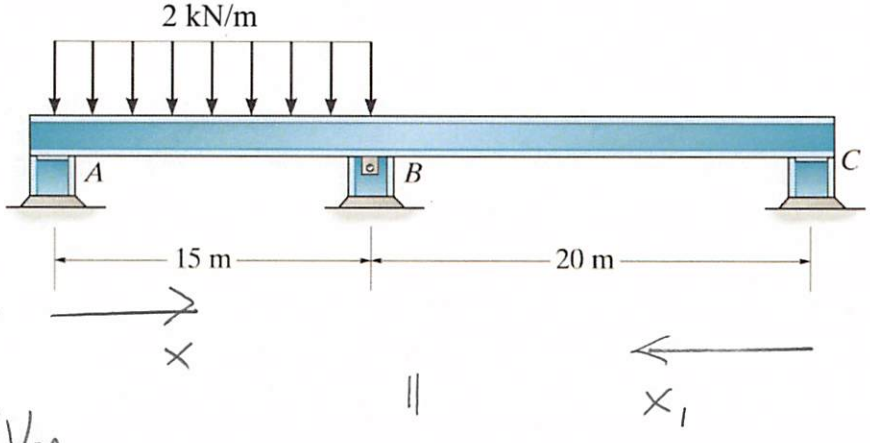
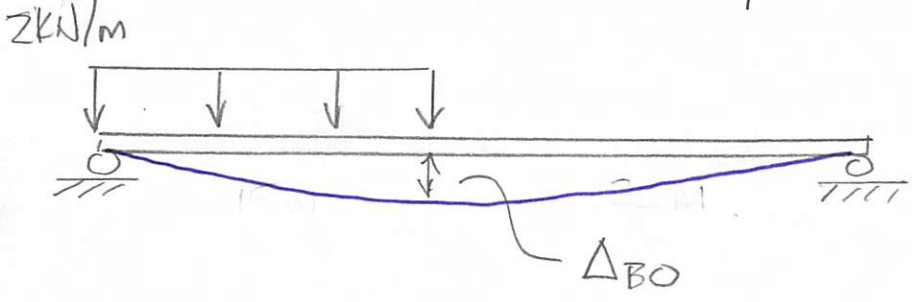
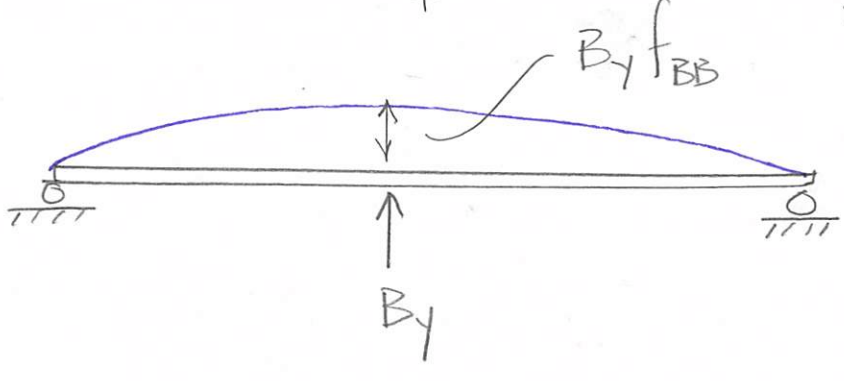
Problem 9a-5 – Compute the reactions for the following beam.



$=$

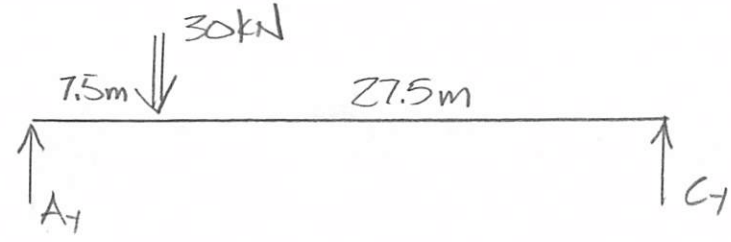


$+$



$$\Delta_B = 0 = \Delta_{BO} + B_y f_{BB}$$

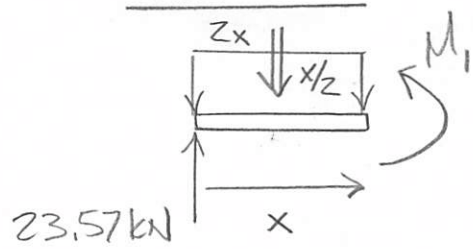
FIND Δ_{BO} USING VIRTUAL WORK



$$\circlearrowleft + \sum M_C = 0 = 30\text{kN}(27.5\text{m}) - A_y(35\text{m})$$

$$A_y = 23.57\text{kN} \qquad C_y = 6.43\text{kN}$$

$0 \le x \le 15$

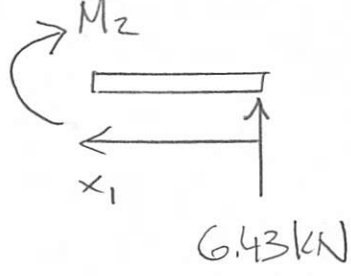


$$\circlearrowleft + \sum M_{CUT} = 0$$

$$= M_1 + 2x\left(\frac{x}{2}\right) - 23.57\text{kN}(x)$$

$$M_1 = \left[-x^2 + 23.57x\right]\text{kNm}$$

$0 \le x_1 \le 20$

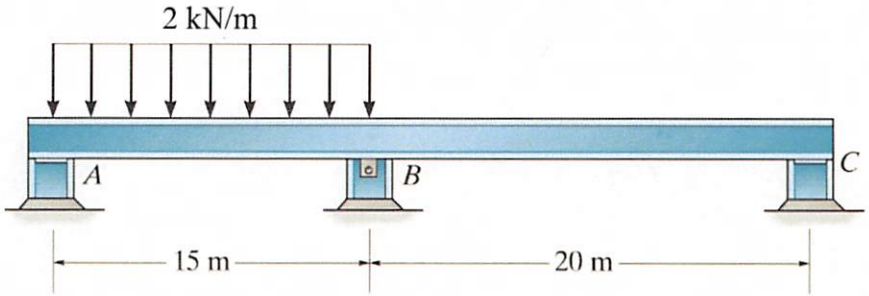


$$\circlearrowleft + \sum M_{CUT} = 0$$

$$= -M_2 + 6.43\text{kN}\,x_1$$

$$M_2 = \left[6.43x_1\right]\text{kNm}$$

Problem 9a-5 – Compute the reactions for the following beam.



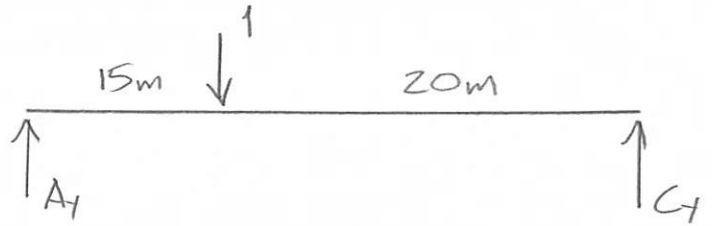
$$\Delta_{B_0} = \frac{1}{EI}\left[\int_0^{15} M_1 m_1\, dx + \int_0^{20} M_2 m_2\, dx_1\right]$$

$$= \frac{1}{EI}\left[\int_0^{15}\left(-x^2 + \frac{165}{7}x\right)\left(\frac{4}{7}x\right)dx + \int_0^{20}\left(\frac{45}{7}x_1\right)\left(\frac{3}{7}x_1\right)dx_1\right]$$

$$= \frac{1}{EI}\left[-\frac{x^4}{7} + \frac{220x^3}{49}\right]_0^{15} + \frac{1}{EI}\left[\frac{45x_1^3}{49}\right]_0^{20}$$

$$\Delta_{B0} = \frac{106{,}875\ \text{kNm}^2}{7EI}$$

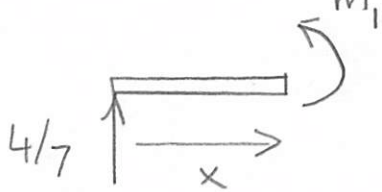
VIRTUAL MOMENTS



$$\circlearrowleft + \sum M_A = 0 = -1(15\text{m}) + C_1(35\text{m})$$

$$C_1 = 3/7 \qquad A_1 = 4/7 \Leftarrow \sum F_y = 0$$

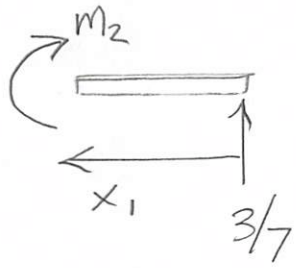
$0 \le x \le 15$



$$\circlearrowleft + \sum M_{CUT} = 0$$

$$= m_1 - 4/7\,x \qquad m_1 = \left[4/7\,x\right]\text{m}$$

$0 \le x_1 \le 20$

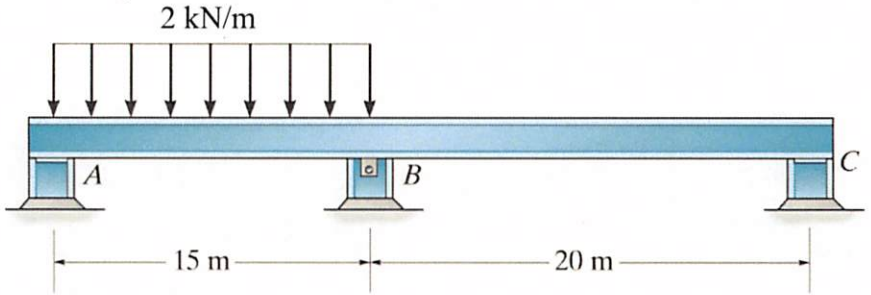


$$\circlearrowleft + \sum M_{CUT} = 0$$

$$= -m_2 + \frac{3}{7}x_1$$

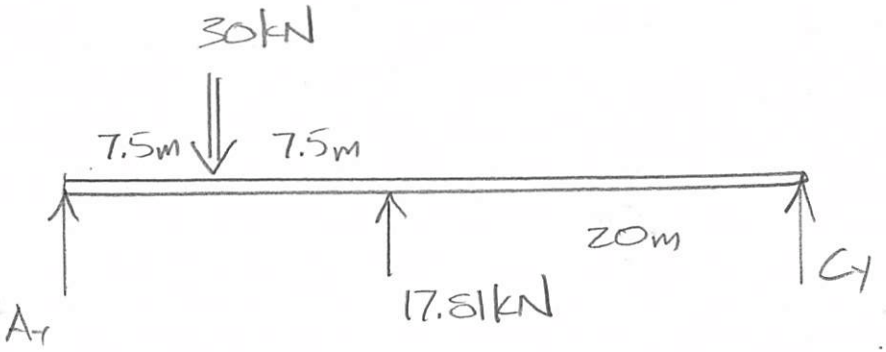
$$m_2 = \left[\frac{3}{7}x_1\right]\text{m}$$

Problem 9a-5 – Compute the reactions for the following beam.



$$\Delta_{BO} + B_y f_{BB} = 0 \qquad B_y = \frac{\Delta_{BO}}{f_{BB}}$$

$$\underline{\underline{B_y = 17.81\ kN}}$$



* FIND f_{BB}

$$f_{BB} = \frac{1}{EI}\left[\int_0^{15}(m_1)^2 dx + \int_0^{20}(m_2)^2 dx_1\right]$$

$$= \frac{1}{EI}\left[\int_0^{15}\left(\frac{4}{7}x\right)^2 dx + \int_0^{20}\left(\frac{3}{7}x_1\right)^2 dx_1\right]$$

$$= \frac{1}{EI}\left[\frac{16x^3}{147}\right]_0^{15} + \frac{1}{EI}\left[\frac{9x_1^3}{147}\right]_0^{20}$$

$$= \underline{\underline{\frac{6{,}000\ m^3}{7EI}}}$$

$$+\circlearrowleft \Sigma M_C = 0 = 30kN(27.5m) - 17.81\,kN(20m) - A_y(35m)$$

$$\underline{\underline{A_y = 13.39\,kN}}$$

$$+\uparrow \Sigma F_y = 0 = A_y + C_y + 17.81\,kN - 30kN$$

$$\underline{\underline{C_y = -1.20\,kN}}$$