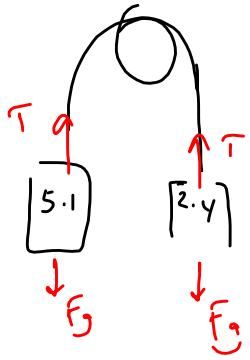
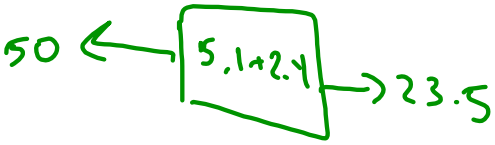


$F_{g_{5.1}} = 5.1(9.8)$

$= 50\ N$

$F_{g_{2.4}} = 2.4(9.8)$

$= 23.5\ N$



$F_{net} = 50 - 23.5$

$= 26.5\ N\ [\leftarrow]$

$ma = 26.5\ N\ [\leftarrow]$

$a = \frac{26.5\ N}{7.5\ kg} = 3.5\ m/s^2\ [\leftarrow]$

FBD of $\quad$ kg

$a = 3.5\ m/s^2\ [\uparrow]$

$F_{net} = T - 23.5$

$8.4 = T - 23.5$

$T = 8.4 + 23.5$

$= 31.9\ N$

$F_{net_{2.4}} = 2.4\ kg(3.5\ m/s^2)$

$= 8.4\ N$

EQUILIBRIUM

Goal:

- to understand the state of equilibrium
- to find an equilibrant
- to solve problems involving static equlibrium

A system is in a state of equilibrium if:

$F_{net} = 0$ $(a = 0)$

Static equilibrium

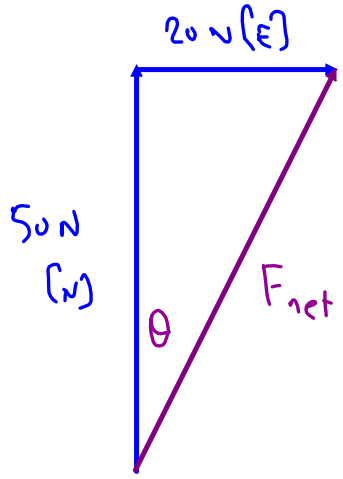
Not moving

Dynamic Equilibrium

Constant velocity

An equilibrant force is the force needed to put a system into a state of equilibrium.

Ex: Given two forces, F_1=50 N [N] and F_2=20 N [E], find the equilibrant.



$F_{net} = \sqrt{50^2 + 20^2}$

$= 53.9$ N

$\theta = \tan^{-1}\left(\frac{20}{50}\right) = 22°$

$\vec{F}_{net} = 53.9$ N [N 22° E]

$F_{eq} = -F_{net}$

$= 53.9$ N [S 22° W]

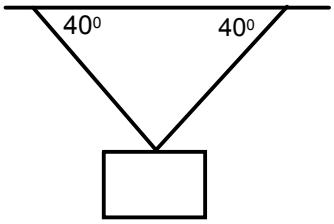
A common problem involving static equilibrium is suspended objects.

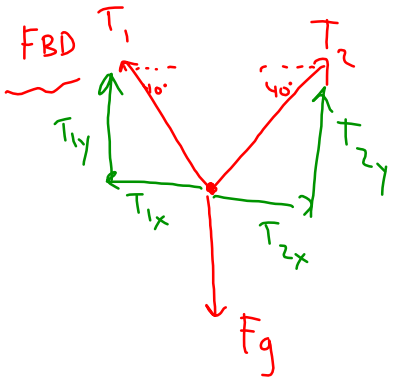
a) symmetric

b) non-symmetric

Symmetric:

A 20 kg sign is supported by two cables as shown. Determine the tension in the cables.





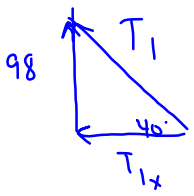
Because of symmetry

$T_1 = T_2$

$F_g = 20\,kg(9.8\,N/kg)$

$= 196\,N$

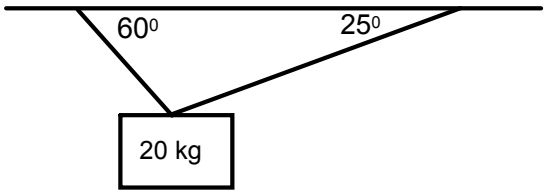
and $T_{1y} = \frac{196}{2} = 98\,N$



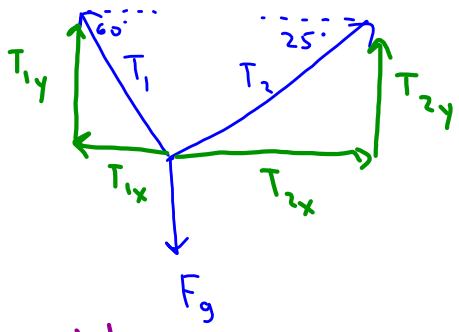
$\sin 40° = \frac{98}{T_1}$

$T_1 = 152.5\,N$

The same sign is supported by two new cables. Determine the tension in the cables.



FBD:



Find components

$T_{1y} \neq T_{2y}$ (not symmetric)

Horizontal:

$T_{1x} = T_{2x}$ (since $F_{net} = 0$)

$T_1 \cos 60^\circ = T_2 \cos 25^\circ$

$0.5 T_1 = 0.906 T_2$

$T_1 = 1.81 T_2$

Vertical:

$T_{1y} + T_{2y} = F_g$ (since $F_{net} = 0$)

$T_{1y} + T_{2y} = 196$

$T_1 \sin 60^\circ + T_2 \sin 25^\circ = 196$

$0.866 T_1 + 0.423 T_2 = 196$

$0.866(1.81 T_2) + 0.423 T_2 = 196$

$1.99 T_2 = 196$

$T_2 = 98.5$ N

$T_1 = 1.81(98.5\text{ N})$

$= 178.3$ N