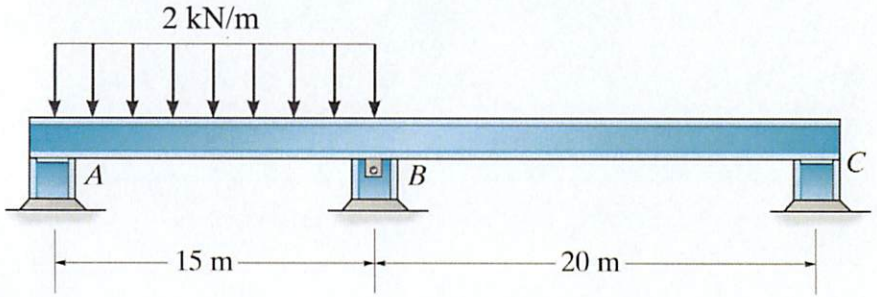
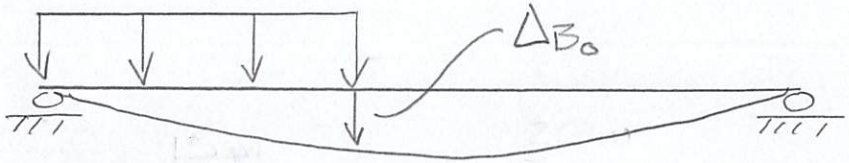
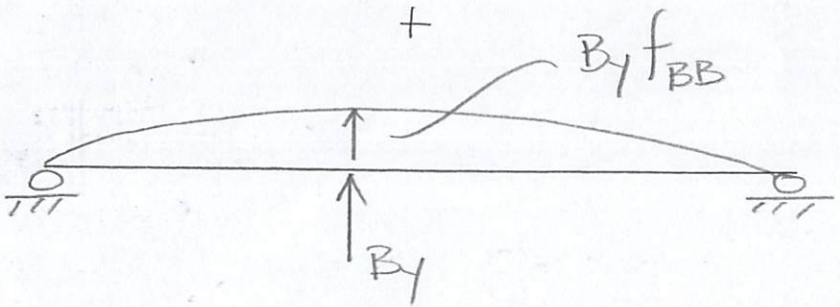
Problem 9a-5 – Compute the reactions for the following beam.



2kN/m

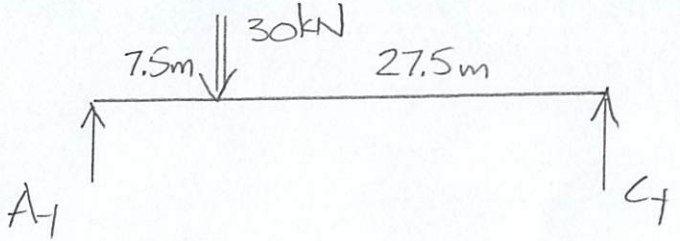


+



$$\Delta_{B_0} + B_y f_{BB} = 0$$

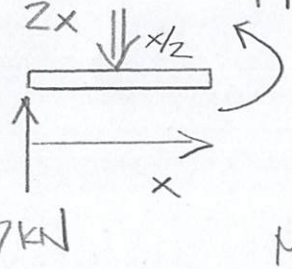
FIND Δ_{B_0} USING VIRTUAL WORK



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

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

$0 \le x \le 15$

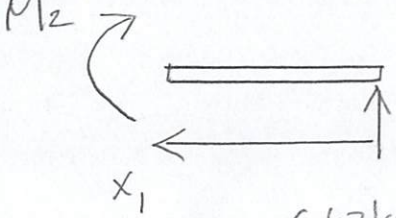


$$\circlearrowleft + \sum M_{CUT} = 0$$

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

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

$0 \le x_1 \le 20$

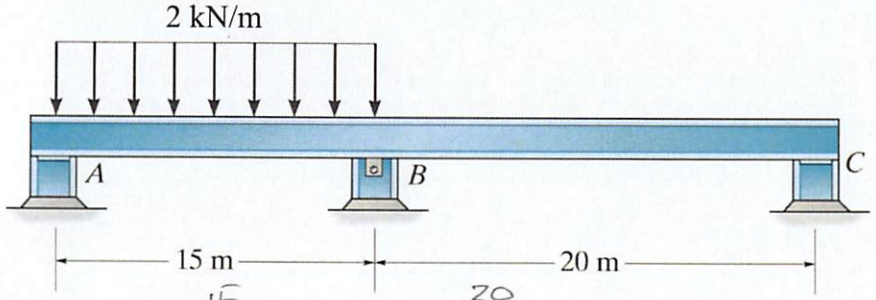


$$\circlearrowleft + \sum M_{CUT} = 0$$

$$= -M_2 + 6.43x_1$$

$$M_2 = 6.43x_1 \text{ kNm}$$

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



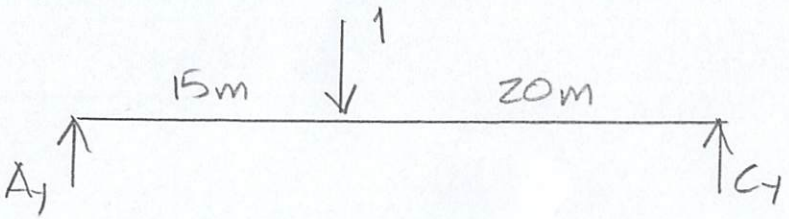
$$\Delta_{B_0} = \frac{1}{EI}\left[\int_0^{15} M_1 m_1 dx + \int_0^{20} M_2 m_2 dx_1\right]$$

$$= \frac{1}{EI}\left[\int_0^{15} (-x^2 + 23.57x)(4/7 x)\, dx + \int_0^{20} (6.43x_1)(3/7 x_1)\, dx_1\right]$$

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

$$= \frac{106{,}875\ \text{kN m}^3}{7EI}$$

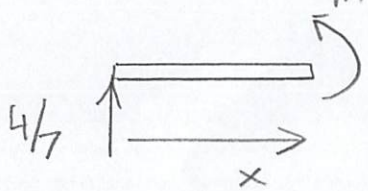
VIRTUAL MOMENTS



$$\circlearrowleft^{+} \Sigma M_A = 0 = -1(15\text{m}) + C_y(35\text{m})$$

$$C_y = 3/7 \qquad A_y = 4/7$$

$0 \le x \le 15$

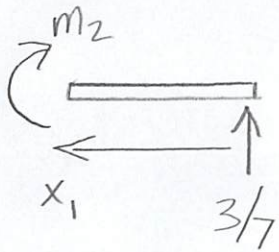


$$\circlearrowleft^{+} \Sigma M_{CUT} = 0$$

$$= m_1 - 4/7\, x$$

$$m_1 = 4/7\, x$$

$0 \le x_1 \le 20$

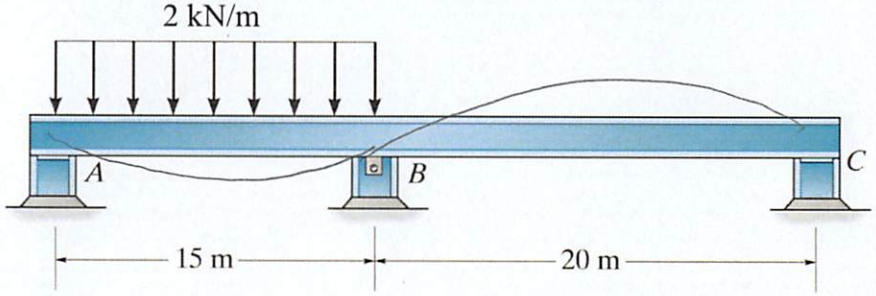


$$\circlearrowleft^{+} \Sigma M_{CUT} = 0$$

$$= -m_2 + 3/7\, x_1$$

$$m_2 = 3/7\, x_1$$

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



FIND f_{BB}

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

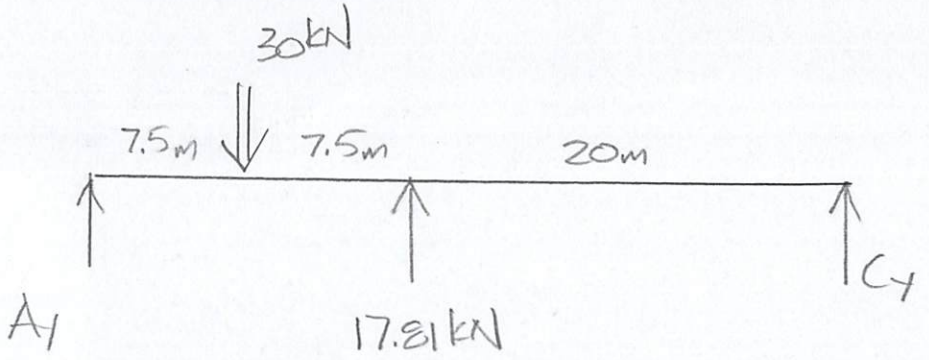
$$= \frac{1}{EI}\left[\int_0^{15} \left(\tfrac{4}{15}x\right)^2 dx + \int_0^{20} \left(\tfrac{3}{15}x_1\right)^2 dx_1\right]$$

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

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

$$\Delta_{B_0} + B_y f_{BB} = 0 \qquad B_y = \frac{\Delta_{B0}}{f_{BB}}$$

$$B_y = 17.81\ kN$$



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

$$A_y = 13.39kN$$

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

$$C_y = -1.2kN$$