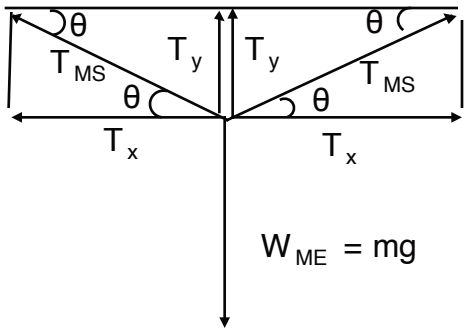
tension - equal angles

A 10.0 kg mass hangs from two strings, each making an angle of 35.0° with the ceiling. What is the tension in each string?

Note: Since the strings make the same angle with the ceiling, the tensions in both strings are equal.

The system is in static equilibrium so

$$F_{NET} = 0$$



Var	Given value	Units	Description
m	10.0	kg	mass of object
θ	35.0	°	angle of strings with ceiling
g	9.80	$\frac{m}{s^2}$	acc. due to gravity on earth
$F_{NET,x}$	0	N	sum of forces in x–direction
$F_{NET,y}$	0	N	sum of forces in y–directions
T_{MS}		N	tension on mass by strings
T_x		N	x–component of tension
T_y		N	y–component of tension
W_{ME}		N	weight on mass by earth

tension - equal angles (continued)

Equation for sum of forces in x–direction:

$$F_{NET,x} = 0$$

$$T_x + (-T_x) = 0$$

Equation for sum of forces in y–direction:

$$F_{NET,y} = 0$$

$$T_y + T_y + -W_{ME} = 0$$

Find the weight of the mass.

$$W_{ME} = mg$$

$$= (10.0\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 98.0\,\text{N}$$ ✓

tension - equal angles (continued)

Substitute in for weight and solve for the y–component of the tension, T_y.

$$T_y + T_y + -W_{ME} = 0$$

$$2\,T_y + -W_{ME} = 0$$

$$2\,T_y = W_{ME}$$

$$T_y = \frac{W_{ME}}{2}$$

$$= \frac{98.0\,\text{N}}{2}$$

$$= 49.0\,\text{N}$$ ✓

Use the value for T_y and some trig to solve for the tension (which is the hypotenuse of the triangle).

$$\sin\theta = \frac{T_y}{T_{MS}}$$

$$T_{MS}\sin\theta = T_y$$

$$T_{MS} = \frac{T_y}{\sin\theta}$$

$$= \frac{49.0\,\text{N}}{\sin(35.0°)}$$

tension - equal angles (continued)

$$= 85.4\,\text{N}$$ ✓