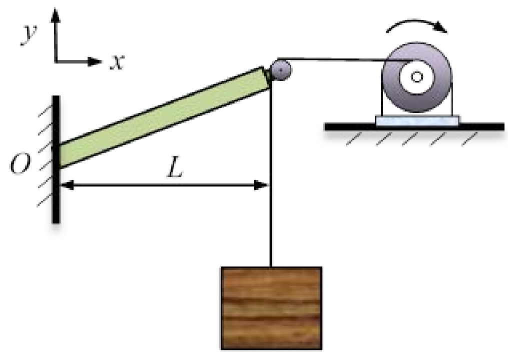
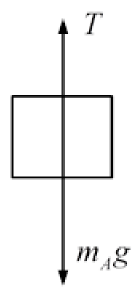
2-25. The motor is hoisting a block with a constant acceleration of $a = 2 \text{ m/s}^2$. The uniform beam has a normal distributed mass $m_B \sim N(50, 5^2)$ kg and the length is $L = 2$ m. If the mass of the block is $m_A \sim N(20, 2^2)$ kg, determine the components of reaction at the fixed support. Assume the size and mass of the pulley is negligible. m_A and m_B are independent.





Block:

$$(+\uparrow)\ \Sigma F_y = m_A a_y : T - m_A g = m_A a$$

$$T = m_A(a+g)$$

Beam:

$$(+\rightarrow)\ \Sigma F_x = 0 : -O_x + T = 0$$

$$O_x = T = m_A(a+g)$$

$$\mu_{O_x} = \mu_{m_A}(a+g) = 20(2+9.81) = 236.2 \text{ N}$$

$$\sigma_{O_x} = \sigma_{m_A}(a+g) = 2(2+9.81) = 23.62 \text{ N}$$

$$(+\uparrow)\ \Sigma F_y = 0 : O_y - m_B g - T = 0$$

$$O_y = m_B g + m_A(a+g)$$

$$\mu_{O_y} = \mu_{m_B} g + \mu_{m_A}(a+g) = 50(9.81) + 20(2+9.81) = 726.7 \text{ N}$$

$$\sigma_{O_y} = \sqrt{\left(\sigma_{m_B} g\right)^2 + \left(\sigma_{m_A}(a+g)\right)^2} = \sqrt{\left(5(9.81)\right)^2 + \left(2(2+9.81)\right)^2} = 54.44 \text{ N}$$

$$\Sigma M_O = 0 : M_O - m_B g \frac{L}{2} - TL = 0$$

$$M_O = \frac{m_B g L}{2} + m_A(a+g)L$$

$$\mu_{M_O} = \frac{\mu_{m_B} g L}{2} + \mu_{m_A}(a+g)L = \frac{50(9.81)(2)}{2} + 20(2+9.81)(2) = 962.9 \text{ N} \cdot \text{m}$$

$$\sigma_{M_O} = \sqrt{\left(\frac{\sigma_{m_B} g L}{2}\right)^2 + \left(\sigma_{m_A}(a+g)L\right)^2} = \sqrt{\left(\frac{5(9.81)(2)}{2}\right)^2 + \left(2(2+9.81)(2)\right)^2} = 68.10 \text{ N} \cdot \text{m}$$

Therefore, $O_x \sim N(236.2, 23.62^2)$ N, $O_y \sim N(726.7, 54.44^2)$ N, $M_O \sim N(962.9, 68.10^2)$ N·m.