

FORCES and Newton's Laws

Force

- Any push or pull on an object caused by physical contact or force field
- The cause of an acceleration or change in an object's motion
- A vector quantity
- SI unit: Newton (N)
- 1 N accelerates 1kg at 1 m/s^2
- $1 \text{ N} = .225 \text{ lb}$

Types of Forces

- Contact Forces

- At a Distance (Field) Forces

Weight

- Force of gravity on a mass
- Always directed downward
- $F_g = mg$
- Units
 - Newtons (N)
 - pounds(lbs)
- Conversions
 - 2.2 lbs in 1kg (on earth)
 - 4.45 N in 1 lb

Newton's First Law

- Law states:
 - An object at rest will stay at rest, an object in motion will stay in motion, unless acted on by an outside force.
- Known as the Law of Inertia
 - Inertia is the ability of an object to maintains its current state of motion
 - Inertia is caused by the mass of an object. The more mass, the more inertia.

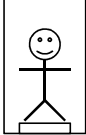
Net Force

- Definition
 - the "sum" of all forces acting on an object.
- Result
 - an acceleration in the direction of the force.
 - If zero, the object is at rest or moving with a constant velocity.

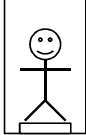


Net Force

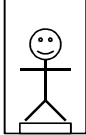
Accelerating up



Constant speed

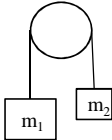


Accelerating down



Atwood's Machine

- Draw all of the forces acting the diagram below.
- What is the net force on each block?



Newton's Second Law

- Law states:
 - any net force applied to an object will cause the object to accelerate in the direction of the force.
 - $F_{net} = ma$
 - When an object has a constant speed or no speed at all, the net force on the object is zero.

Net Force Problem

- You pull a box along a table with a force of 20 N. Assuming the table has a frictional force of 8 N which opposes the direction of the box's motion, and the box is 9 kg, what is the acceleration of the box? What is the box's speed after 2 m?

Newton's Third Law

- Law States
 - For every action, there is an equal and opposite reaction.
 - When you push on a wall, do you exert a force? If you do, does the wall move? Why not?
 - Due to gravity, the Earth pulls on you. Using Newton's 3rd Law, do you exert a force on the Earth? In which direction? What is the magnitude?
