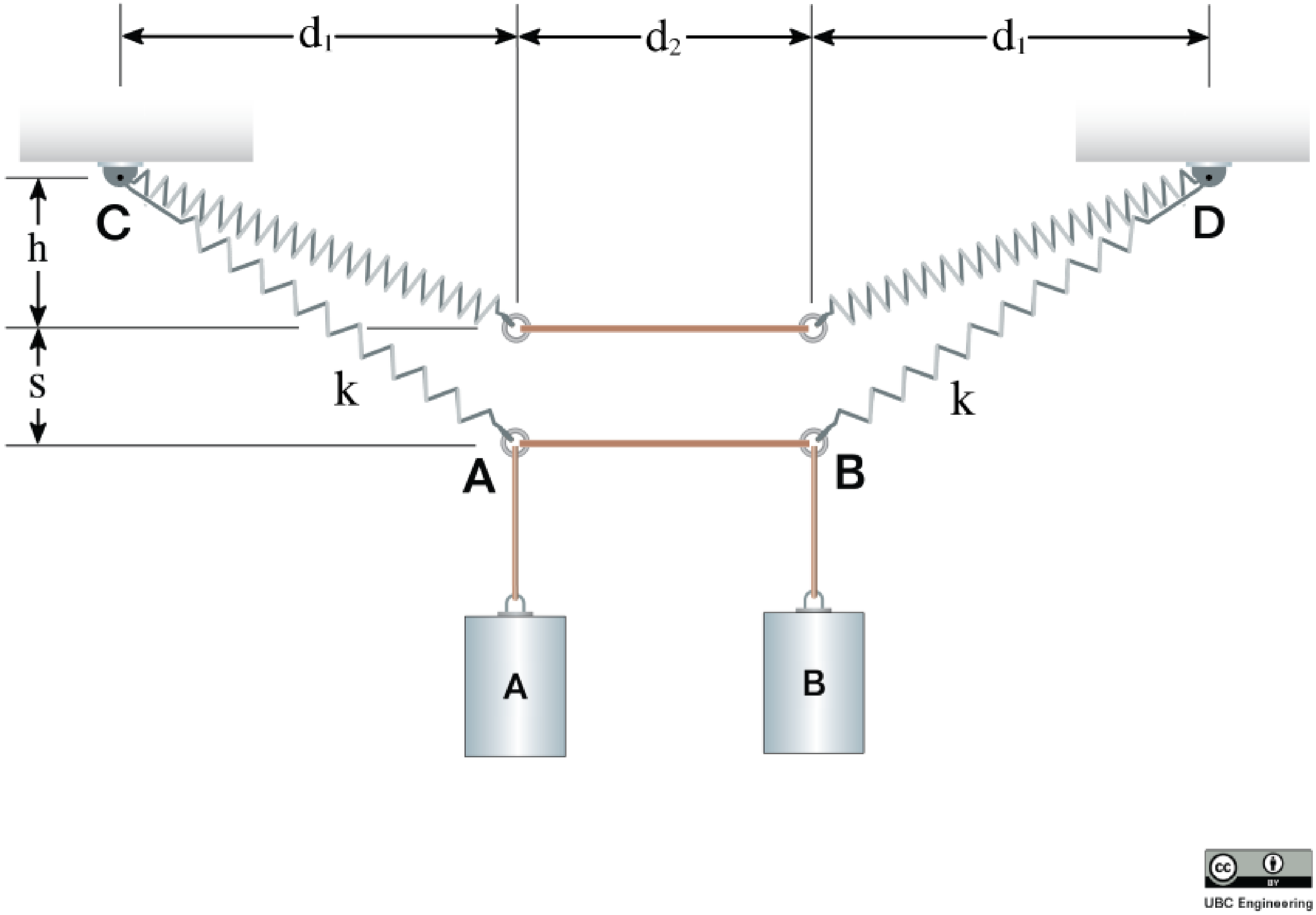
21-S-3-3-GD-002



When the two weights are attached to the metal loops (A and B), the k N/m springs lower by $s = s$ m. If $d_1 = d_1$ m, $d_2 = d_2$ m, and $h = h$ m, what is the mass of each weight?

(When the weights are removed, $s = 0$ m. Assume $g = 9.81$ m/s^2)

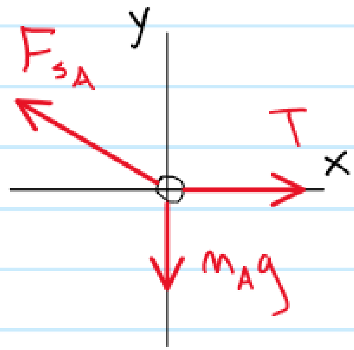
given

K, s, d_1, d_2, h, g

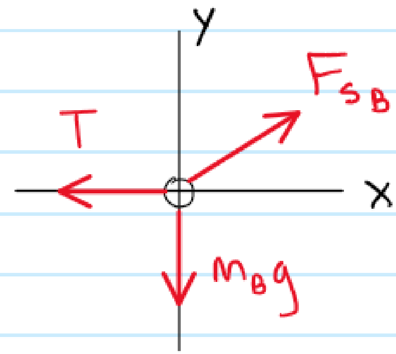
Find

m_A, m_B

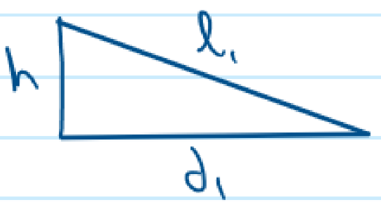
FBD A



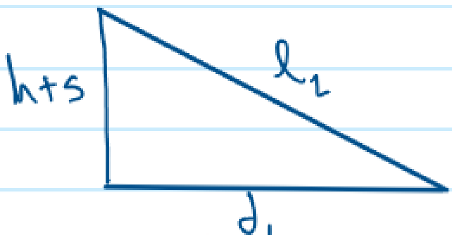
FBD B



Find Stretch in Spring



unstretched



stretched

$$l_1 = \sqrt{h^2 + d_1^2}$$

$$l_2 = \sqrt{(h+s)^2 + d_1^2}$$

$$\Delta x = l_2 - l_1$$

Force Equilibrium FBD A

$$\Sigma F_x = 0 = T - F_{sA}\frac{d_1}{l_2} \quad (1)$$

$$\Sigma F_y = 0 = F_{sA}\frac{h+s}{l_2} - m_A g \quad (2)$$

Unknowns: $T, F_{sA}, F_{sB}, m_A, m_B$

Force Equilibrium FBD B

$$\Sigma F_x = 0 = F_{sB}\frac{d_1}{l_2} - T \quad (3)$$

$$\Sigma F_y = 0 = F_{sB}\frac{h+s}{l_2} - m_B g \quad (4)$$

Observation: Since both springs stretch the same amount and they have the same K

$$F_{sA} = F_{sB} = F_s$$

$$F_s = K\Delta x$$

Using Observation

$$0 = T - F_s \frac{d_1}{\ell_2} \quad (1)' \qquad 0 = F_s \frac{h+s}{\ell_2} - m_A g \quad (2)' \qquad 0 = F_s \frac{d_1}{\ell_2} - T \quad (3)' \qquad 0 = F_s \frac{h+s}{\ell_2} - m_B g \quad (4)'$$

$$F_s = m_A g \frac{\ell_2}{h+s} \quad (2)'' \qquad F_s = m_B g \frac{\ell_2}{h+s} \quad (4)''$$

$$K\Delta x = m_A g \frac{\ell_2}{h+s} \qquad K\Delta x = m_B g \frac{\ell_2}{h+s}$$

$$m_A = \frac{K\Delta x(h+s)}{g\ell_2} \qquad m_A = m_B \qquad m_B = \frac{K\Delta x(h+s)}{g\ell_2}$$