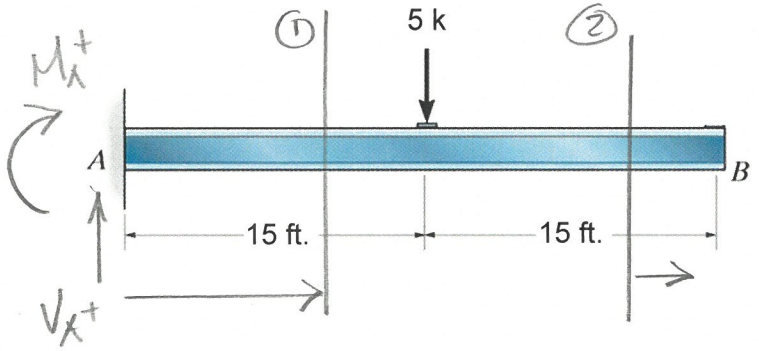
Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

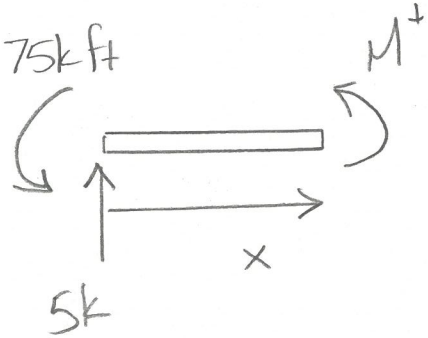
Real loads



$\circlearrowleft^+ \Sigma M_A = 0 = -M_A - 5k(15')$ $\quad M_A = -75\,k\text{-}ft$

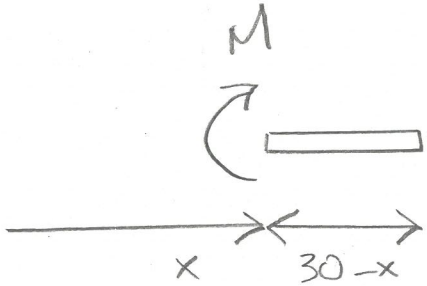
$+\uparrow \Sigma F_y = 0 = V_A - 5k$ $\quad V_A = 5k$

$0 \le x \le 15$



$\circlearrowleft^+ \Sigma M_{CUT} = 0 = M + 75k\text{-}ft - 5x$ $\quad M(x) = [5x - 75]\,k\text{-}ft$

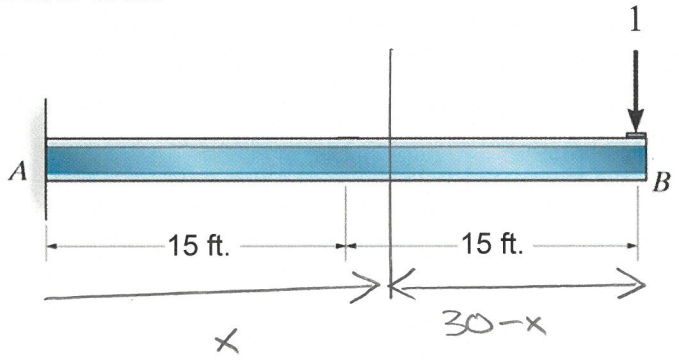
$15 \le x \le 30$



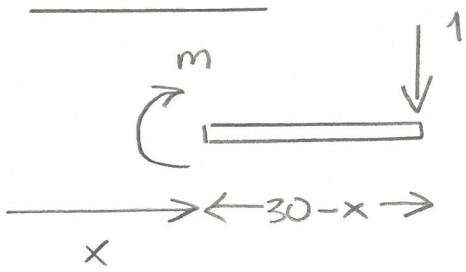
$\circlearrowleft^+ \Sigma M_{CUT} = 0 = -M$

Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Virtual load



$0 \le x \le 30$



$\curvearrowleft \Sigma M_{CUT} = 0$

$= -m - 1(30-x)$

$m = (x-30)$ ft

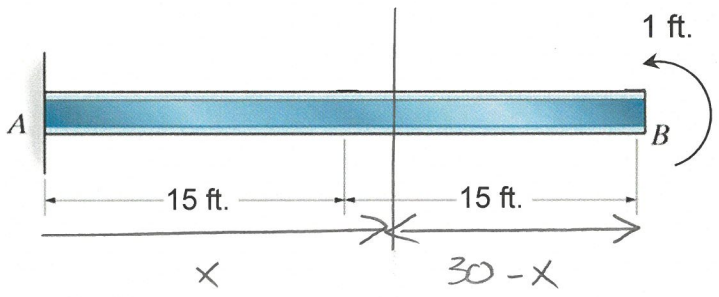
$$\gamma_B = \int_0^{30} \frac{Mm}{EI}\,dx = \int_0^{15} \frac{Mm}{EI}\,dx + \int_{15}^{30} \frac{Mm}{EI}\,dx = \frac{1}{EI}\int_0^{15} (5x-75)(x-30)\,dx \quad \left(\frac{\text{kft}}{}\cdot\frac{\text{ft}}{}\cdot\text{ft}\right)$$

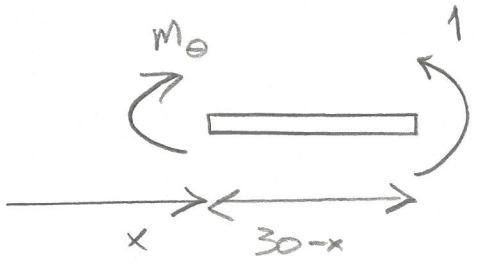
$$= \frac{1}{EI}\int_0^{15} (5x^2-225x+2{,}250)\,dx = \left[\frac{5x^3}{3} - \frac{225x^2}{6} + 2{,}250x\right]_0^{15} = \frac{28{,}125\ \text{kft}^3}{2EI}$$

$$= \frac{28{,}125\ \text{kft}^3}{2} \cdot \frac{\text{IN}^2}{30{,}000\ \text{k}} \cdot \frac{(12\ \text{IN})^3}{800\ \text{IN}^4} \cdot \frac{}{\text{ft}^3} = 1.01\ \text{IN}$$

Example 8b-0: Determine the slope and the displacement at point B for the following beam. Assume that E = 30,000 ksi and I = 800 in^4.

Virtual moment





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

$= -M_\theta + 1$

$M_\theta = 1$

$$\theta_B = \int_0^{30} \frac{M m_\theta}{EI} dx = \int_0^{15} \frac{(5x-75)(1)}{EI} dx = \frac{1}{EI}\left[\frac{5x^2}{2} - 75x\right]_0^{15}$$

$$= -\frac{1{,}125\ \text{k ft}^2}{2EI} = -\frac{1{,}125\ \text{k ft}^2}{2} \cdot \frac{\text{IN}^2}{30{,}000\ \text{k}} \cdot \frac{(12\ \text{IN})^2}{800\ \text{IN}^4} \cdot \frac{}{\text{ft}^2}$$

$= -0.0034$ RADIANS