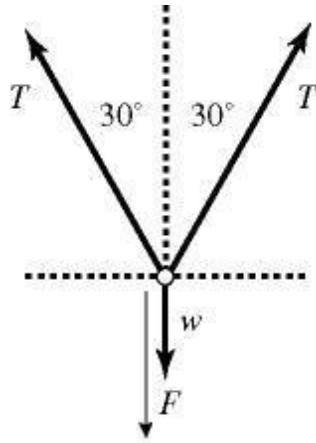A 6 kg box is held at rest by two ropes that form 30° angles with the vertical. An external force F acts vertically downward on the box. The force exerted by each of the two ropes is denoted by T. A force diagram, showing the four forces that act on the box in equilibrium, is shown in the figure. The magnitude of force F is 410 N. What is the magnitude of force T?

Solution

The four forces that act on the box are in equilibrium, so lets write the projection of the sum of all forces on vertical axis:

$$2T \cos 30° - W - F = 0.$$

The magnitude of force T is

$$T = \frac{W + F}{2 \cos 30°} = \frac{mg + F}{2 \cdot \frac{\sqrt{3}}{2}} = \frac{6 \cdot 9.8 + 410}{\sqrt{3}} = 271 \ N.$$

Answer: $271 \ N$.

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