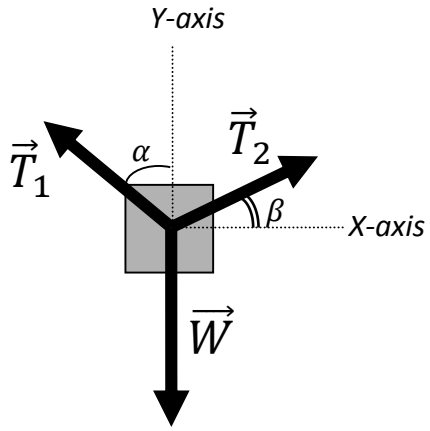
Answer on Question #63907, Physics / Mechanics | Relativity

Question:

A 30-lb body is suspended by two cords, one making 53° with the vertical and the other making 30° with the horizontal. What are the tensions in the cord?

Solution:



The body is in equilibrium, so we may write that $\vec{T}_1 + \vec{T}_2 + \vec{W} = \vec{0}$.

Now we decompose this vector equation into two scalar: $T_1^x = T_2^x$ and $T_1^y + T_2^y = W$.

$T_1^x = T_1 \cdot \sin\alpha$, $T_2^x = T_2 \cdot \cos\beta$ and then $T_1 \cdot \sin\alpha = T_2 \cdot \cos\beta$ ...(1)

$T_1^y = T_1 \cdot \cos\alpha$, $T_2^y = T_2 \cdot \sin\beta$ and $T_1 \cdot \cos\alpha + T_2 \cdot \sin\beta = W$ ...(2)

From equation (1) $T_2 = T_1 \cdot \frac{\sin\alpha}{\cos\beta}$, and we substitute it into equation (2):

$T_1 \cdot \cos\alpha + T_1 \cdot \frac{\sin\alpha}{\cos\beta} \cdot \sin\beta = W \quad \blacktriangleright \quad T_1 \cdot (\cos\alpha + \sin\alpha \cdot \tan\beta) = W$

Finally $T_1 = \frac{W}{\cos\alpha + \sin\alpha \cdot \tan\beta} = \frac{mg}{\cos\alpha + \sin\alpha \cdot \tan\beta}$

and $T_2 = \frac{mg}{\cos\alpha + \sin\alpha \cdot \tan\beta} \cdot \frac{\sin\alpha}{\cos\beta} = \frac{mg\sin\alpha}{\cos\alpha\cos\beta + \sin\alpha\sin\beta} = \frac{mg\sin\alpha}{\cos(\alpha-\beta)}$.

$m = 30lb = 30 \cdot 0.45kg = 13.5kg$

$g = 9.81m/s^2, \ \alpha = 53°, \ \beta = 30°$

$$T_1 = \frac{13.5 \cdot 9.81}{\cos 53° + \sin 53° \cdot \tan 30°} = 124.6N$$

$$T_2 = \frac{13.5 \cdot 9.81 \cdot \sin 53°}{\cos(53° - 30°)} = 114.9N$$

Answer: $T_1 = 124.6N \ T_2 = 114.9N$