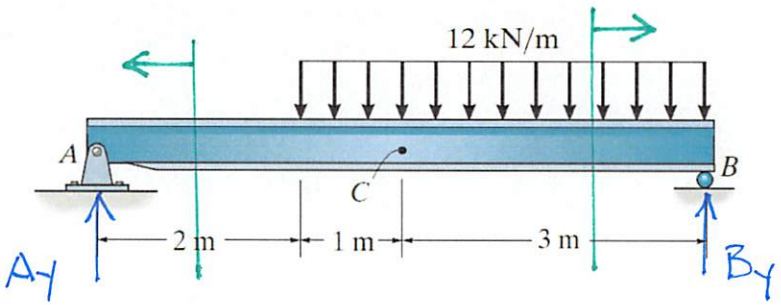
Problem 8b-5. Determine the displacement at x = 2 m. Use the principle of virtual work. *EI* is constant.

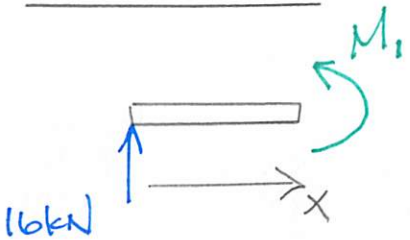
Real loads



$$\circlearrowleft^{+}\Sigma M_B = 0 = 12\,kN/m(4m)(2m) - A_y(6m) \qquad A_y = 16\,kN$$

$$+\uparrow \Sigma F_y = 0 = A_y + B_y - 12\,kN/m(4m) \qquad B_y = 32\,kN$$

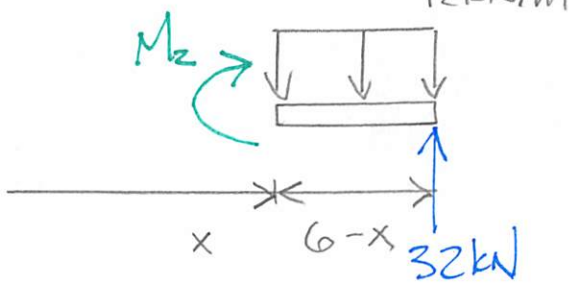
$0 \le x \le 2m$



$$\circlearrowleft^{+}\Sigma M_{CUT} = 0 = M_1 - 16kN(x) \qquad M_1(x) = [16x]\,kN\,m \;\checkmark$$

$$M_1(x=0) = 0$$

$2 \le x \le 6m$



F d

$$\circlearrowleft^{+}\Sigma M_{CUT} = 0 = -M_2 - 12\,kN/m\,(6-x)\tfrac{1}{2}(6-x) + 32kN(6-x)$$

$$M_2(x) = \left[-6(6-x)^2 + 32(6-x)\right] kN\,m \;\checkmark$$

$$M_2(x=6m) = 0$$

$$M_1(x=2m) = M_2(x=2m)$$

Problem 8b-5. Determine the displacement at $x = 2$ m. Use the principle of virtual work. *EI* is constant.

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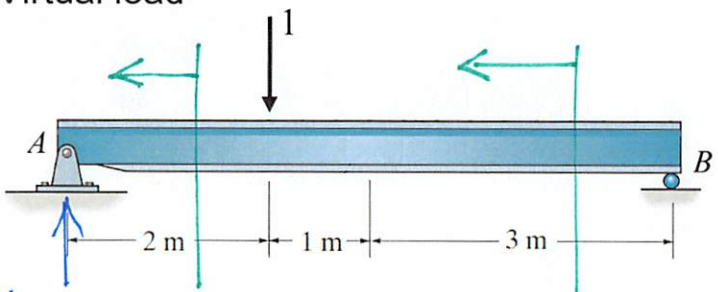
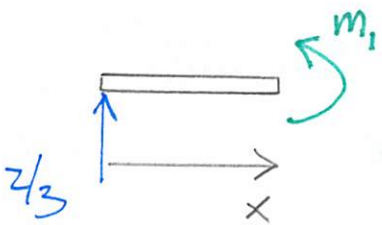
Virtual load



A_y

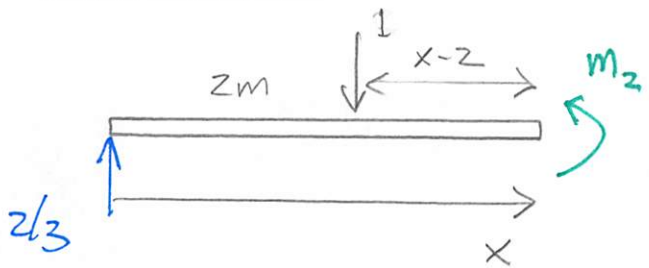
$\circlearrowleft^{+} \sum M_B = 0 = 1(4m) - A_y(6m) \qquad A_y = 2/3$

$0 \le x \le 2m$



$\circlearrowleft^{+} \sum M_{CUT} = 0 = m_1 - 2/3(x) \qquad m_1 = \frac{2x}{3} \qquad m_1(x=0) = 0$ ✓

$2m \le x \le 6m$



$\circlearrowleft^{+} \sum M_{CUT} = 0 = m_2 + 1(x-2) - 2/3(x)$

$m_2 = -\frac{x}{3} + 2 \qquad m_2(x=6) = 0$ ✓

$m_1(x=2) = m_2(x=2)$ ✓

Problem 8b-5. Determine the displacement at $x = 2$ m. Use the principle of virtual work. *EI* is constant.

$$Y(x=2m) = \frac{1}{EI}\int_0^6 Mm\,dx = \frac{1}{EI}\left[\int_0^2 M_1 m_1\,dx + \int_2^6 M_2 m_2\,dx\right]$$

VIRTUAL WORK EXPRESSION

$$= \frac{1}{EI}\left[\frac{32x^3}{3}\Big|_0^2 + \frac{x^4}{2} - \frac{76x^3}{9} + 44x^2 - 48x\Big|_2^6\right]$$

$$= \frac{128\ kN\,m^3}{EI}$$