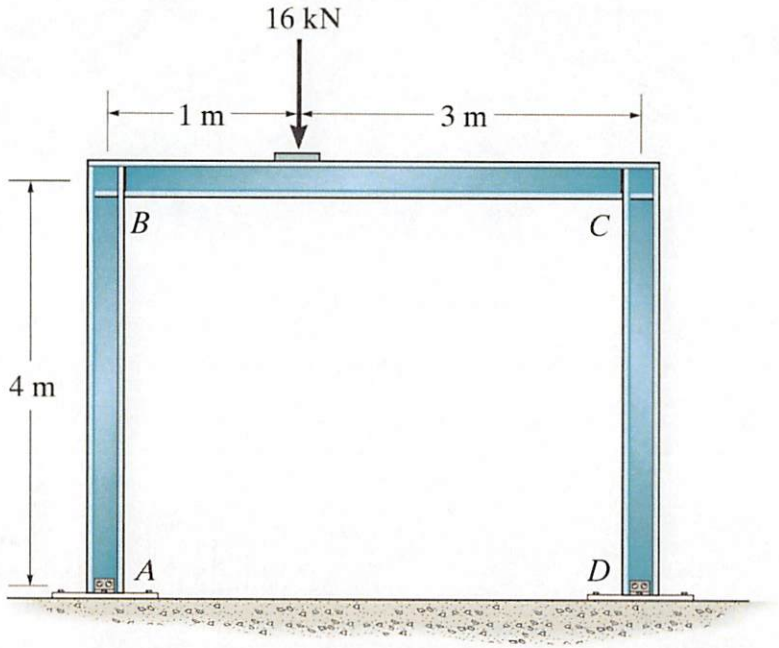
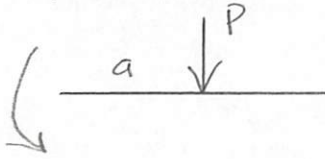
Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.



$FEM_{BC} =$  $\frac{Pa^2b}{L^2}$

$\frac{Pb^2a}{L^2}$

$$\frac{Pb^2a}{L^2} = \frac{16kN(3m)^2(1m)}{(4m)^2} = -9kNm$$

$$\frac{Pa^2b}{L^2} = \frac{16kN(1m)^2(3m)}{(4m)^2} = 3kNm$$

$\psi = \frac{\Delta}{L}$

SECTION AB – 1 EQN.

$$M_{BA} = \frac{3EI}{4m}\left[\theta_B - \psi_{AB}\right] \quad (1)$$

SECTION BC – 2 EQNS.

$$M_{BC} = \frac{2EI}{4m}\left[2\theta_B + \theta_C\right] - 9kNm \quad (2)$$

$$M_{CB} = \frac{2EI}{4m}\left[2\theta_C + \theta_B\right] + 3kNm \quad (3)$$

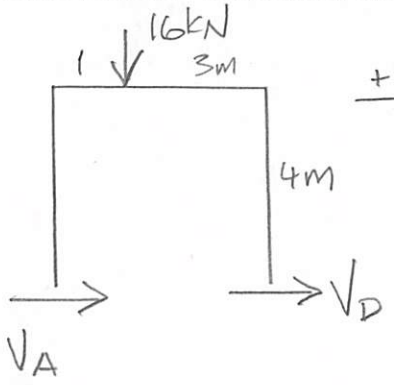
SECTION CD – 1 EQN.

$$M_{CD} = \frac{3EI}{4m}\left[\theta_C - \psi_{CD}\right] \quad (4)$$

JOINT B $\quad M_{BA} + M_{BC} = 0 \quad (5)$

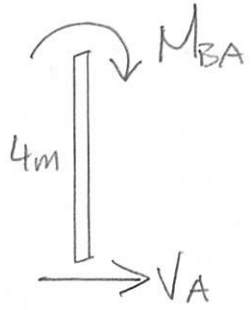
JOINT C $\quad M_{CB} + M_{CD} = 0 \quad (6)$

Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.



$$\overset{+}{\rightarrow}\sum F_x = 0 = V_A + V_D \quad (7)$$

FBD AB

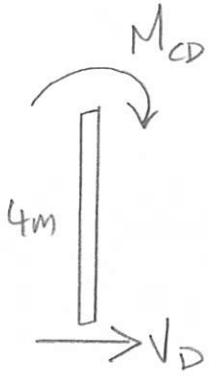


$$\overset{+}{\circlearrowleft}\sum M_B = 0$$

$$= -M_{BA} + V_A(4m)$$

$$V_A = \frac{M_{BA}}{4m} \; *$$

FBD CD



$$\overset{+}{\circlearrowleft}\sum M_C = 0$$

$$= -M_{CD} + V_D(4m)$$

$$V_D = \frac{M_{CD}}{4m} \; *$$

(7a) $$\frac{M_{BA}}{4m} + \frac{M_{CD}}{4m} = 0 = \frac{3EI}{4m}\left[\theta_B - \psi\right] + \frac{3EI}{4m}\left[\theta_C - \psi\right]$$

$$0.75\theta_B + 0.75\theta_C - 1.5\psi = 0$$

(5a) $$M_{BA} + M_{BC} = 0 = \frac{3EI}{4m}\left[\theta_B - \psi\right] + \frac{2EI}{4m}\left[2\theta_B + \theta_C\right] - 9kNm$$

$$1.75\theta_B + 0.5\theta_C - 0.75\psi = 9kNm$$

Problem 10c-1 – Determine the moments at *B* and *C*. Assume the supports at *A* and *D* are pins. *EI* is constant.

(6a) $M_{CB} + M_{CD} = 0 = \frac{2EI}{4m}\left[2\theta_C + \theta_B\right] + 3kNm + \frac{3EI}{4m}\left[\theta_C - \psi\right]$

$$0.5\theta_B + 1.75\theta_C - 0.75\psi = -3kNm$$

SOLVING THESE 3 EQUATION USING EXCEL

$$\theta_B = \frac{6.80\,kNm^2}{EI}$$

$$\theta_C = -\frac{2.80\,kNm^2}{EI}$$

$$\psi = \frac{2\,kNm^2}{EI}$$

$$M_{BA} = \frac{3EI}{4m}\left[\theta_B - \psi\right] = 3.6\,kNm$$

$$M_{BC} = \frac{2EI}{4m}\left[2\theta_B + \theta_C\right] - 9kNm = -3.6\,kNm$$

$$M_{CB} = \frac{2EI}{4m}\left[2\theta_C + \theta_B\right] + 3kNm = 3.6\,kNm$$

$$M_{CD} = \frac{3EI}{4m}\left[\theta_C - \psi\right] = -3.6\,kNm$$