Newton's Laws

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FORCES:- • a force is a push or a pull
• the 4 fundamental forces are: the electromagnetic force, gravitational force, strong nuclear force and weak nuclear force

FRICTION:- • a contact force parallel to the contact surfaces
• static friction acts to prevent objects from sliding → $f = \mu_s N$
• kinetic friction acts to make sliding objects slow down → $f = \mu_d N$

TENSION:- • an ideal chord has zero mass, does not stretch, and the tension is the same throughout the chord

SPRING FORCE:- • exerted by a compressed or stretched spring upon any object that is attached to it.
• an object that compresses or stretches a spring is always acted upon by a force that restores the object to its rest/equilibrium position.

NORMAL FORCE:- • acts in the direction ⊥ to the contact surface

LAWS OF MOTION:- • if an object moves with uniform motion (constant velocity), no force is required for the motion to be maintained, for example, moon-earth system, electron-nucleus system.
• an object accelerates only if the net force acting on it ≠ zero, else acc = zero, velocity remains constant, and object is said to be in equilibrium.

NEWTON'S LAWS:- 1. an object at rest/in motion will stay at rest/in motion at const. velocity, unless acted upon by an unbalanced force
2. acceleration of an object is directly proportional to the net force acting on it, and inversely proportional to its mass ($\Sigma f = ma$)
3. every action force has an equal and opposite reaction force ($F_A = -F_B$)

INERTIA:- the tendency of an object to resist any attempt to change its velocity
MASS:- how much inertia an object has
WEIGHT:- weight = magnitude of gravitational force exerted on object

ATWOOD'S MACHINE:-

When two objects of unequal mass are hung vertically over a frictionless pulley of negligible mass, Determine the magnitude of the acceleration of the two objects and the tension in the lightweight cord.

$$\Sigma F_y = m_2 g - T = m_2 a_y$$

$$\Sigma F_y = T - m_1 g = m_1 a_y$$

$$-m_1 g + m_2 g = m_1 a_y + m_2 a_y$$

$$a_y = \left(\frac{m_2 - m_1}{m_1 + m_2}\right) g \qquad T = \left(\frac{2 m_1 m_2}{m_1 + m_2}\right) g$$

Special Cases When $m_1 = m_2$, then $a_y = 0$ and $T = m_1 g$, as we would expect for this balanced case. If $m_2 \gg m_1$, then $a_y \approx g$ (a freely falling body) and $T \approx 2 m_1 g$.