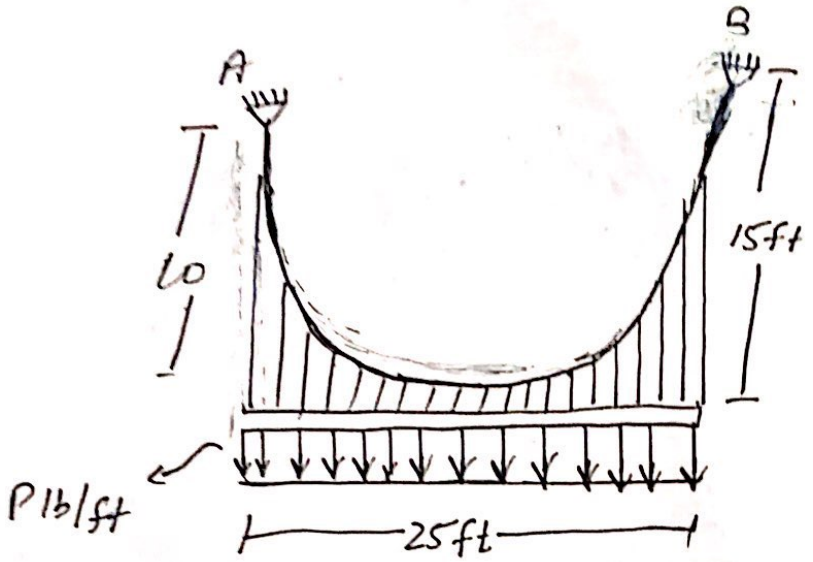
Now shear force and bending moment.





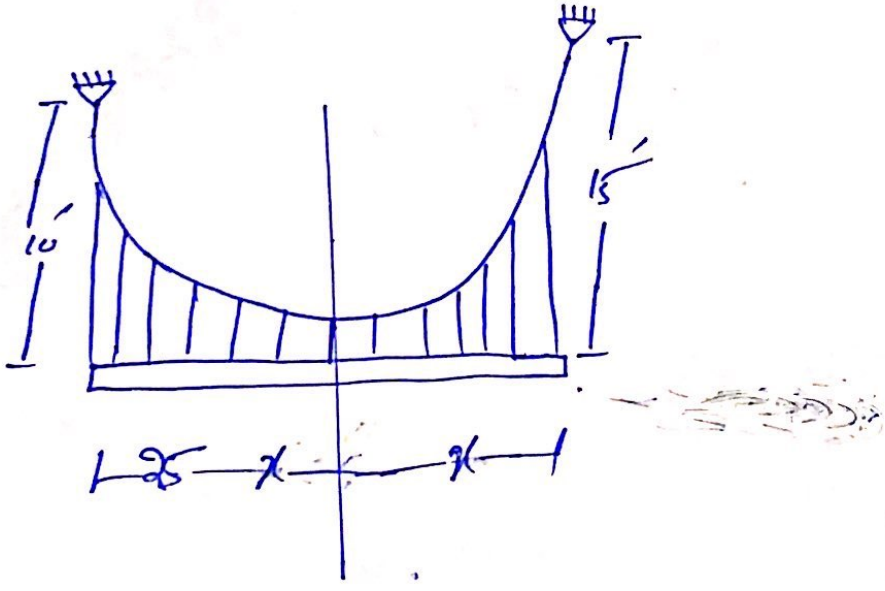


Problem #02:-



$P = 839\ lb/ft$

Sol:- Let suppose we take a Point "O" in the Cable which is the lowest Point, where Slope is Zero.



using formula

$$y = \frac{w_0}{2T_0} \times x^2 = \frac{839}{2T_0} x^2$$

$$\boxed{y = \frac{419.5}{T_0} x^2}$$

Now

Assume Point C is located at x distance from point "0" (lowest Point)

So, $y = \frac{419.5}{T_0} \times x^2$

→ From Point "0" to Right

For distance 'x', $y = 15'$

$$\Rightarrow y = \frac{419.5}{T_0} \times x^2 \Rightarrow T_0 = \frac{419.5}{15} x^2$$

$$\boxed{T_0 = 27.96\, x^2}$$

Again

⇒ From Point "0" to left

For distance $-(25-x)$, $y = 10$

$$\Rightarrow y = \frac{419.5}{T_0} x^2$$

$$10 = \frac{419.5}{T_0}(-(25-x))^2$$

$$\boxed{10 = \frac{419.5}{T_0}\left[-(25-x)\right]^2} \quad \text{—— (2)}$$

Again

=> From Point "0" to left

For distance $-(25-x)$, $y = 10$

$$\Rightarrow y = \frac{419.5}{T_0}x^2$$

$$\Rightarrow 10 = \frac{419.5}{T_0}\left[-(25-x)\right]^2$$

$$\Rightarrow T_0 = \frac{419.5}{10}\left[-(25-x)\right]^2 \quad \text{—— (3)}$$

Comparing eq (1) And (3)

$$\frac{419.5}{15}x^2 = \frac{419.5}{10}\left[-(25-x)\right]^2$$

Interchanging

$$\frac{419.5}{419.5}x^2 = \frac{15}{10}(625 - 50x + x^2)$$

$$x^2 = 1.5(625 - 50x + x^2)$$

$$x^2 = 937.50 - 75x + 1.5x^2$$

$$\Rightarrow 937.50 - 75x + 1.5x^2 - x^2 = 0$$

$$\Rightarrow 0.5x^2 - 75x + 937.50 = 0$$

By solving
using Quadratic Equation

$$a = 0.5,\ b = -75,\ c = 937.50$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-75) \pm \sqrt{(-75)^2 - 4(0.5)(937.50)}}{2(0.5)}$$

$$x = \frac{\sqrt{5625 - 1875}}{1}$$

$$x = 75 \pm \sqrt{3750}$$

we got

$$\boxed{x = 13.76 \text{ ft}} \quad \text{—(4)}$$

No Putt eq (4) in Eq (2)

$$T_0 = 27.96x^2$$

$$= 27.96(13.76)^2$$

$$\boxed{T_0 = 5293.66 \text{ lbs}}$$

Now we have to find the Tension at given Point.

By using formula

$$y = \frac{w_0}{2T_0} x^2$$

$$y = \frac{419.5}{T_0} x^2$$

Differentiate the above eq w.r.t "x"

$$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{419.5}{T_0} x^2\right)$$

$$= \frac{419.5}{T_o} \cdot 2x$$

$$\frac{dy}{dx} = \frac{839}{T_o} x \quad \text{—— (a)}$$

Also $\frac{dy}{dx} = \tan\theta$ —— (b)

$$\boxed{\text{So} \quad \tan\theta = \frac{839}{T_o} x}$$

As Point "A" is -11.24 away from "O"

So

$$\tan\theta_A = \frac{839}{5293.66}(-11.24)$$

$$\theta_A = \tan^{-1}(-1.78)$$

$$\boxed{\theta_A = -60.67^\circ}$$

Now, Tension at Point A is

$$T_A = \frac{T_o}{\cos\theta_A} \qquad \because \left(\cos\theta = \frac{T_o}{T_A}\right)$$

$$= \frac{5293.66}{\cos(-60.67)} = 10807 \text{ lbs}$$

$$= 10.2 \text{ kips}$$

→ Now Point "O" where $x = 13.76$ ft

$$\tan \theta_B = \frac{839}{T_o} (13.76)$$

$$= \frac{839}{5293.66} (13.76)$$

$$\theta_B = \tan^{-1}(2.18)$$

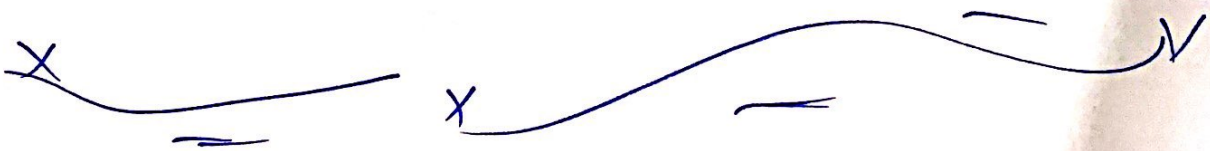
$$\boxed{\theta_B = 65.3^\circ}$$

Now Tension

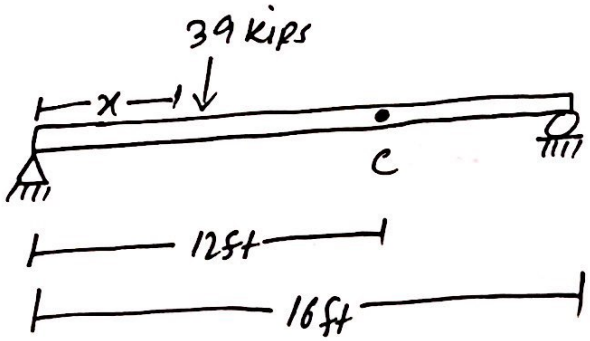
$$T_c = \frac{T_o}{\cos \theta_B}$$

$$T_c = \frac{5293.66}{\cos(65.3)} = 12670 \text{ lbs}$$

$$= 12.6 \text{ Kips}$$



Problem # 03



$P = 39$

For $x = 0$ $\quad R_A = ?$

$\circlearrowright \Sigma M_B = 0$

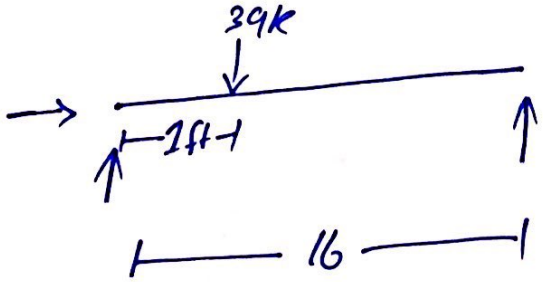
$$(39 \times 16) - R_A(16) = 0$$

$$624 - R_A(16) = 0$$

$$\frac{R_A \cancel{16}}{\cancel{16}} = \frac{624}{16}$$

$$\boxed{R_A = 39}$$

For $x = 1ft$ $\quad R_A = ?$



$\curvearrowright \Sigma M_B = 0$

$$(39 \times 15) - RA(16) = 0$$

$$585 - RA(16) = 0$$

$$\frac{RA\,16}{16} = \frac{585}{16}$$

$$\boxed{RA = 36.56}$$

For $x = 5$ $\quad RA = ?$

$\curvearrowright \Sigma M_B = 0$

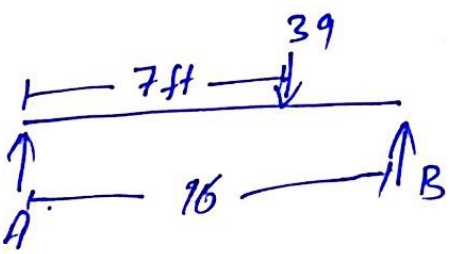
$$(39 \times 5) - RA(16) = 0$$

$$195 - RA(16) = 0$$

$$\frac{RA\,16}{16} = \frac{195}{16}$$

$$\boxed{RA = 12.18}$$

Putt $x = 7$ $\quad RA = ?$



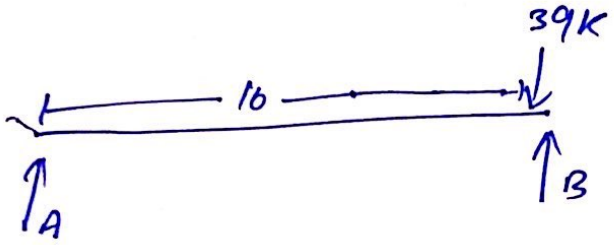
$\zeta \Sigma M_B = 0$

$$(39 \times 7) - RA(16) = 0$$

$$273 - RA(16) = 0$$

$$\frac{RA\cancel{16}}{\cancel{16}} = \frac{273}{16}$$

$$\boxed{RA = 17.06}$$



$$-RA16 + 39(0) = 0$$

$$\boxed{RA = 0}$$

$RA_1 = 39$

$RA_2 = 36.56$

$RA_3 = 12.18$

$RA_4 = 17.06$

$RA_5 = 0$