In an experiment to prove the concept of the second condition of equilibrium, a boy balanced the meterstick on a peg board exactly at the midpoint. He then put a cylindrical metal at the 10cm mark and moved the meterstick to balance it again. If the meterstick weighs 12g, how much does the cylindrical metal weighs?

Solution:
$L = 1m - length\ of\ the\ meterstick;$
$m_1 = 12g - weight\ of\ the\ meterstick;$
$m_2 - weight\ of\ the\ cylindrical\ metal;$
$d = 10cm - distance\ from\ the\ end\ of\ meterstick\ to\ the\ celindrical\ metal;$
$x - displacement\ of\ the\ meterstick;$
Second condition of equilibrium (point A):

$$A: M_1 + M_2 = 0 \qquad (1)$$

$$M_1 = m_1 g \cdot \left(\frac{L}{2} - x - d\right) \qquad (2)$$

$$M_2 = -m_2 g \cdot \left(\frac{L}{2} + x\right) \qquad (3)$$

$(3) and (2) in (1)$:

$$m_1 g \cdot \left(\frac{L}{2} - x - d\right) - m_2 g \cdot \left(\frac{L}{2} + x\right) = 0$$

$$m_2 = m_1 \cdot \frac{\frac{L}{2} - x - d}{\frac{L}{2} + x} = m_1 \cdot \frac{L - 2x - 2d}{L + 2x} = 12g \cdot \frac{100cm - 2x - 20cm}{1cm + 2x}$$

$$= 12g \cdot \frac{80cm - 2x}{100cm + 2x}$$

Hence, to find m_2 we need to know the displacement of the meterstick (x)
Answer: to find m_2 we need to know the displacement of the meterstick, formula for the m_2:

$$m_2 = 12g \cdot \frac{80cm - 2x}{100cm + 2x}.$$