# Physics 151 Class Exercise: Statics and Traction - KEY

1.   The pulley arrangement shown below applies traction to a hapless skier's leg.  A 25.0 kg mass acted on by gravity produces the tension in the rope that applies the traction.  If the angles are a shown, what is the horizontal force applied to the leg? (Assume the pulleys are frictionless and 3 significant figures for all problems).
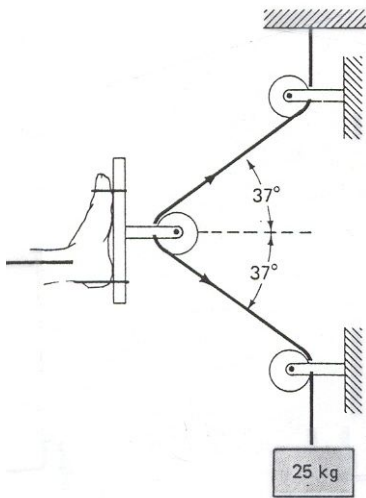
First note that the tension in the rope must be
$T = (25.0 \text{ kg}) (9.8 \text{ m/s}^2) = 245$ N.
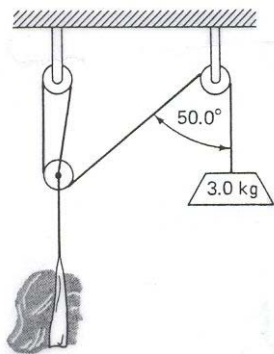
Summing forces at the pulley yields …
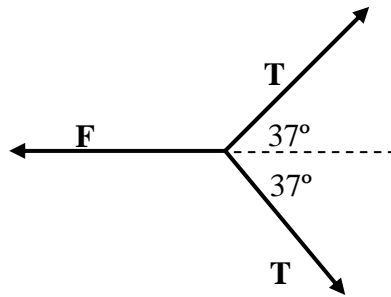


$$\Sigma F_y = T \sin 37° - T \sin 37° = 0$$
$$\Sigma F_x = -F + T \cos 37° + T \cos 37° = 0$$
$$F = 2T \cos 37°$$
$$= 2(245N)(\cos 37°) = 392\,N$$

2.   Calculate the vertical traction force exerted on the neck of the woman below.  The hanging weight has a mass of 3.00 kg.  (Assume that the free pulley cannot move horizontally.)
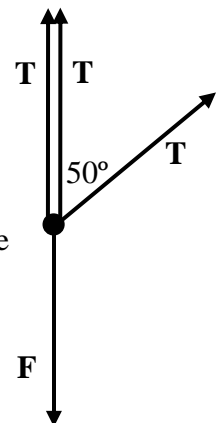
First note that the tension in the rope must be
$T = (3.00 \text{ kg}) (9.81 \text{ m/s}^2) = 29.4$ N.

The FBD is difficult to draw since there are two tension acting upward.  Summing forces at the pulley directly above the women yields …
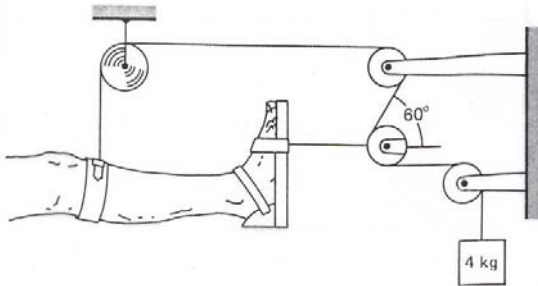
$$\Sigma F_y = -F_{Neck} + T + T + T \cos 50° = 0$$
$$F_{Neck} = T(2 + \cos 50°)$$
$$= (29.4N)(2 + \cos 50°) = 77.7\,N$$

3. The figure below shows a device often used to provide support and traction for an injured leg. Determine the tension in the rope and the traction force (tension) on the leg.
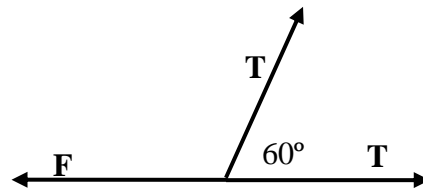


First note that the tension in the rope must be
$T = (4.00 \text{ kg}) (9.81 \text{ m/s}^2) = 39.4 \text{ N}$.
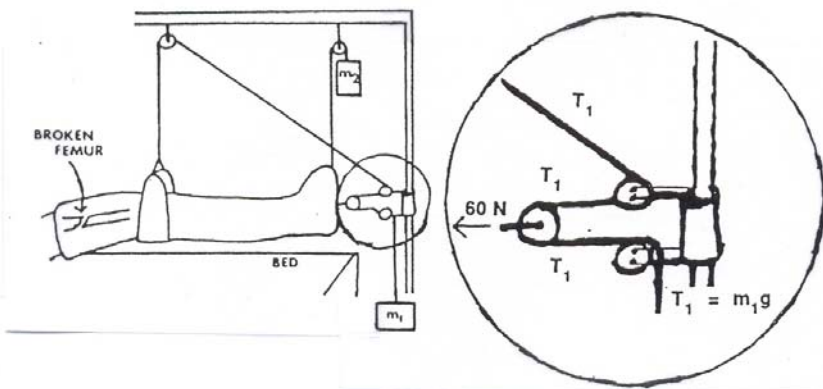
Summing forces at the pulley nearest foot yields …



$$\Sigma F_x = -F_{Traction} + T + T\cos 60° = 0$$
$$F_{Neck} = (T + T\cos 60°)$$
$$= (39.4N)(1+\cos 60°) = 58.9\,N$$

4. The Russell traction apparatus is used for fracture of a femur. The system is shown below. The mass of the leg is 4 kg and the tension required is 60 N. Find the values of masses $m_1$ and $m_2$.



Summing forces at the pulley nearest foot yields …

$$\Sigma F_x = -F_{Traction} + 2m_1 g = 0$$
$$m_1 = \frac{(F_{Traction})}{2g} = \frac{(60.0N)}{2\left(9.81\frac{m}{s^2}\right)} = 3.06\,kg$$

Summing forces on entire leg yields …

$$\Sigma F_y = m_1 g + m_2 g - (4.0 kg) g = 0$$
$$m_2 = 4.00\,kg - 3.06\,kg = 0.94\,kg$$