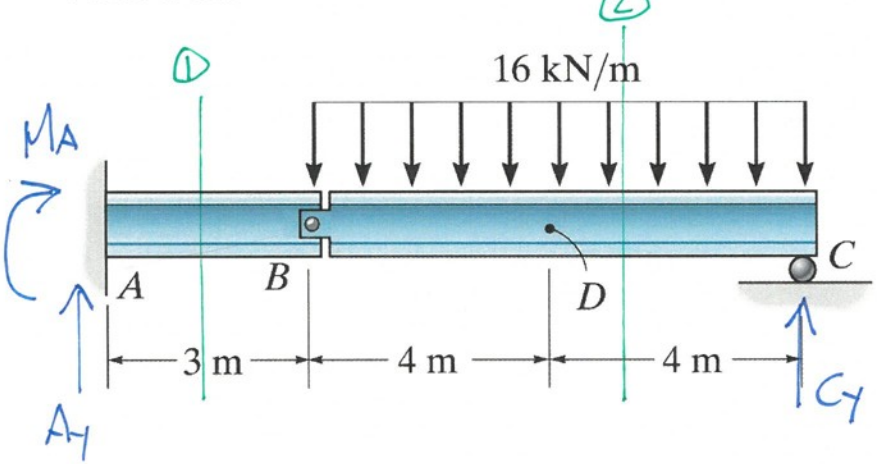
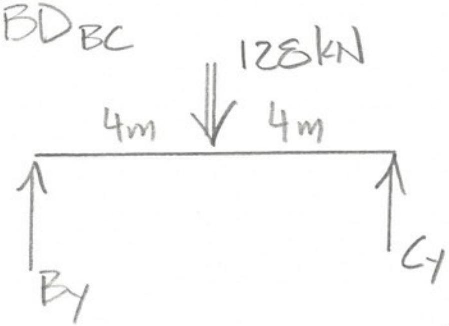
Problem 8b-6. Determine the displacement at *B*. Use the principle of virtual work. *EI* is constant.

Real loads



FBD$_{BC}$



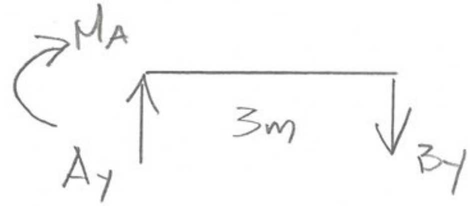
$\circlearrowleft + \sum M_C = 0 = 128\,\text{kN}(4\,\text{m}) - B_y(8\,\text{m})$

$\underline{B_y = 64\,\text{kN}}$

$+\uparrow \sum F_y = 0 = B_y + C_y - 128\,\text{kN}$

$\underline{C_y = 64\,\text{kN}}$

FBD$_{AB}$



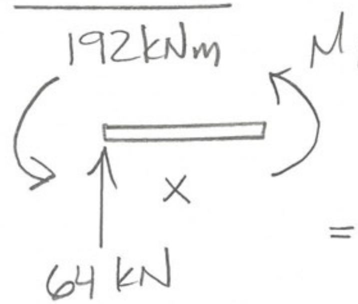
$\circlearrowleft + \sum M_A = 0 = -M_{AB} - B_y(3\,\text{m})$

$\underline{M_{AB} = -192\,\text{kNm}}$

$+\uparrow \sum F_y = 0 = A_y - B_y$

$\underline{A_y = 64\,\text{kN}}$

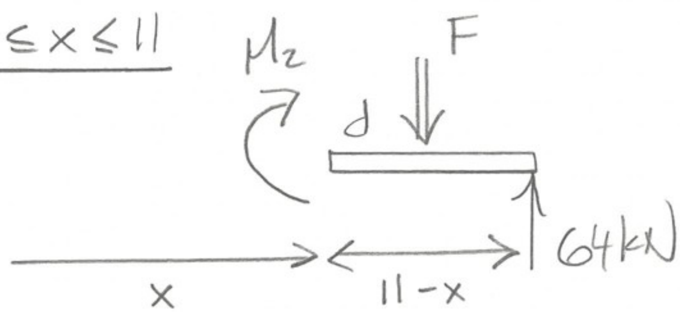
$\underline{0 \le x \le 3}$



$\circlearrowleft + \sum M_{CUT} = 0 = M_1 + 192\,\text{kNm} - 64x$

$\underline{M_1 = [64x - 192]\,\text{kNm}}$

$\underline{3 \le x \le 11}$



$F = 16(11-x)\,\text{kN}$

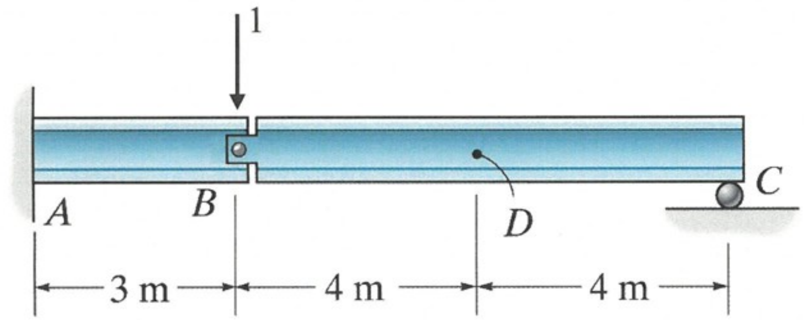
$d = \dfrac{11-x}{2}$

$\circlearrowleft + \sum M_{CUT} = 0 = -M_2 - Fd + 64(11-x)$

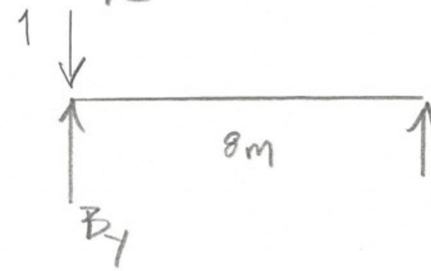
$\underline{M_2 = [-8(11-x)^2 + 64(11-x)]\,\text{kNm}}$

Problem 8b-6. Determine the displacement at *B*. Use the principle of virtual work. *EI* is constant.

Virtual load



FBD$_{BC}$



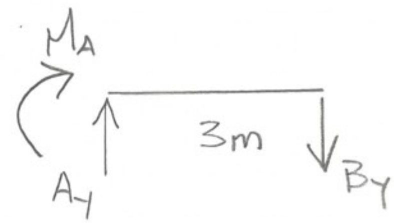
$$\circlearrowleft^{+} \Sigma M_B = 0 = C_y(8m)$$

$$\underline{C_y = 0}$$

$$+\uparrow \Sigma F_y = 0 = B_y + C_y - 1$$

$$\underline{B_y = 1}$$

FBD$_{AB}$



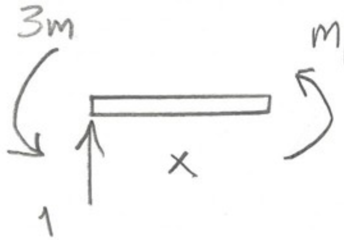
$$\circlearrowleft^{+} \Sigma M_A = 0 = -M_A - B_y(3m)$$

$$\underline{M_A = -3m}$$

$$+\uparrow \Sigma F_y = 0 = A_y - B_y$$

$$\underline{A_y = 1}$$

$\underline{0 \le x \le 3}$

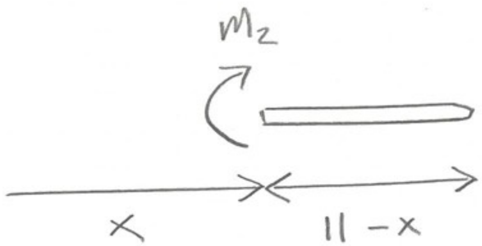


$$\circlearrowleft^{+} \Sigma M_{CUT} = 0$$

$$= m_1 + 3 - 1x$$

$$\underline{m_1 = x - 3} \checkmark$$

$\underline{3 \le x \le 11}$



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

$$= -m_2$$

$$\underline{m_2 = 0}$$

$$Y_B = \int_0^{11} \frac{Mm}{EI}\,dx = \int_0^{3} \frac{M_1 m_1}{EI}\,dx$$

$$= \int_0^{3} (64x - 192)(x-3)\,dx$$

$$= \frac{576\,\text{kN}\,\text{m}^3}{EI}$$