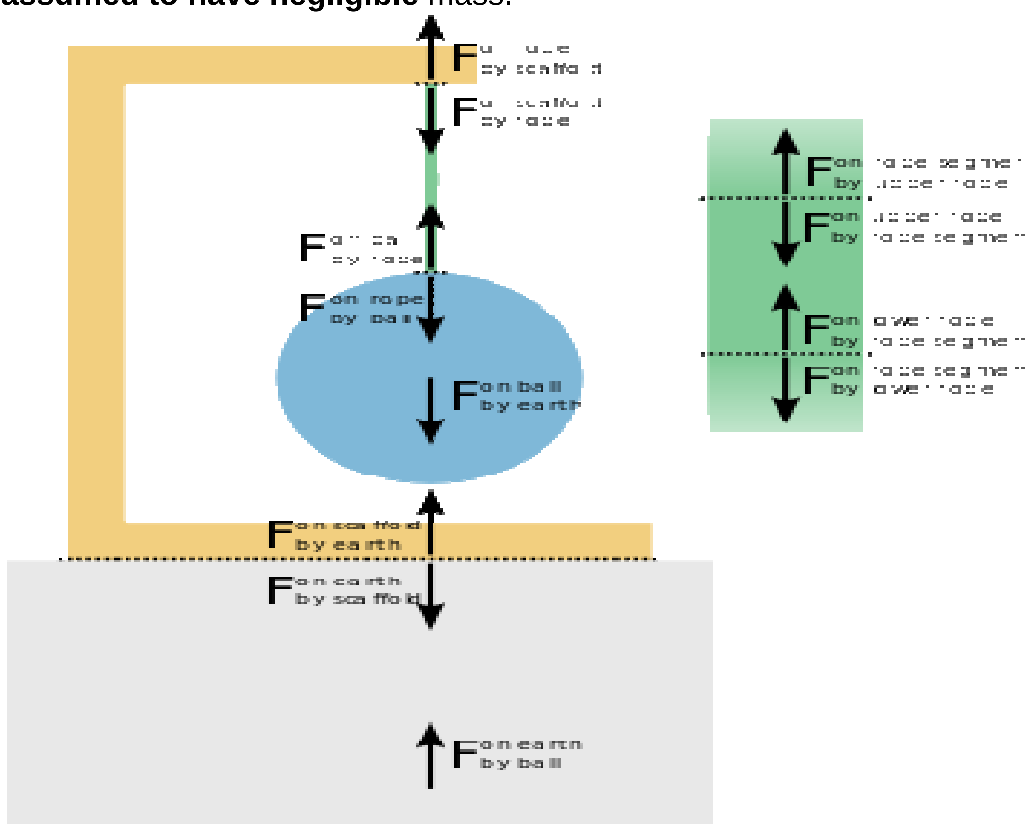
Tension

Tension is the pulling force exerted by a string, cable, chain, or similar solid object on another object. It results from the net electrostatic attraction between the particles in a solid when it is deformed so that the particles are further apart from each other than when at equilibrium, where this force is balanced by repulsion due toelectron shells; as such, it is the pull exerted by a solid trying to restore its original, more compressed shape. Tension is the opposite of compression. Slackening is the reduction of tension.

As tension is the magnitude of a force, it is measured in newtons (or sometimes pounds-force) and is always measured parallel to the string on which it applies. There are two basic possibilities for systems of objects held by strings: Either acceleration is zero and the system is therefore in equilibrium, or there is acceleration and therefore a net force is present. Note that a string is assumed to have negligible mass.



System in equilibrium

A system is in equilibrium when the sum of all forces is zero.

$$\sum \vec{F} = 0$$

For example, consider a system consisting of an object that is being lowered vertically by a string with tension, T, at a constant velocity. The system has a constant velocity and is therefore in equilibrium because the tension in the string (which is pulling up on the object) is equal to the force of gravity, mg, which is pulling down on the object.

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

System under net force

A system has a net force when an unbalanced force is exerted on it, in other words the sum of all forces is not zero. Acceleration and net force always exist together.

$$\sum \vec{F} \neq 0$$

For example, consider the same system as above but suppose the object is now being lowered with an increasing velocity downwards (positive acceleration) therefore there exists a net force somewhere in the system. In this case, negative acceleration would indicate that $|mg| > |T|$**.**

$$\sum \vec{F} = T - mg \neq 0$$

In another example, suppose that two bodies A and B having masses m_1 **and** m_2 **respectively are connected with each other by an inextensible string over a frictionless pulley. There are two forces acting on the body A: its weight (**$w_1 = m_1 g$**) pulling down, and the tension** T **in the string pulling up. If body A has greater mass than body B,** $m_1 > m_2$**. Therefore, the net force** F_1 **on body A is** $w_1 - T$**, so** $m_1 a = m_1 g - T$**.**