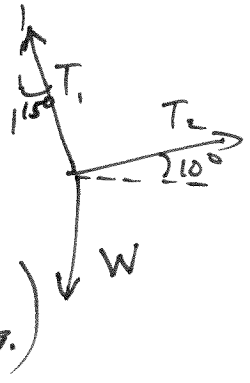
Chapter 6 Problem 30

$m = 76.0\ kg$



Calculate the tension in the 2 ropes.

$\sum \vec{F} = m\vec{a} = 0$ (The performer is not accelerating.)

$\vec{T}_1 + \vec{T}_2 + \vec{W} = 0$

Let x-direction be horizontal and y-direction be vertical.

$\vec{T}_1 = -T_1 \sin 15^\circ \hat{i} + T_1 \cos 15^\circ \hat{j}$

$\vec{T}_2 = T_2 \cos 10^\circ \hat{i} + T_2 \sin 10^\circ \hat{j}$

$\vec{W} = -W\hat{j} = -mg\hat{j}$

Then $-T_1 \sin 15^\circ \hat{i} + T_1 \cos 15^\circ \hat{j} + T_2 \cos 10^\circ \hat{i} + T_2 \sin 10^\circ \hat{j} - mg\hat{j} = 0$

x-dir $-T_1 \sin 15^\circ + T_2 \cos 10^\circ = 0$ (#1)

y-dir $T_1 \cos 15^\circ + T_2 \sin 10^\circ - mg = 0$ (#2)

Use (#1) & solve for T_1

$$T_1 = T_2 \frac{\cos 10^\circ}{\sin 15^\circ} \quad (\#3)$$

sub (#3) into (#2)

$$T_2 \frac{\cos 10^\circ}{\sin 15^\circ} \cdot \cos 15^\circ + T_2 \sin 10^\circ - mg = 0$$

$$T_2 \frac{\cos 10^\circ}{\tan 15^\circ} + T_2 \sin 10^\circ = mg$$

$$T_2 \left[\frac{\cos 10^\circ}{\tan 15^\circ} + \sin 10^\circ\right] = mg$$

$$T_2 = \frac{mg}{\frac{\cos 10^\circ}{\tan 15^\circ} + \sin 10^\circ} = \frac{(76.0\ kg)(9.80\ m/s^2)}{\frac{\cos 10^\circ}{\tan 15^\circ} + \sin 10^\circ} = \frac{744.8\ N}{3.849} = \boxed{194\ N}$$

sub into (#3)

$$T_1 = T_2 \frac{\cos 10^\circ}{\sin 15^\circ} = (194\ N)\frac{\cos 10^\circ}{\sin 15^\circ} = \boxed{736\ N}$$