

Displacement and velocity

(kinematics in one dimension)

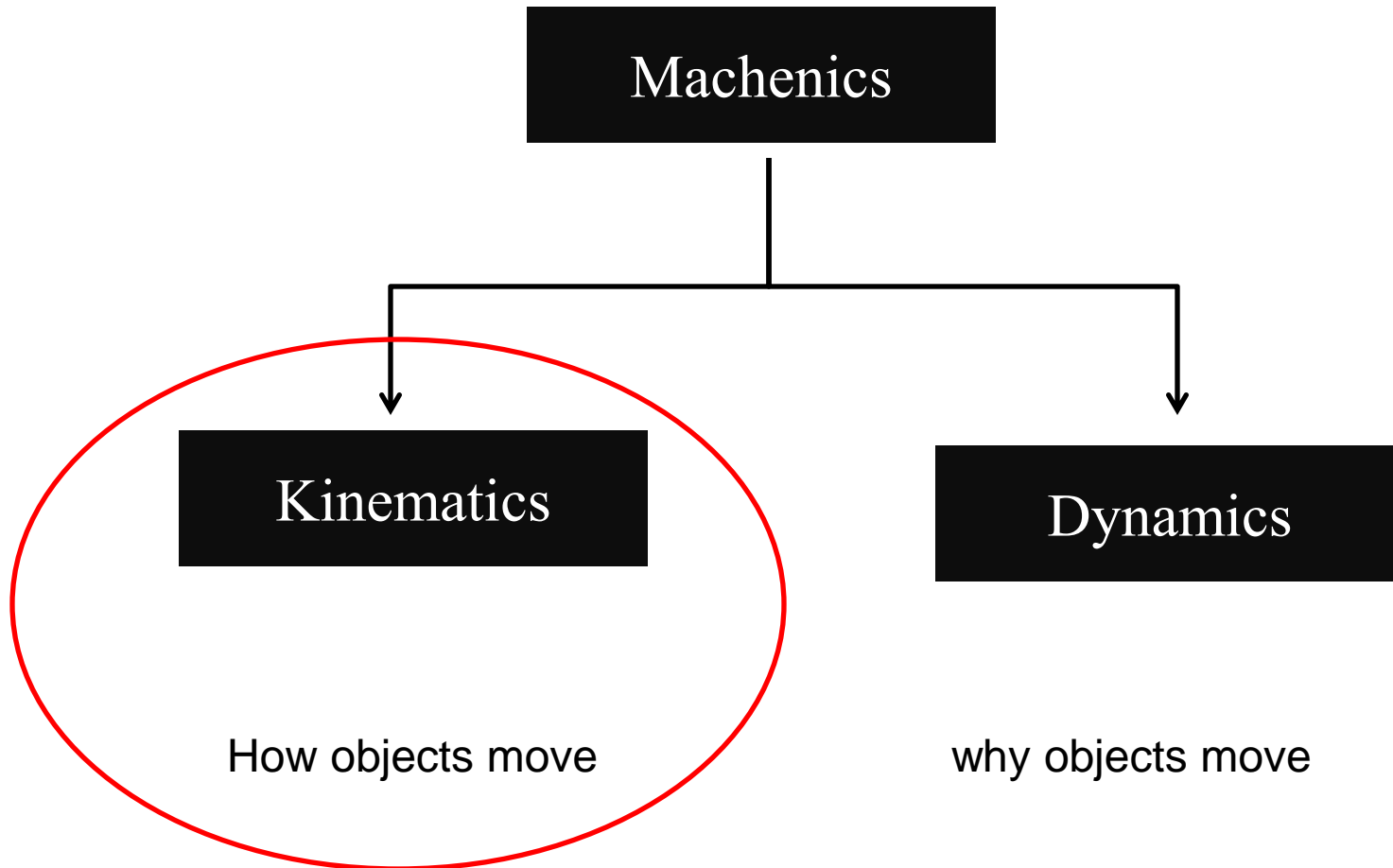
Introduction

- The motion of object- automobiles, train, even the Sun and Moon-is an obvious part of everyday life.

Introduction

- But our understanding of motion was not established until the 16th and 17th centuries.
- Many individuals contributed to this understand, particularly Galilei (1564-1642) and Isaac Newton (1642-1727).
- The study of the motion of objects, and the related concepts of force and energy, form the field called **Mechanics**.

Introduction

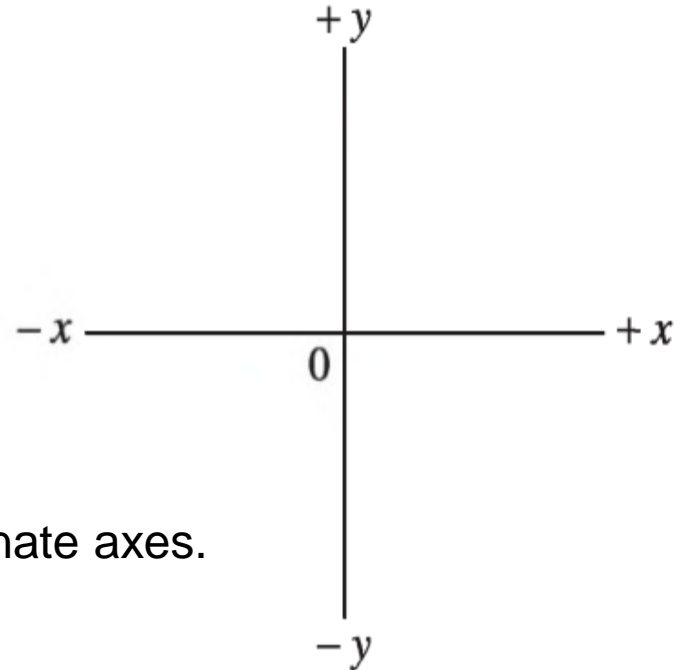


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Displacement

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For one-dimensional motion, we often choose the x axis as the line along which the motion takes place. Then the **position** of an object at any moment is given by x coordinate.



Standard set of xy coordinate axes.

Displacement

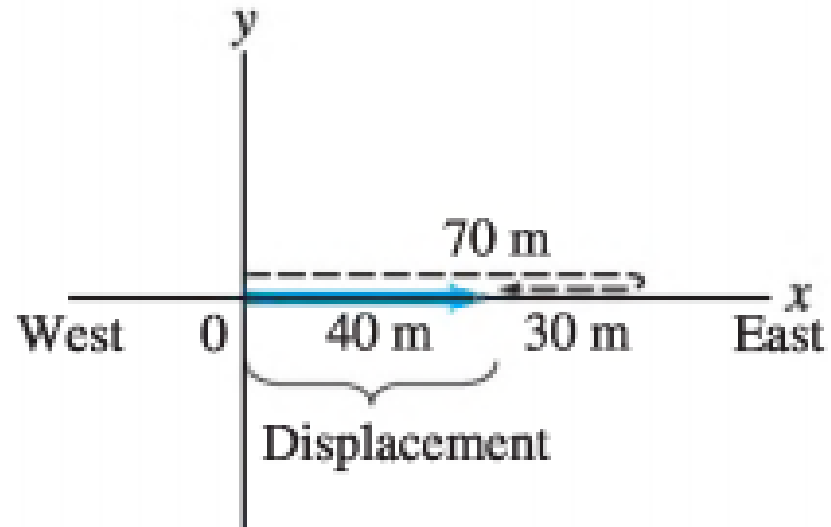
(kinematics in one dimension)

Firstly, we need to make a distinction between the **distance** an object has traveled and its **displacement**.

Example: imagine a student walking 70 m to the east and then walking back to the west a distance of 30 m (see figure).

The total distance: 100 m.

The displacement: 40 m.



Displacement

(kinematics in one dimension)

Displacement:

Displacement is how far the object is from its starting point (change in position).

Displacement is a quantity that has both magnitude and direction, it is called vector.

Displacement

(kinematics in one dimension)

Consider the motion of an object over a particular time interval. Suppose that at initial time, t_1 , it's position is x_1 . At some later time, t_2 , the object move to position x_2 . The displacement is written:

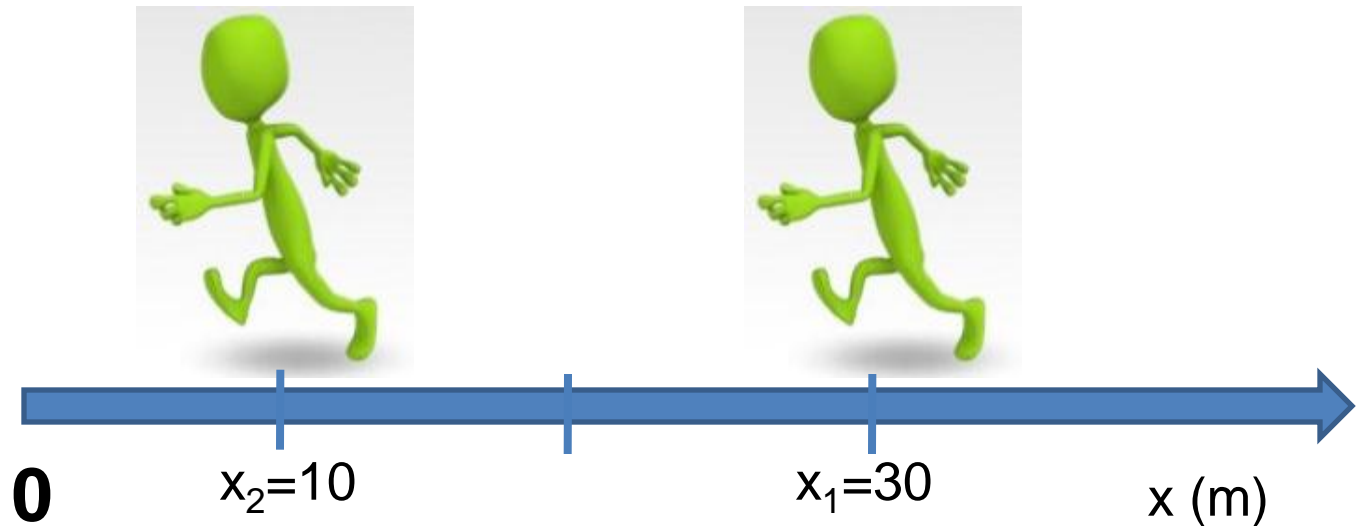
$$\Delta x = x_2 - x_1$$

Displacement

(kinematics in one dimension)

Example: A person starts at $x_1=30$ m and walks to the left to the point $x_2=10$ m. what is the person's displacement and total distance traveled?

Answer:



Average Velocity

(kinematics in one dimension)

The most obvious aspect of the motion of a moving object is how fast it is moving---its speed or velocity.

Average Speed: how far an object travels in a given time interval. In general, the average speed of a object is defined as **The total distance traveled along its path divided by the time it takes to travel distance.**

$$\textit{average speed} = \frac{\text{distance traveled}}{\text{time elapsed}} \quad (\text{m/s})$$

Average Velocity

(kinematics in one dimension)

Velocity: the average velocity of a object is defined as:

$$\textit{average velocity} = \frac{\textit{displacement}}{\textit{time elapsed}}$$

$$\bar{v} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

Average Velocity

(kinematics in one dimension)

Example: A runner walking 70 m to the east and then walking back to the west a distance of 30 m . Suppose this walk took 70 s to complete. What was the runner's average speed and average velocity?