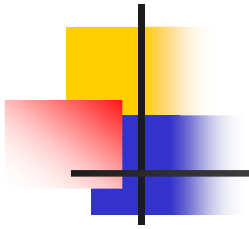


Relative Velocity

- Relative velocity is about relating the measurements of two different observers
- It may be useful to use a moving frame of reference instead of a stationary one
- It is important to specify the frame of reference, since the motion may be different in different frames of reference
- There are no specific equations to learn to solve relative velocity problems

Relative Velocity Notation

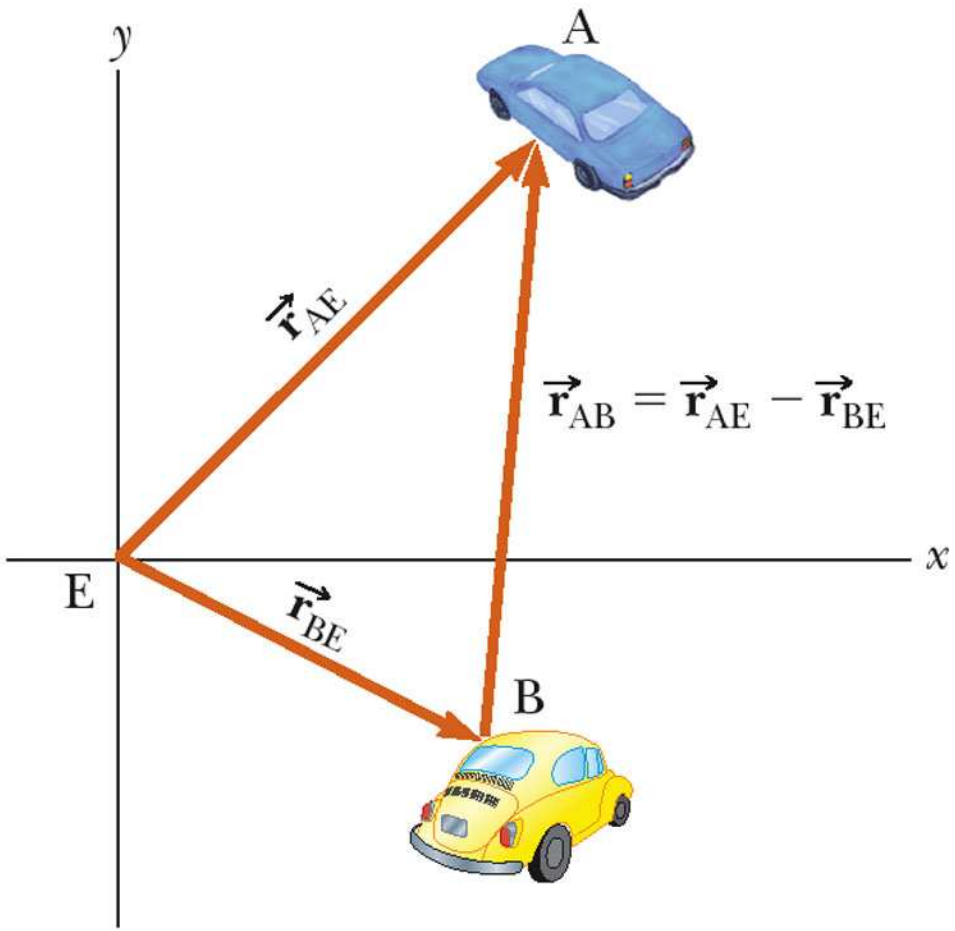
- The pattern of subscripts can be useful in solving relative velocity problems
- Assume the following notation:
  - E is an observer, stationary with respect to the earth
  - A and B are two moving cars

Relative Position Equations

- $\vec{\mathbf{r}}_{AE}$ is the position of car A as measured by E
- $\vec{\mathbf{r}}_{BE}$ is the position of car B as measured by E
- $\vec{\mathbf{r}}_{AB}$ is the position of car A as measured by car B
- $\vec{\mathbf{r}}_{AB} = \vec{\mathbf{r}}_{AE} - \vec{\mathbf{r}}_{EB}$

Relative Position

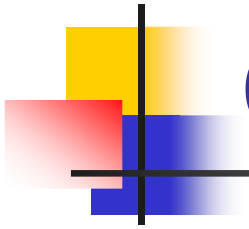
- The position of car A relative to car B is given by the vector subtraction equation



Relative Velocity Equations

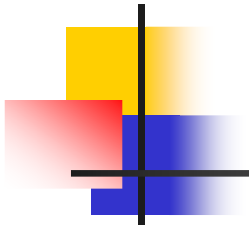
- The rate of change of the displacements gives the relationship for the velocities

$$\vec{\mathbf{v}}_{AB} = \vec{\mathbf{v}}_{AE} - \vec{\mathbf{v}}_{EB}$$



Classical Mechanics

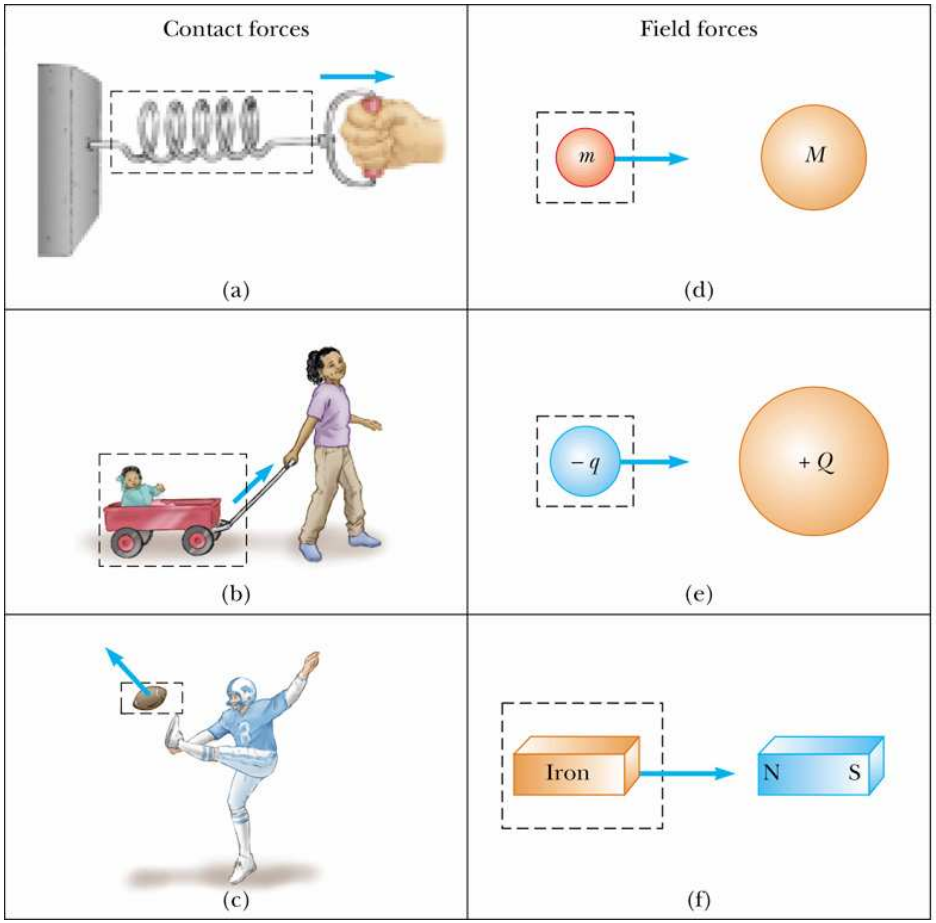
- Describes the relationship between the motion of objects in our everyday world and the forces acting on them
- Conditions when Classical Mechanics does not apply
  - very tiny objects (< atomic sizes)
  - objects moving near the speed of light

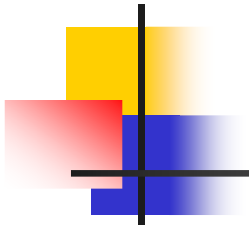


Forces

- Usually think of a force as a push or pull
- Vector quantity
- May be a **contact force** or a **field force**
  - Contact forces result from physical contact between two objects
  - Field forces act between disconnected objects
    - Also called “action at a distance”

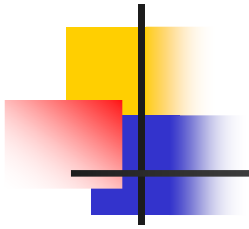
Contact and Field Forces





Fundamental Forces

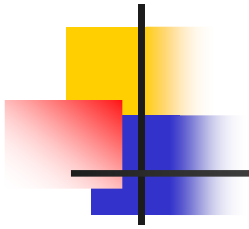
- Types
  - Strong nuclear force
  - Electromagnetic force
  - Weak nuclear force
  - Gravity
- Characteristics
  - All field forces
  - Listed in order of decreasing strength
  - Only gravity and electromagnetic in mechanics



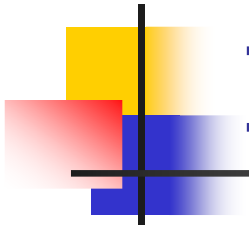
Newton's First Law

- An object moves with a velocity that is constant in magnitude and direction, unless acted on by a nonzero net force
  - The net force is defined as the vector sum of all the external forces exerted on the object

External and Internal Forces



- External force
  - Any force that results from the interaction between the object and its environment
- Internal forces
  - Forces that originate within the object itself
  - They cannot change the object's velocity



Inertia

- Is the tendency of an object to continue in its original motion

Mass

- A measure of the resistance of an object to changes in its motion due to a force
- Scalar quantity
- SI units are kg