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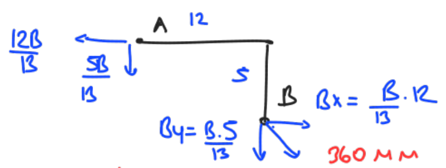
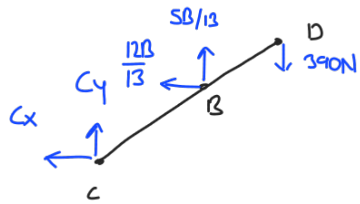
HOMEWORK 6

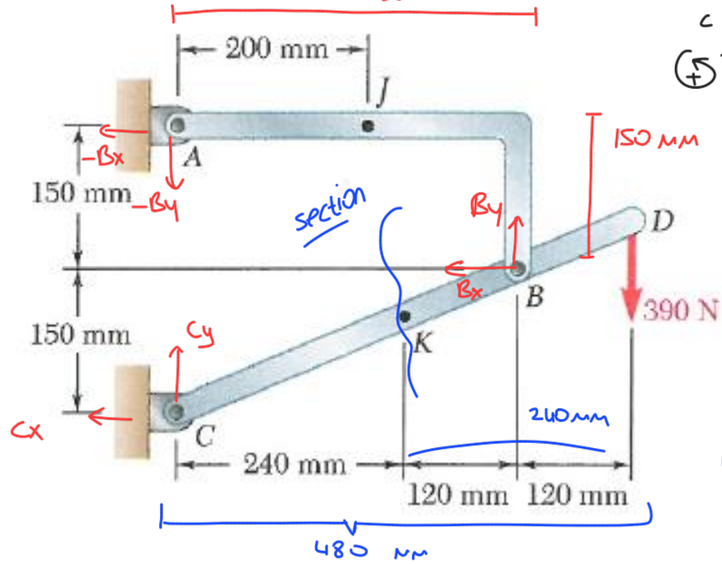
FBD

* AB is a two force member.





Q1)

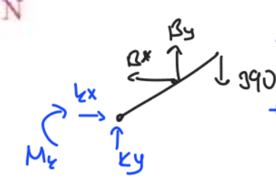


$\circlearrowleft + \sum M_C = 0 = \frac{12B}{13} \times 0.15 + \frac{5B}{13} \times 0.36 - 390 \times 0.48 = 0$

$B\left(\frac{12}{13} \times 0.15 + \frac{5}{13} \times 0.36\right) = 390 \times 0.48$

$B = 676$ N $\quad B_x = 676 \cdot 12/13 = 624$ N

$B_y = 676 \cdot 5/13 = 260$ N



$\xrightarrow{+} \sum F_x = 0 \rightarrow K_x = 624\ N \rightarrow$

$+ \sum F_y = 0 \rightarrow K_y = 130\ N \uparrow$

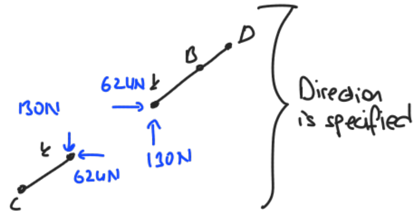
$K_x = 624$ N

$K_y = 130$ N

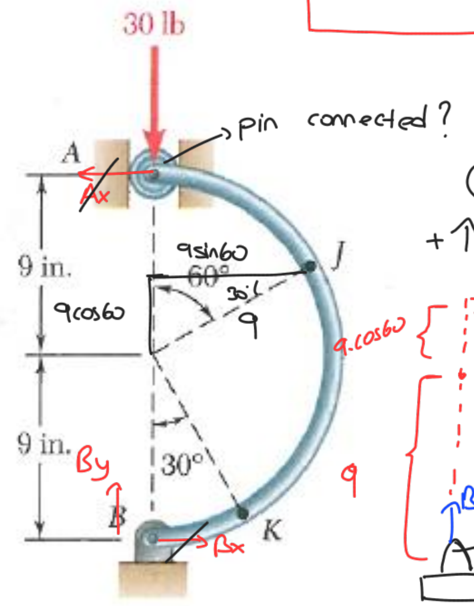
Determine the internal forces at point K of the structure shown.

Q2)

* Question do not ask the moment developed.

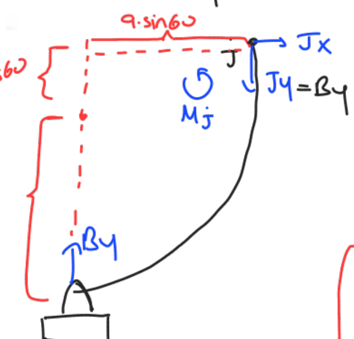


Direction is specified



$\circlearrowleft + \sum M_B = 0 = 18 A_x = 0 \rightarrow A_x = B_x = 0$

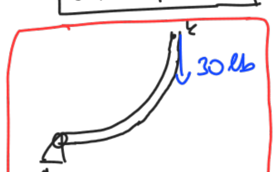
$+\uparrow \sum F_y = 0 = B_y = 30 lb$



$+\uparrow \sum F_y = B_y - J_y = 0 \rightarrow \boxed{J_y = B_y}$

$\xrightarrow{+} \sum F_x = 0 = J_x \rightarrow \boxed{J_x = 0}$

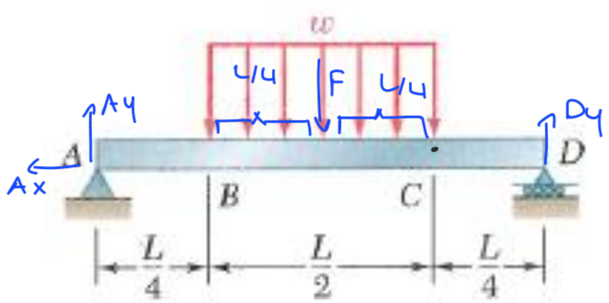
$\boxed{J_y = B_y = 30 lb}$



A semicircular rod is loaded as shown. Determine the internal forces at point J.

Q3)

$F = w \cdot \frac{L}{2}$



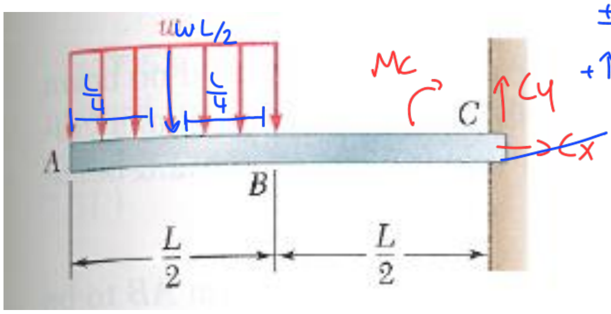
$A_y = D_y = \frac{wL}{4}$

$A_x = 0$

* I have found the reactions, now I will solve the rest in the next page.

For the beam and loading shown, (a) draw the shear and bending-moment diagrams, (b) determine the maximum absolute values of the shear and bending moment.

Q4)



$\xrightarrow{+} \sum F_x = 0 \rightarrow \boxed{C_x = 0}$

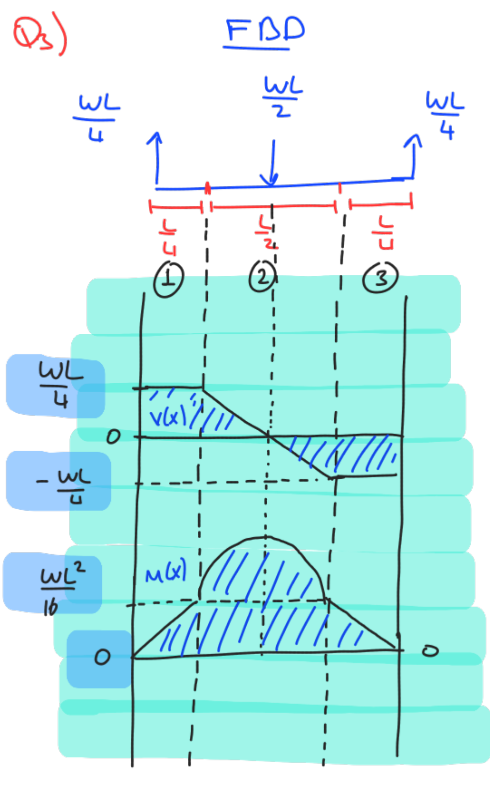
$+\uparrow \sum F_y = \boxed{C_y = \frac{wL}{2}}$

$\circlearrowleft + \sum M_C = 0 = \frac{wL}{2} \cdot \frac{3L}{4} - M_C = 0 \quad \boxed{M_C = \frac{3wL^2}{8}}$

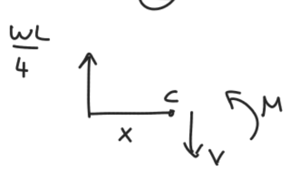
* I have found the reactions, now I will solve the rest in the next page.

For the beam and loading shown, (a) draw the shear and bending-moment diagrams, (b) determine the maximum absolute values of the shear and bending moment.

Q3)



①



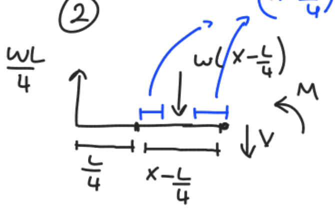
$+\uparrow \sum F_y = \frac{wL}{4} - V = 0 \quad V = \frac{wL}{4}$

$\circlearrowleft + \sum M_C = 0 = M - \frac{wLx}{4} = 0 \rightarrow M = \frac{wLx}{4}$

$\frac{wLx}{4} \rightarrow x = 0 \rightarrow 0$

$\rightarrow x = \frac{L}{4} \rightarrow \frac{wL^2}{16}$

②



$+\uparrow \sum F_y = 0 = \frac{wL}{4} - w\left(x - \frac{L}{4}\right) - V = 0$

$V = \frac{wL}{4} - w\left(x - \frac{L}{4}\right)$

$x = \frac{L}{4} \rightarrow V = \frac{wL}{4}$

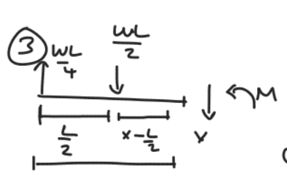
$x = \frac{3L}{4} \rightarrow V = \frac{wL}{4} - \frac{wL}{2} = -\frac{wL}{4}$

$\circlearrowleft + \sum M_C = 0 = M - \frac{wL}{4}x + \frac{\left(x - \frac{L}{4}\right)^2}{2} w = 0$

$M = \frac{wL}{4}x - \frac{\left(x - \frac{L}{4}\right)^2 w}{2}$

$x = \frac{3L}{4} \rightarrow \frac{3wL^2}{16} - \frac{L^2 w}{8}$

③



$+\uparrow \sum F_y = 0 = \frac{wL}{4} - \frac{wL}{2} - V = 0 \quad V = -\frac{wL}{4}$

$\circlearrowleft + \sum M_C = 0 = -\frac{wLx}{4} + \frac{wL}{2}\left(x - \frac{L}{2}\right) + M = 0$

$M = \frac{wLx}{4} - \frac{wL}{2}\left(x - \frac{L}{2}\right)$

$x = 3L/4 \rightarrow M = \frac{3wL^2}{16} - \frac{wL}{2} \cdot \frac{L}{4} = \frac{wL^2}{16}$

$x = L \rightarrow M = \frac{wL^2}{4} - \frac{wL^2}{4} = 0$

b)

$$V_{max} = \frac{wL}{4} \qquad M_{min} = 0$$

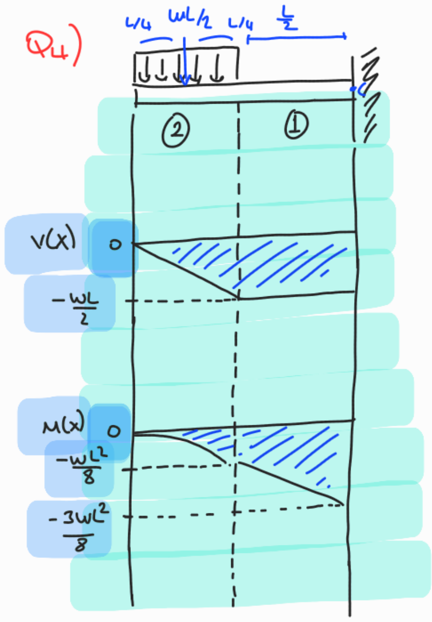
$$V_{min} = -\frac{wL}{4} \qquad M_{max} = \frac{3wL^2}{32}$$

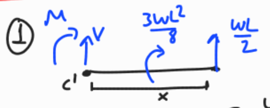
$$M_{max} = M(x) = \frac{wLx}{4} - \left(x - \frac{L}{4}\right)^2 \frac{w}{2}$$

$$M\left(\frac{L}{2}\right) = \frac{wL^2}{8} - \frac{L^2}{16}\frac{w}{2} = \frac{3wL^2}{32}$$

(4)

Q4)



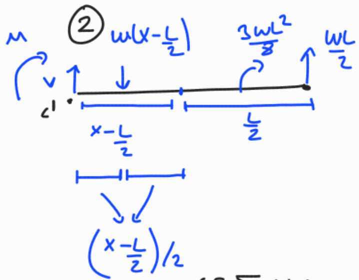


$$+\uparrow \sum F_y = 0 = \frac{wL}{2} + V = 0 \qquad V = -\frac{wL}{2}$$

$$\circlearrowleft \sum M_{c'} = 0 = -M - \frac{3wL^2}{8} + \frac{xwL}{2} = 0 \rightarrow M = -\frac{3wL^2}{8} + \frac{xwL}{2}$$

$$x = 0 \rightarrow M = -\frac{3wL^2}{8}$$

$$x = \frac{L}{2} \rightarrow M = -\frac{3wL^2}{8} + \frac{wL^2}{4} = -\frac{wL^2}{8}$$



$$+\uparrow \sum F_y = 0 = V - w\left(x - \frac{L}{2}\right) + \frac{wL}{2} = 0$$

$$V = w\left(x - \frac{L}{2}\right) - \frac{wL}{2} = wx - wL = w(x - L)$$

$$V(x) = w(x-L)$$

$$x = \frac{L}{2} \rightarrow V = -\frac{wL}{2}$$

$$x = L \rightarrow V = 0$$

$$\circlearrowleft \sum M_{c'} = -M - \left(x - \frac{L}{2}\right)\frac{1}{2}w\left(x - \frac{L}{2}\right) - \frac{3wL^2}{8} + \frac{wLx}{2}$$

$$M = -\left(x - \frac{L}{2}\right)^2 \frac{w}{2} + \frac{wLx}{2} - \frac{3wL^2}{8}$$

$$x = \frac{L}{2} \rightarrow M = \frac{wL^2}{4} - \frac{3wL^2}{8} = -\frac{wL^2}{8}$$

$$x = L \rightarrow M = -\left(\frac{L}{2}\right)^2 \frac{w}{2} + \frac{wL^2}{2} - \frac{3wL^2}{8} = -\frac{L^2 w}{8} + \frac{wL^2}{2} - \frac{3wL^2}{8} = 0$$

b)

$$V_{min} = 0$$

$$V_{max} = \frac{wL}{2}$$

$$M_{min} = 0$$

$$M_{max} = \frac{3wL^2}{8}$$

→ I took the absolute values since the question asks the absolute max-min