

Question:

a 3.0m beam with a mas of 130kg is supported at each end. a 70kg student stands 2.0m from support, how much upward force does each support exert on the beam?

Solution:

$L = 3.0 \text{ m}$ – the lengths of beam;

$M = 130 \text{ kg}$ – the mass of beam.

$m = 70 \text{ kg}$ – the mass of student

$$g = 10 \frac{\text{m}}{\text{s}^2}$$

\vec{F}_1, \vec{F}_2 - upward forces;

First Newton's law of motion:

$$F_1 + F_2 = mg + Mg$$

$$mg \cdot \frac{L}{3} + Mg \cdot \frac{L}{2} - F_2 \cdot L = 0$$

$$mg \cdot \frac{1}{3} + Mg \cdot \frac{1}{2} = F_2 = 70 \cdot 10 \frac{1}{3} + 130 \cdot 10 \frac{1}{2} \approx 233 + 650 = 883 \text{ N}$$

$$F_1 + mg \cdot \frac{1}{3} + Mg \cdot \frac{1}{2} = mg + Mg$$

$$F_1 = mg \cdot \frac{2}{3} + Mg \cdot \frac{1}{2} = 70 \cdot 10 \frac{2}{3} + 130 \cdot 10 \frac{1}{2} \approx 467 + 650 = 1117 \text{ N}$$

