# Tension force problems: suspending with cables

## Teaching Sciences & Engineering with Jupyter Notebooks

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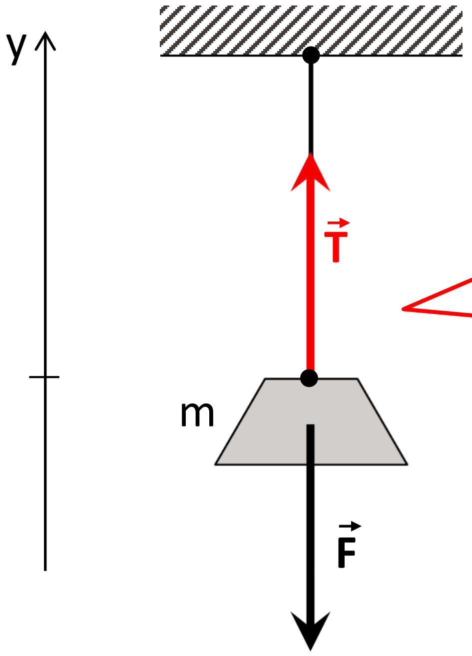
# Suspending with one cable



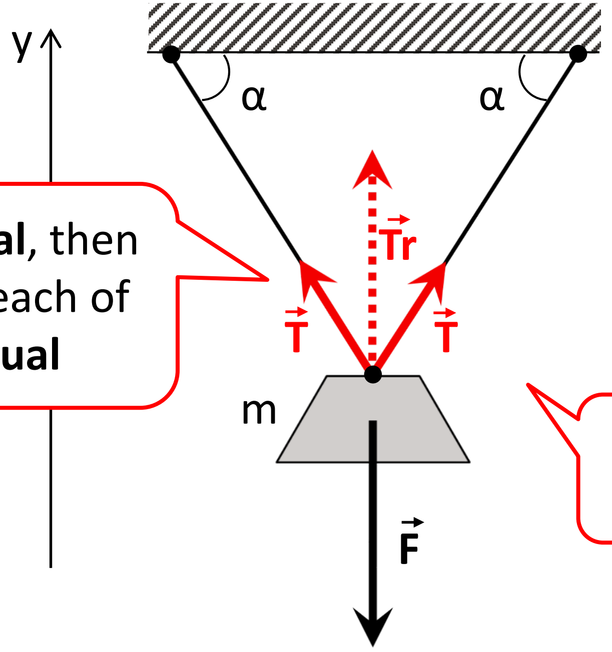

The **tension** is exerted at the point of attachment in the **direction** of the cable

If the object is not moving, then it is in **static equilibrium.**
By Newton's First Law (zero net force), the tension in the cable is :

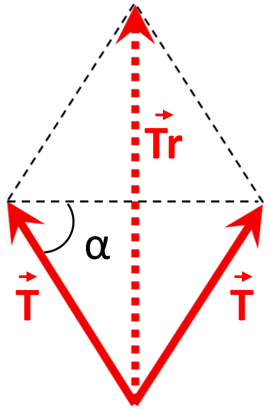
$$\vec{T} + \vec{F} = \vec{0}$$
$$|\vec{T}| = |\vec{F}|$$
$$|\vec{T}| = m.g$$

The **tension** compensates the **weight**

# Suspending with two cables




If the **two angles** are **equal**, then the **tensions** exerted on each of the two cables are **equal**




$$\sin(\alpha) = \frac{\frac{1}{2}|\vec{Tr}|}{|\vec{T}|}$$

$$|\vec{Tr}| = 2.|\vec{T}|.\sin(\alpha)$$

The two tensions combine into a **resulting vertical tension**

If the object is not moving, then it is in **static equilibrium.** By Newton's First Law (zero net force), the tension in **each of the cables** is :

$$\vec{T} + \vec{T} + \vec{F} = \vec{0}$$

$$\vec{Tr} + \vec{F} = \vec{0}$$

$$|\vec{Tr}| = |\vec{F}|$$

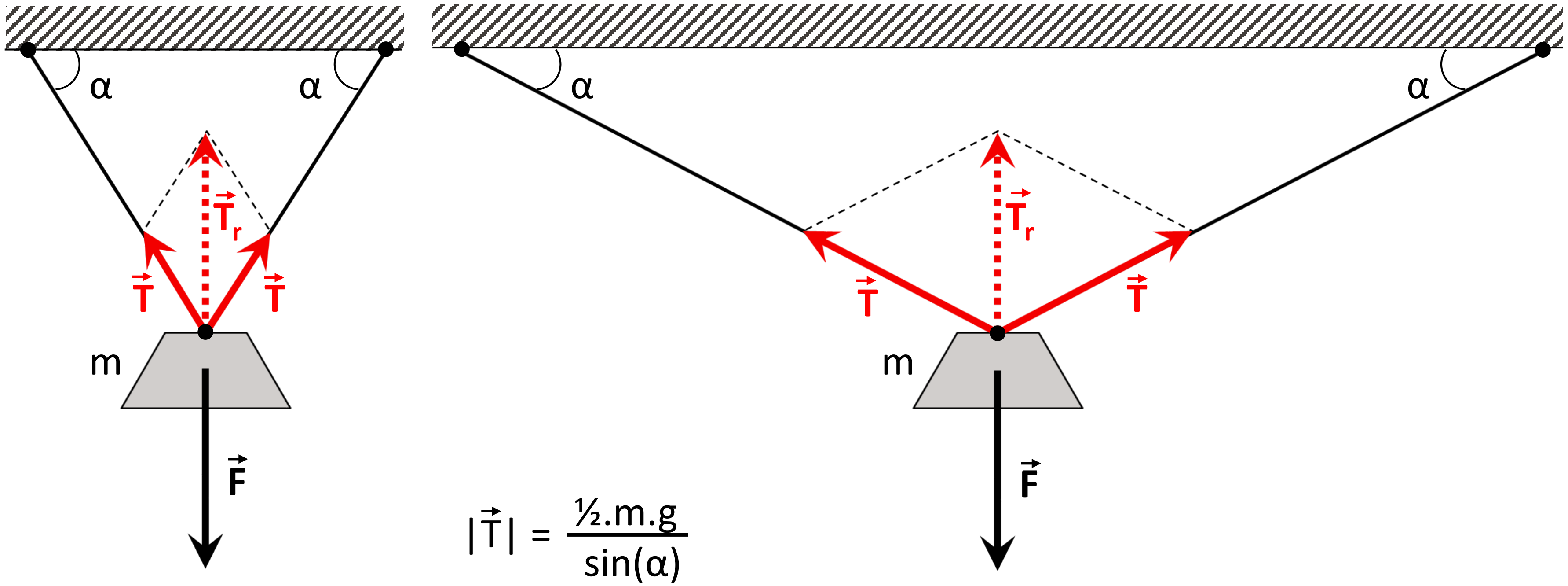
$$2.|\vec{T}|.\sin(\alpha) = m.g$$

$$|\vec{T}| = \frac{\frac{1}{2}.m.g}{\sin(\alpha)}$$

The tension *in each cable* compensates **half** the weight

The tension *in each cable* depends on the **angle**

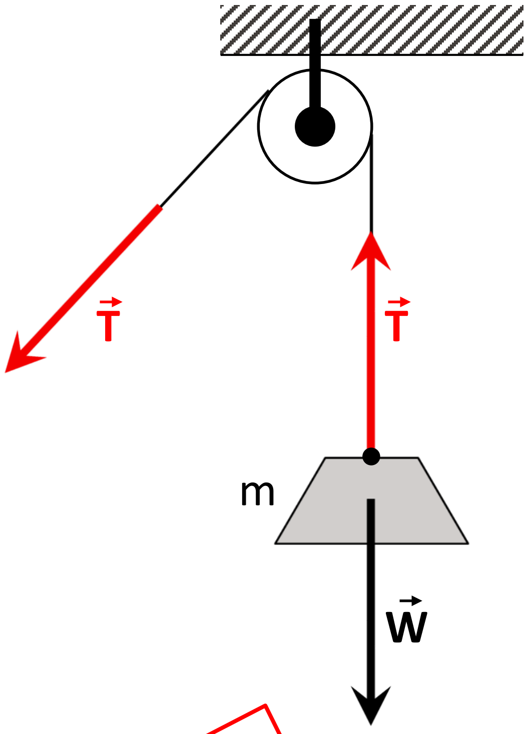
# Zoom on the influence of the angle




$$|\vec{T}| = \frac{½.m.g}{\sin(\alpha)}$$

**smaller angle = higher tension**
in each cable to compensate
the same weight

# Suspending with a fixed pulley




A **fixed pulley** simply changes the **direction** of the tension