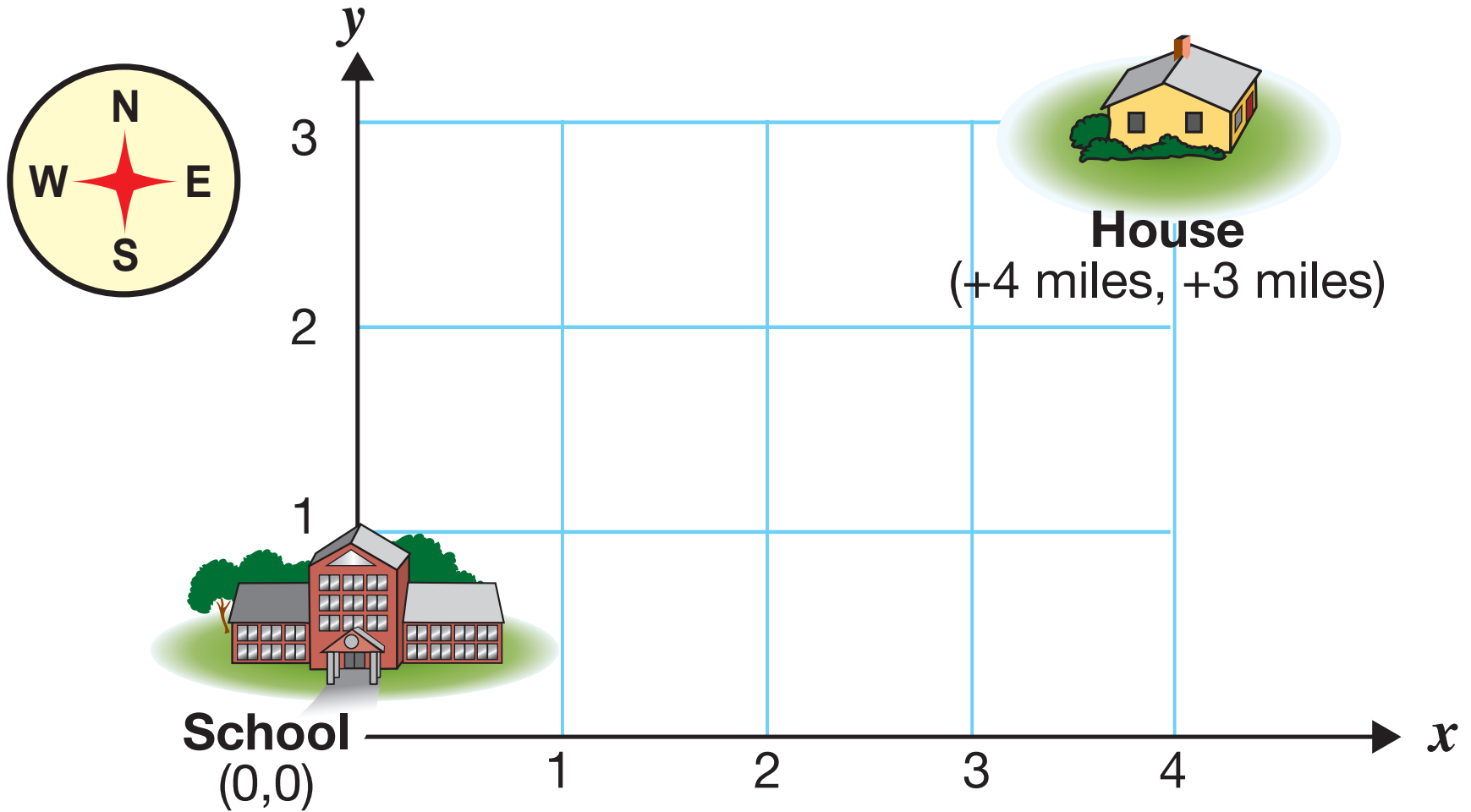


# X and Y Coordinates



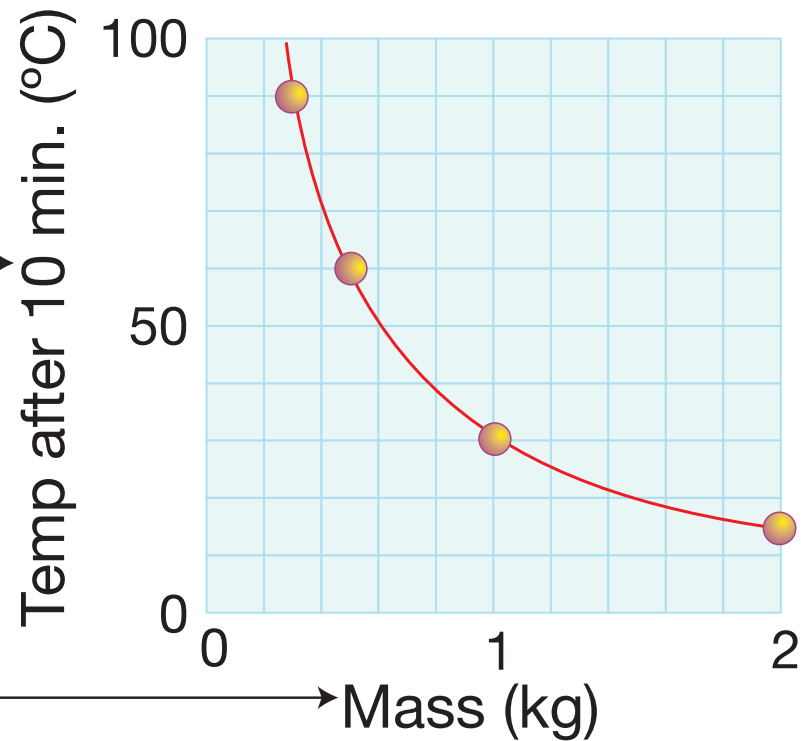
# Dependent and Independent Variables

## Dependent variable

This is the variable that **responds** to changes in the independent variable.

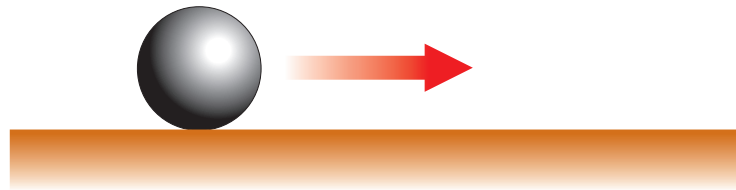
## Independent variable

This is the variable that **causes** the changes in the dependent variable.

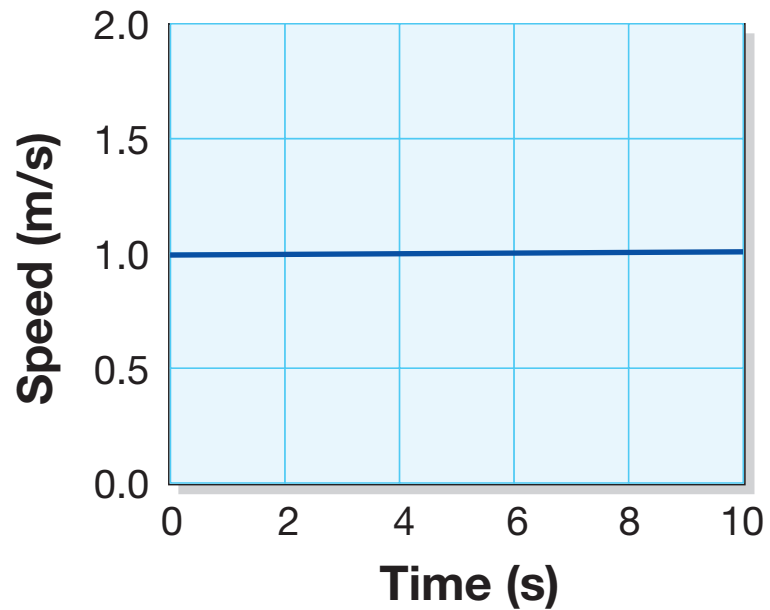


# Drawing a Speed vs. Time Graph

Constant speed

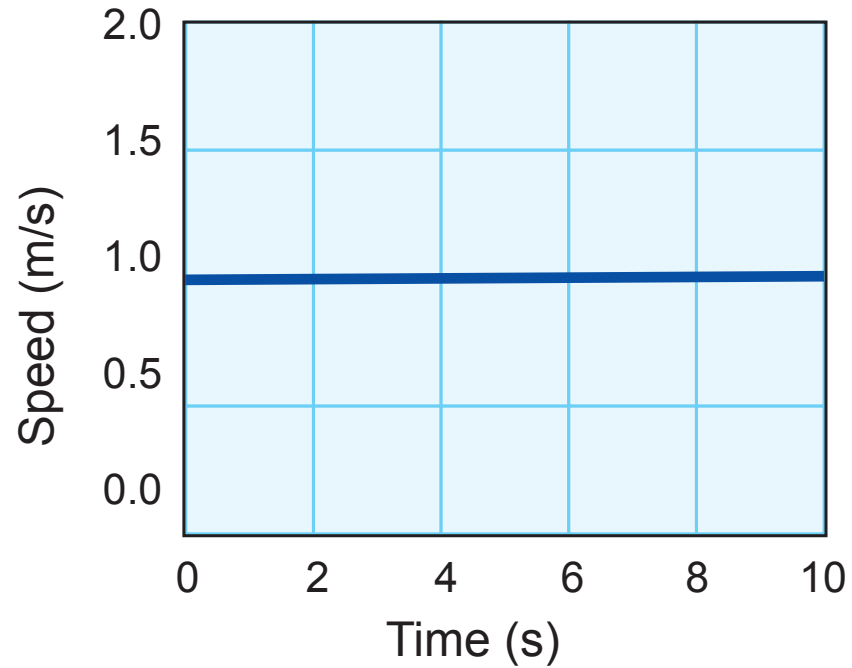


Speed vs. Time

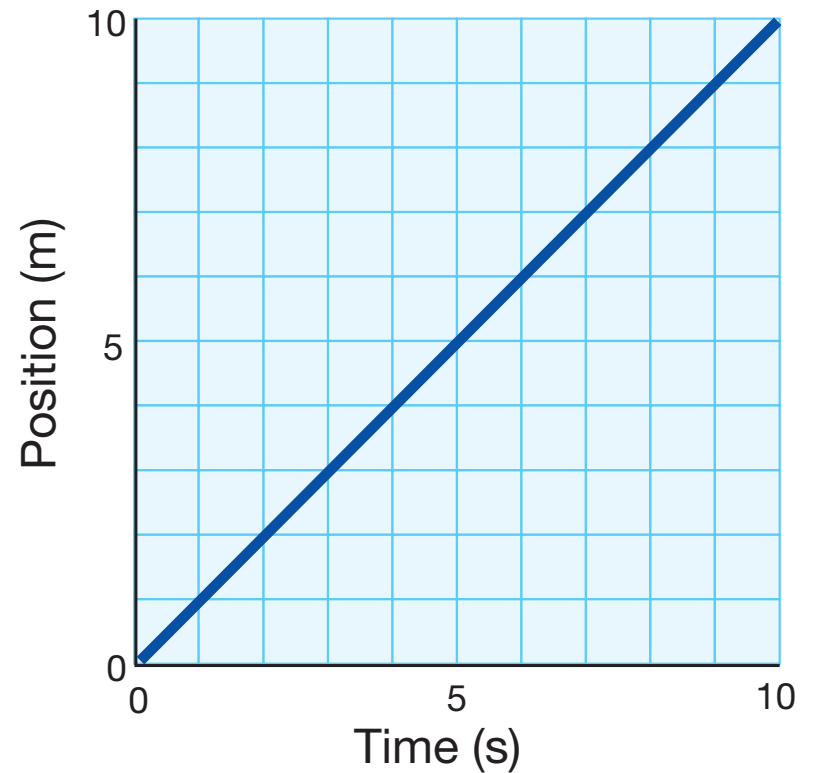


# Graphs: Speed vs. Time and Position vs. Time

## Speed vs. Time



## Position vs. Time



# Acceleration Formula

*Acceleration*  
(m/s<sup>2</sup>)

→

*Change in speed* (m/s)

$$a = \frac{v_2 - v_1}{t}$$

*t* ← *Time* (s)

# Units of Acceleration

$$\text{Acceleration} = \frac{\text{Change in speed}}{\text{Change in time}}$$

*How we get units of m/s<sup>2</sup>*

*Plug in values*

$$\frac{50 \frac{\text{m}}{\text{s}}}{\text{s}}$$

=

*Clear the compound fraction*

$$50 \frac{\text{m}}{\text{s}} \times \frac{1}{\text{s}} = 50 \frac{\text{m}}{\text{s} \times \text{s}}$$


=

*Final units*

$$50 \frac{\text{m}}{\text{s}^2}$$

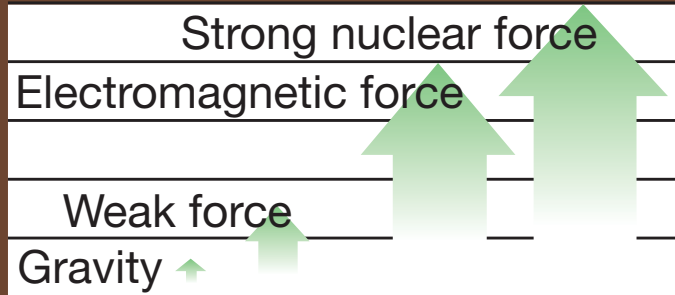
# Calculating Weight

$$\text{Weight (N)} \quad W = mg \quad \leftarrow \text{Strength of gravity (N/kg)}$$

*Mass (kg)* 

# Four Elementary Forces

## The four elementary forces



### **Strong nuclear force**

This force holds the nucleus of an atom together. This force is very strong but only reaches a very short distance.

### **Electromagnetic force**

This force acts between positive and negative charges. This force holds atoms together into molecules.

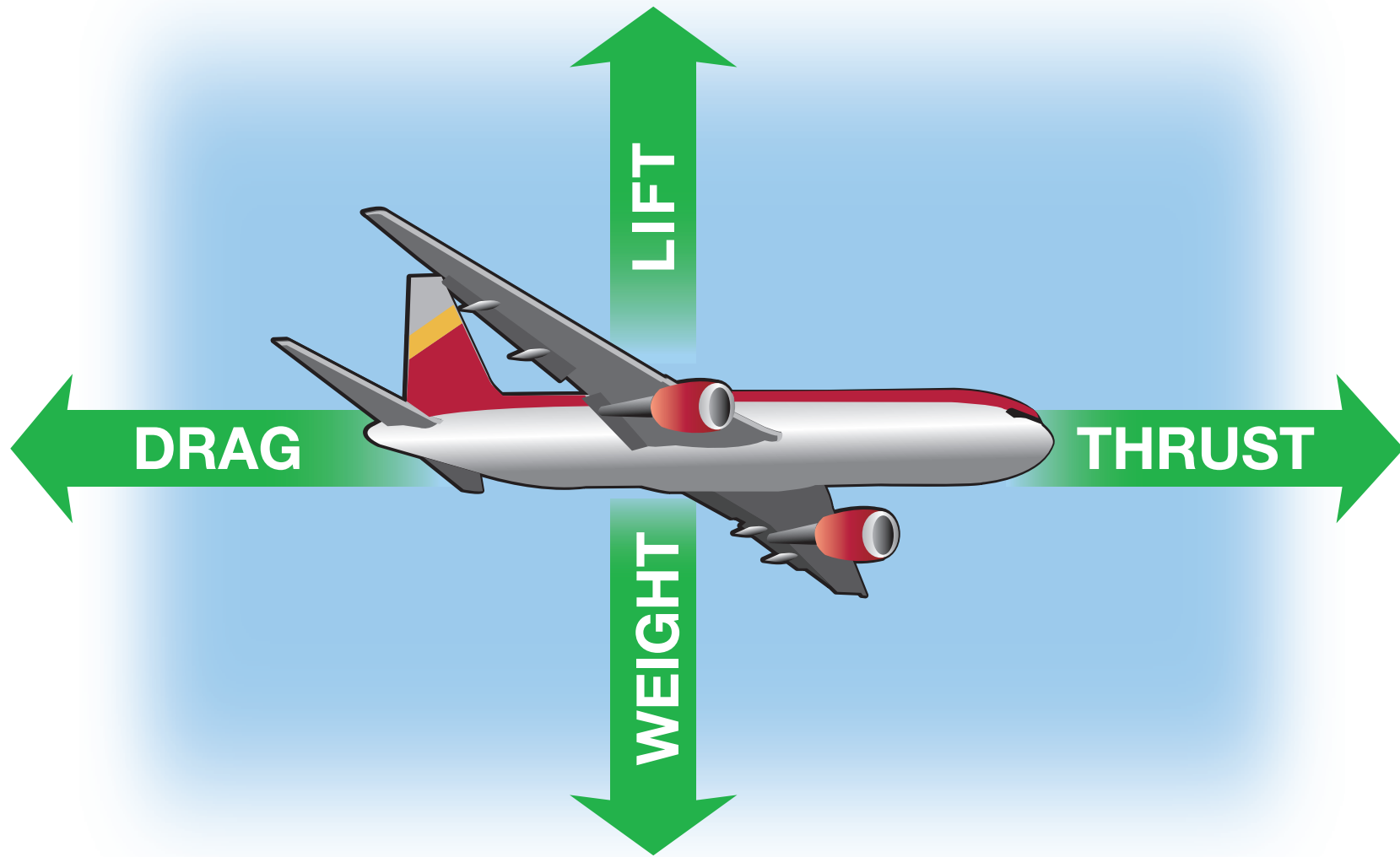
### **Weak force**

This force causes some kinds of radioactivity.

### **Gravity**

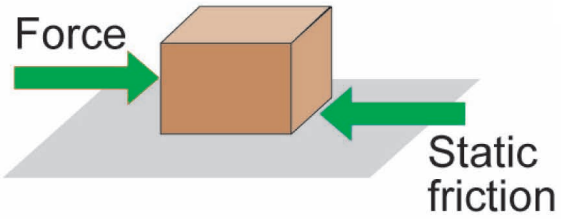
This force causes all masses to attract each other. Your weight comes from the mass of the Earth attracting the mass of your body.

# Airplane Forces

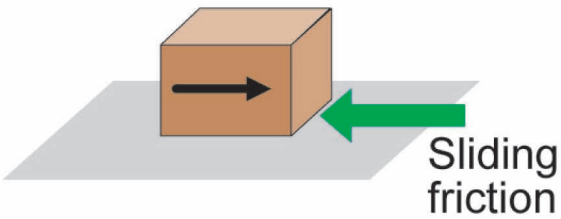


# Friction

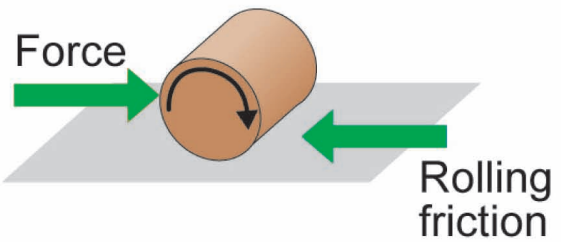
**No motion**



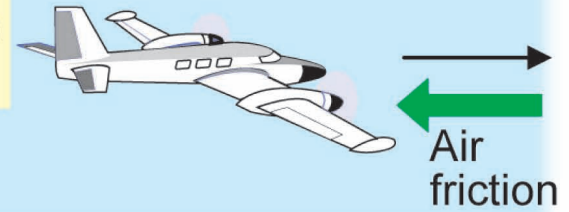
**Sliding motion**



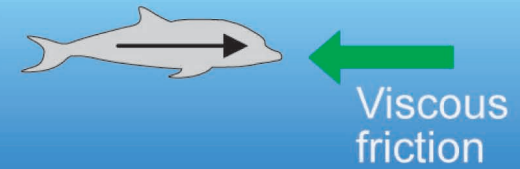
**Rolling motion**



**Motion through air**

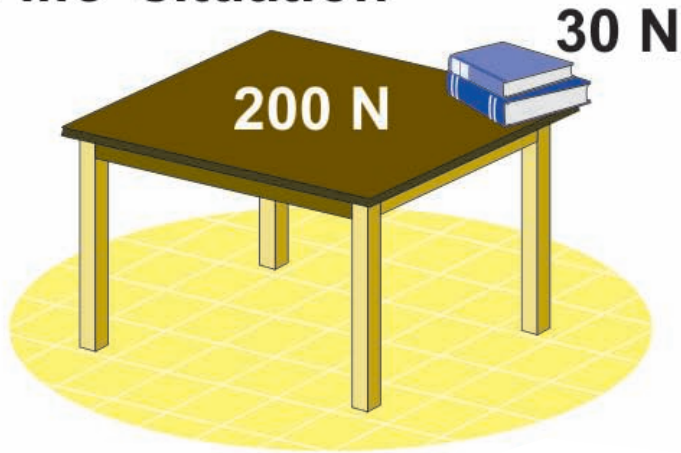


**Motion through water**

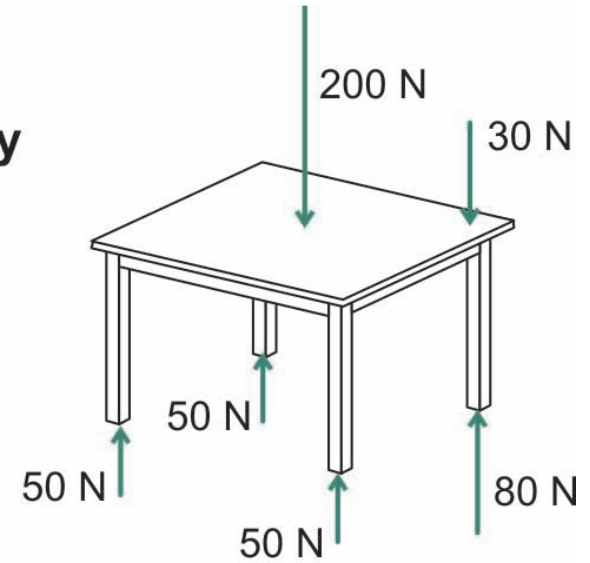


# Free-body diagram

Real-life situation



Free-body diagram



Equilibrium (net force = 0)

