Newton's Laws

- **Newton's first law, the law of inertia.** An object stays in the same motion or stays at rest unless acted upon by an outside force.
- Inertia is the resistance to change in motion.
- Inertia is determined by the amount of mass.
- The more mass, the more the resistance to the change in motion.

Newton's Second Law

- F=ma, The acceleration of an object is directly proportional to the **net** force and inversely proportional to the mass.
- This means the more **net** force, the more the acceleration and
- the more the mass the less the acceleration.
- Force and acceleration are both vectors, they must be going the same direction for this equation to work. Mass is scalar – it doesn't have direction.

Units

- Force has the symbol **F** in equations and has metric units of Newtons (N). 1 N = 1kg m/s^2
- Mass has the symbol **m** in equations and has metric units of kilograms (kg).
- English units of force are pounds (lbs).
- English units of mass are slugs.

Weight

- Weight (F_g) is a special kind of force, the force of gravity.
- Weight can be calculated by using the mass and the acceleration of gravity
- $g=9.80\ m/s^2$ or $32\ ft/s^2$
- $F_g=mg$

Applications of N2L

- Newton's Second Law: F=ma
- The F and the a **MUST** correspond
- example 1: F_g and g correspond so both are used in the same equation
- example 2: F_{net} and a_{net} correspond so both are used in the same equation
- This means that **MOST** of the time we need to determine the **Net Force** (F_{net}) so we can find the **net acceleration**

Net Force

- The net force is the sum of all the forces
- The net acceleration is the acceleration we observe for objects

Force Examples

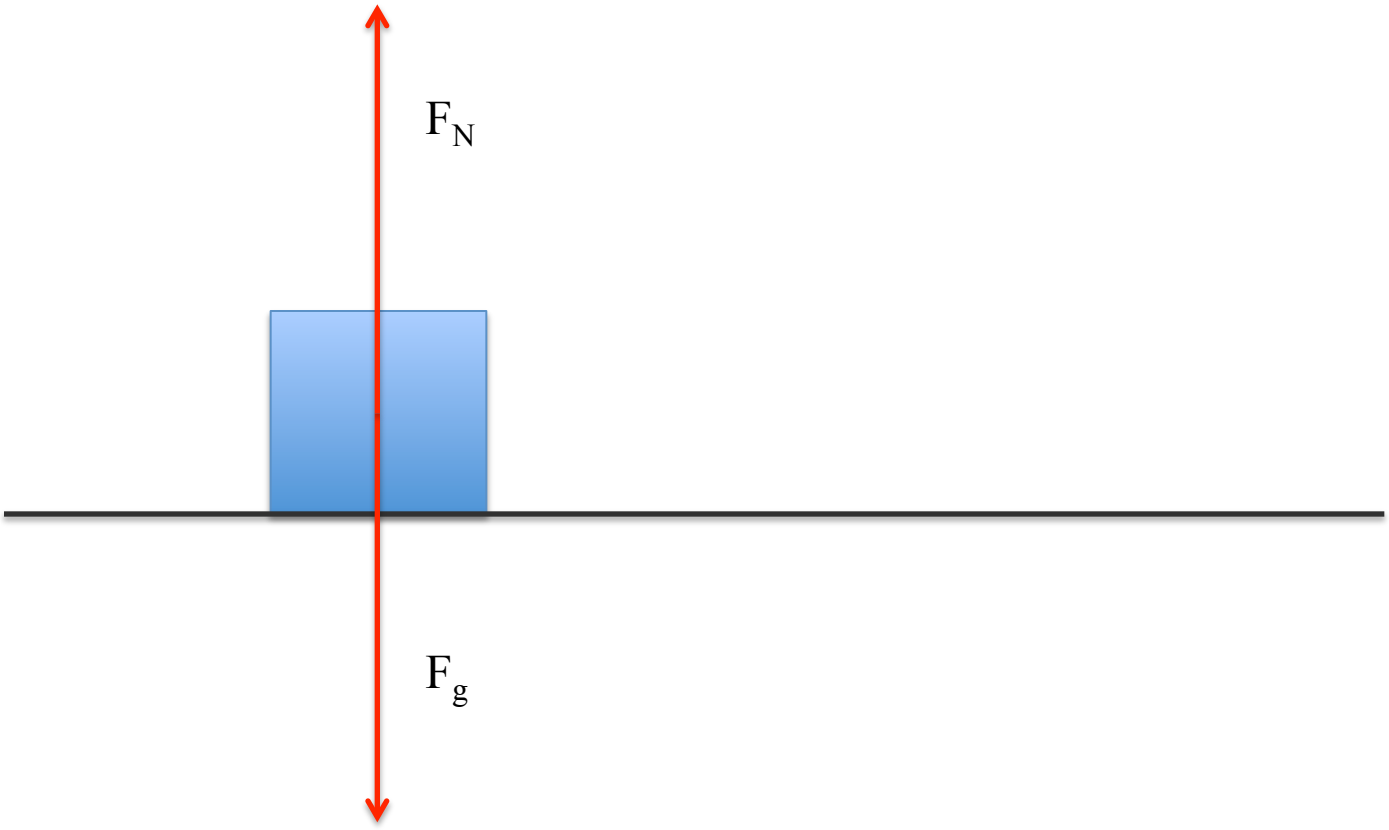
- F_g the force of gravity
- F_N the normal force – a pushing force
- F_T the tension force – a pulling force
- F_f the friction force – a force that **generally** causes an object to move slower.

Free Body Diagrams

- Free Body Diagrams (FBDs) are pictures that include all the forces on an object.
- The diagram helps us to determine the Net Force on the object.
- After we know all the forces, the forces in the same direction are added and forces in the opposite direction are subtracted (adding a negative) to determine the net force.

Free Body Diagrams

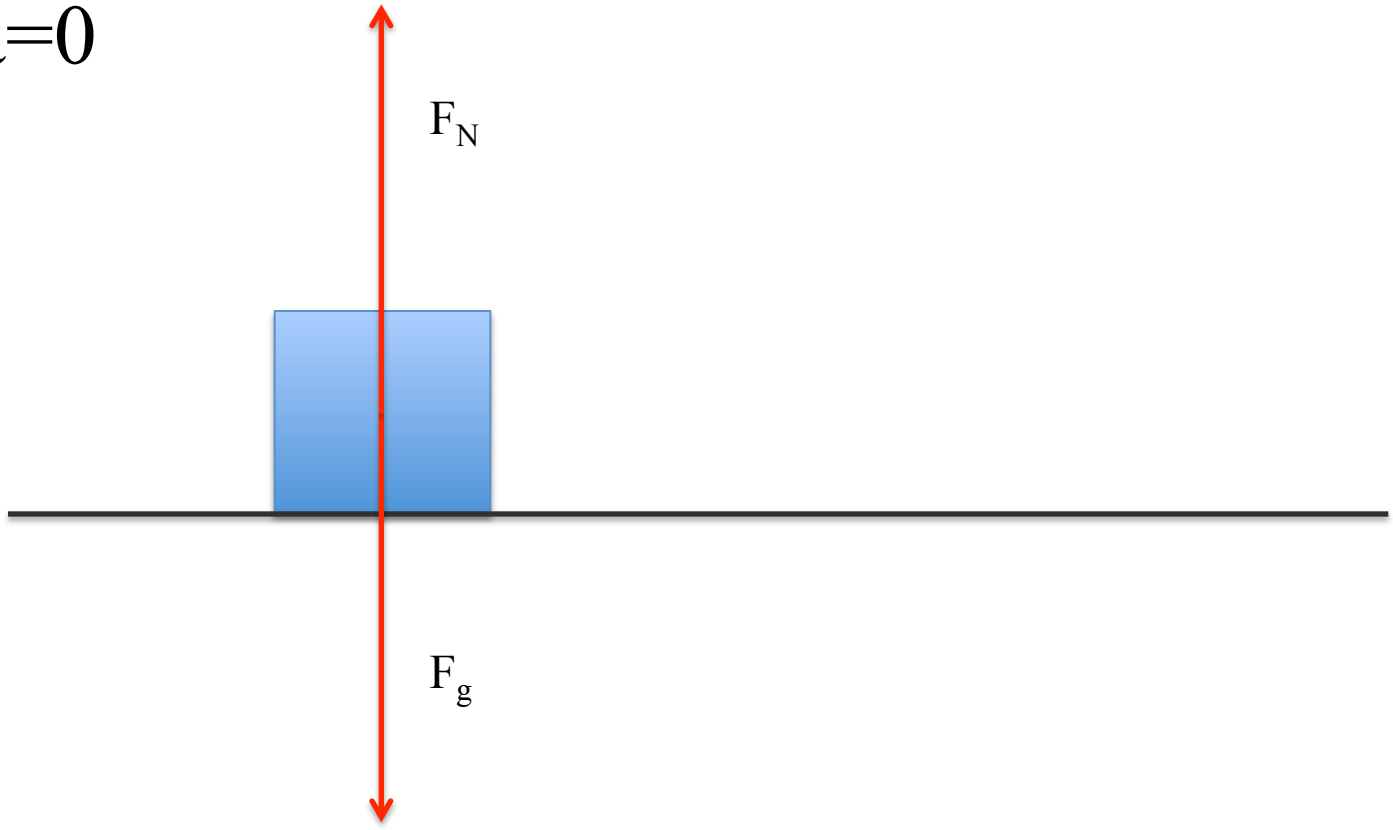
An object at rest on a table



Free Body Diagrams

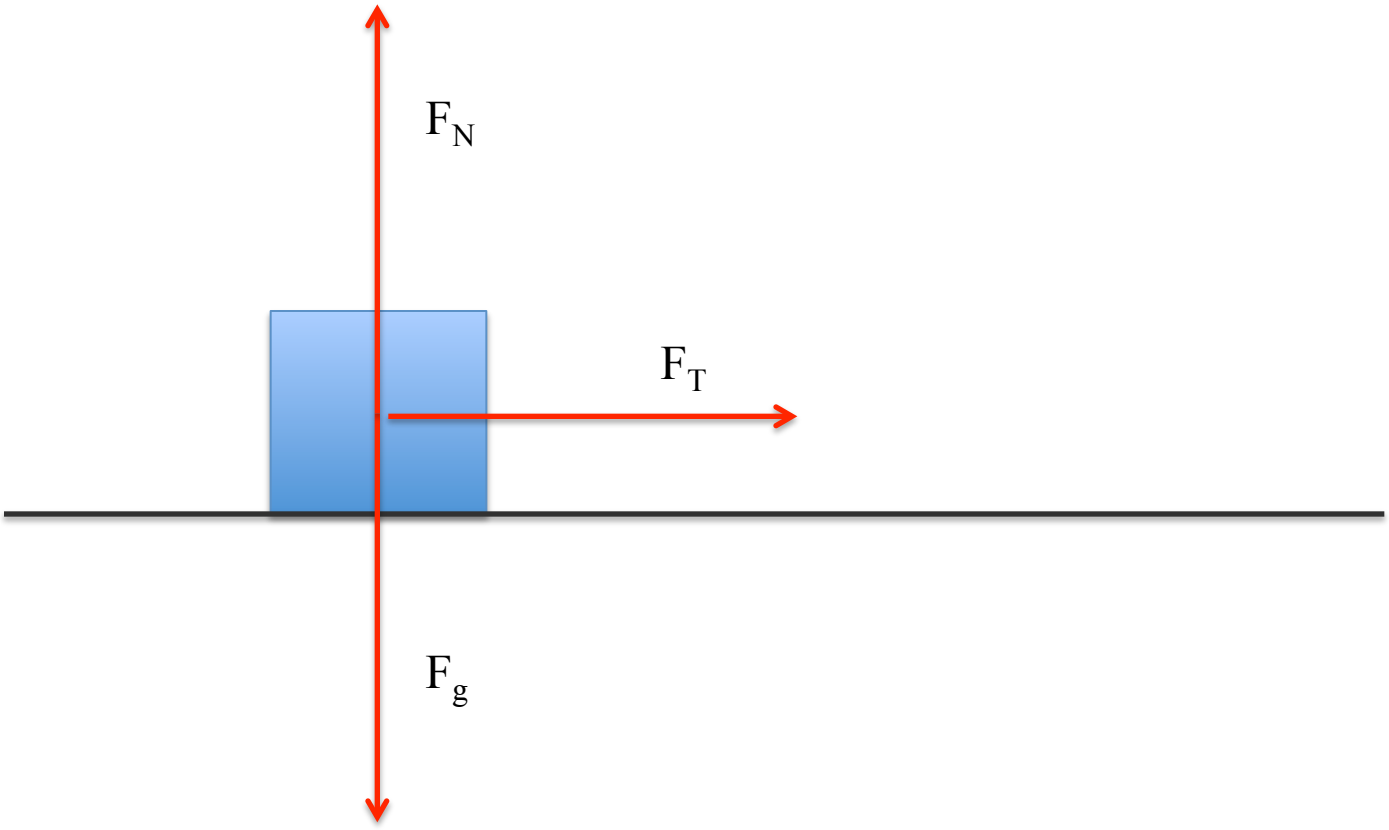
A box moving at constant velocity on a table

a=0



Free Body Diagrams

An object being pulled on a table with no friction.



Free Body Diagrams

An object being pulled on a table with friction.