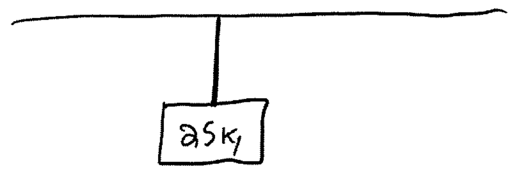
Translational Equilibrium

A 25.0 kg sign is supported by a rope from the ceiling as shown. What is the net force acting on the sign?



0

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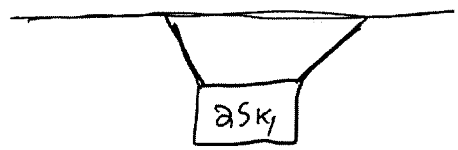


0

Any time an object is not moving (or is moving at a constant velocity) the net force acting on it is 0. We say such an object is in translational equilibrium.

If an object is in translational equilibrium the sum of all forces $=$ F_{net} = 0

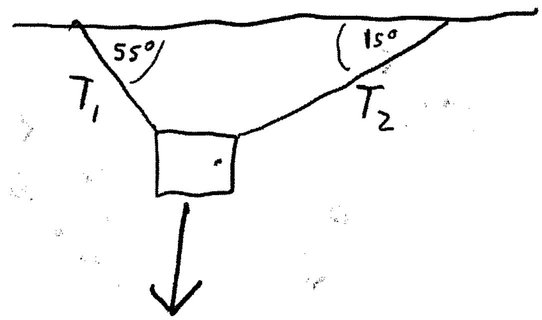
And so

Sum of all forces in x direction = 0

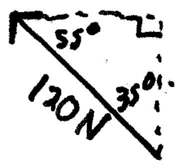
Sum of all forces in y direction = 0

Method #1: Use Vector Components

A block is hung from two ropes as shown, the tension in the first rope is 120 N. What is the tension in the second rope, and what is the mass of the block?



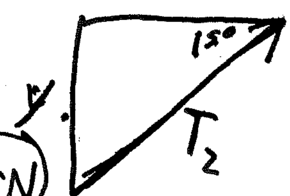
$\cos 55 \times 120$
$= 68.83N$



$\sin 55 \times 120$
$= 98.30N$

Sum of x forces equals zero

So T_2 looks like



so $\cos 15 = \frac{68.83N}{T_2}$

$T_2 = \frac{68.83N}{\cos 15} = 71.26N$

$\tan 15 = \frac{y}{68.83N} \rightarrow y = 18.44N$

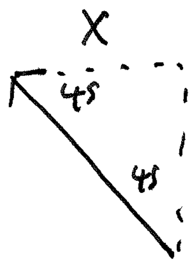
Total Force up = Total force down

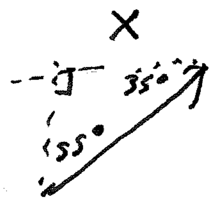
$98.30 + 18.44 = F_g$

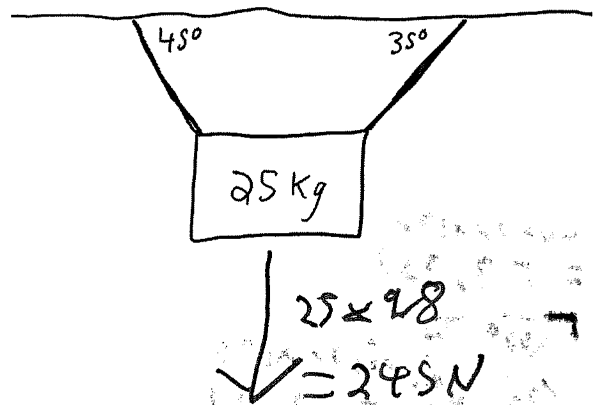
$116.74N = F_g = mg$

$\frac{116.74}{9.8} = 11.91 \approx 12\,kg$

Determine the tension in each of the ropes:

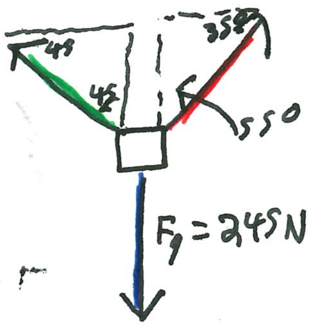


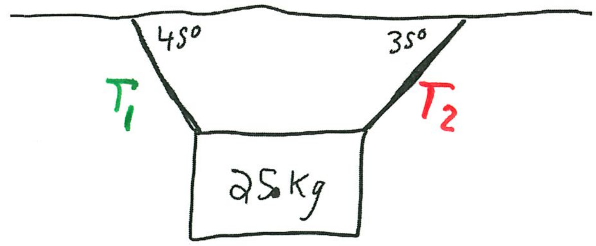


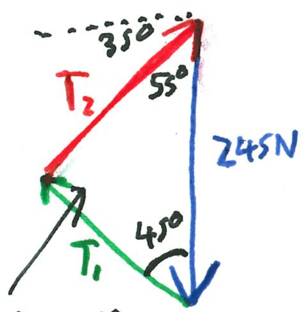


CAN NOT
Be SOLVED
EASILY This
WAY

Method #2: Use a closed vector diagram.







$180^\circ - 55^\circ - 45^\circ$
$= 80^\circ$

$$\frac{T_1}{\sin 55} = \frac{245}{\sin 80}$$

$$T_1 = 204\,N$$

$$\frac{T_2}{\sin 45} = \frac{245}{\sin 80}$$

$$T_2 = 176\,N$$