

January 18, Week 1

Today: Chapter 2, Position and Average Velocity

Homework Assignment #1 - Due Today

Mastering Physics: 9 Introductory Questions About Mastering Physics.

Written Question: None

Homework Assignment #2 - Due January 25

Mastering Physics: 6 problems from chapters 1 and 2.

Written Question: 2.75

No class on Monday. Next reading quiz due Tuesday, January 22.

Special Announcement

THE OFFICE OF ACCESSIBILITY RESOURCE CENTER IS LOOKING FOR A STUDENT IN THIS CLASS TO VOLUNTEER TO PROVIDE NOTES FOR THIS CLASS. THE STUDENT WILL BE PAID A STIPEND FOR THE SEMESTER. INTERESTED STUDENT SHOULD COME BY OUR OFFICE AT 2021 MESA VISTA HALL TO COMPLETE THE REQUIRED HIRING PAPERWORK.

S. I. Units

To compare physical quantities, everyone must use the same system of units.

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).
- There are three fundamental units/measurements in S. I.

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).
- There are three fundamental units/measurements in S. I.
 - ◆ Unit of length

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).
- There are three fundamental units/measurements in S. I.
 - ◆ Unit of length = meter (m)

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).

- There are three fundamental units/measurements in S. I.
 - ◆ Unit of length = meter (m)

 - ◆ Unit of mass

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).

- There are three fundamental units/measurements in S. I.
 - ◆ Unit of length = meter (m)

 - ◆ Unit of mass = kilogram (kg)

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).

- There are three fundamental units/measurements in S. I.
 - ◆ Unit of length = meter (m)
 - ◆ Unit of mass = kilogram (kg)
 - ◆ Unit of time

S. I. Units

To compare physical quantities, everyone must use the same system of units.

- Physics uses the S. I. system (Système International D'unités).

- There are three fundamental units/measurements in S. I.
 - ◆ Unit of length = meter (m)
 - ◆ Unit of mass = kilogram (kg)
 - ◆ Unit of time = second (s)

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

- Unit of length

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

- Unit of length = foot (*ft*)

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

- Unit of length = foot (*ft*)
- Unit of weight

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

- Unit of length = foot (*ft*)
- Unit of weight = Pound (*lb*)

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

- Unit of length = foot (*ft*)
- Unit of weight = Pound (*lb*)
- Unit of time

U. S. Customary Units

In the United States, we use the U. S. customary system or British engineering system of units in everyday life.

There are also three fundamental units in the U. S. customary.

- Unit of length = foot (*ft*)
- Unit of weight = Pound (*lb*)
- Unit of time = second (*s*)

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9
- tera (T) = 10^{12}

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9
- tera (T) = 10^{12}
- centi (c) = 0.01 = 10^{-2}

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9
- tera (T) = 10^{12}
- centi (c) = 0.01 = 10^{-2}
- mili (m) = 0.001 = 10^{-3}

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9
- tera (T) = 10^{12}
- centi (c) = 0.01 = 10^{-2}
- mili (m) = 0.001 = 10^{-3}
- micro (μ) = 10^{-6}

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9
- tera (T) = 10^{12}
- centi (c) = 0.01 = 10^{-2}
- mili (m) = 0.001 = 10^{-3}
- micro (μ) = 10^{-6}
- nano (n) = 10^{-9}

S. I. Prefixes

To make more convenient units, the S. I. system has a uniform system of prefixes that act as multipliers of powers of ten.

- kilo (k) = 1000 = 10^3
- mega (M) = 10^6
- giga (G) = 10^9
- tera (T) = 10^{12}
- centi (c) = 0.01 = 10^{-2}
- mili (m) = 0.001 = 10^{-3}
- micro (μ) = 10^{-6}
- nano (n) = 10^{-9}
- pico (p) = 10^{-12}

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

(b) 5 Ms , 3.6 ks , 1500 s

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

(b) 5 Ms , 3.6 ks , 1500 s

(c) $29\text{ }\mu\text{s}$, 3.6 ks , 5 Ms

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

(b) 5 Ms , 3.6 ks , 1500 s

(c) $29\text{ }\mu\text{s}$, 3.6 ks , 5 Ms

(d) 700 ms , 1500 s , $29\text{ }\mu\text{s}$

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

(b) 5 Ms , 3.6 ks , 1500 s

(c) $29\text{ }\mu\text{s}$, 3.6 ks , 5 Ms

(d) 700 ms , 1500 s , $29\text{ }\mu\text{s}$

(e) 700 ms , $29\text{ }\mu\text{s}$, 3.6 ks

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

(b) 5 Ms , 3.6 ks , 1500 s

(c) $29\text{ }\mu\text{s}$, 3.6 ks , 5 Ms

(d) 700 ms , 1500 s , $29\text{ }\mu\text{s}$

(e) 700 ms , $29\text{ }\mu\text{s}$, 3.6 ks

S.I. Exercise

Which of the following correctly lists time intervals from longest to shortest?

(a) 1500 s , 3.6 ks , 700 ms

(b) 5 Ms , 3.6 ks , 1500 s

(c) $29\text{ }\mu\text{s}$, 3.6 ks , 5 Ms

(d) 700 ms , 1500 s , $29\text{ }\mu\text{s}$

(e) 700 ms , $29\text{ }\mu\text{s}$, 3.6 ks

$$3.6\text{ ks} = 3.6(1000)\text{ s} = 3600\text{ s} = 1\text{ h}$$

Motion

Mechanics - Study of how and why objects move.

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

One-Dimensional Motion - Straight-line motion. The object can only go left/right or up/down.

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

One-Dimensional Motion - Straight-line motion. The object can only go left/right or up/down.

To describe motion *completely*, we need to know:

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

One-Dimensional Motion - Straight-line motion. The object can only go left/right or up/down.

To describe motion *completely*, we need to know:

- Where the object is located at every time = Position

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

One-Dimensional Motion - Straight-line motion. The object can only go left/right or up/down.

To describe motion *completely*, we need to know:

- Where the object is located at every time = Position
- How fast and in what direction the object is going at every time = Velocity

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

One-Dimensional Motion - Straight-line motion. The object can only go left/right or up/down.

To describe motion *completely*, we need to know:

- Where the object is located at every time = Position
- How fast and in what direction the object is going at every time = Velocity
- Whether the object is speeding up or slowing down at every time = Acceleration

Motion

Mechanics - Study of how and why objects move.

Kinematics - Motion without regard to how it is caused.

One-Dimensional Motion - Straight-line motion. The object can only go left/right or up/down.

To describe motion *completely*, we need to know:

- Where the object is located at every time = Position
- How fast and in what direction the object is going at every time = Velocity
- Whether the object is speeding up or slowing down at every time = Acceleration

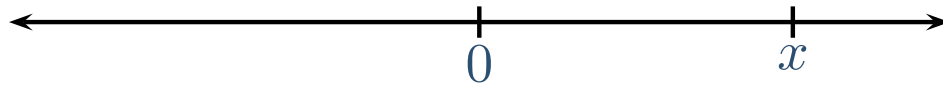
Particle Model - For now, it suffices to treat moving objects as particles \Rightarrow little dots with a single value of position.

Position

Position = How far and what direction from an origin.

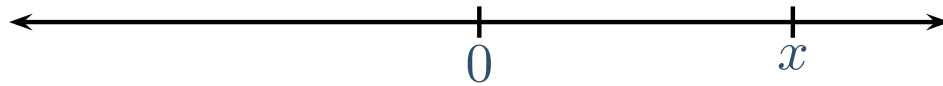
Position

Position = How far and what direction from an origin.

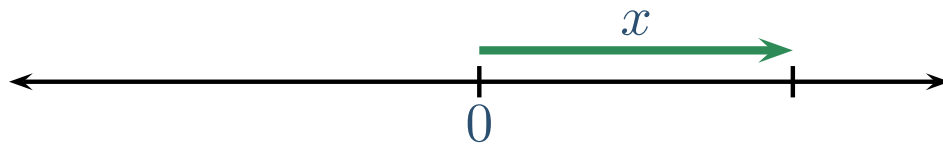


Position

Position = How far and what direction from an origin.

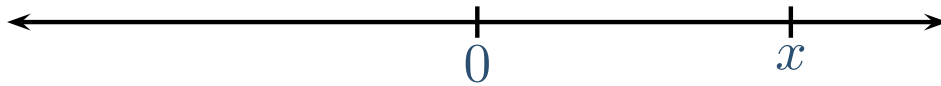


What we mean is:

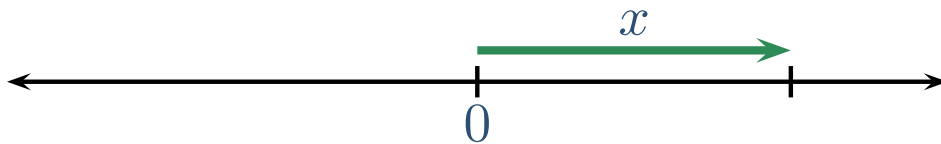


Position

Position = How far and what direction from an origin.



What we mean is:



For 1D Motion, direction is indicated by giving positive or negative values for physics quantities. The usual convention is that right = positive and left = negative or up = positive and down = negative.

Displacement

Moving objects change their position, so we introduce displacement.

Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Initial Position = x_1 ,

Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Initial Position = x_1 , Final Position = x_2

Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Initial Position = x_1 , Final Position = x_2



Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Initial Position = x_1 , Final Position = x_2

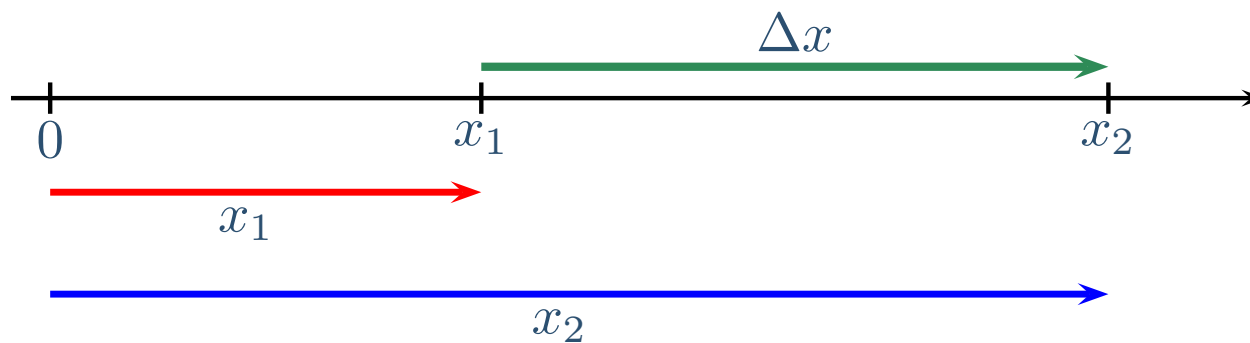


Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Initial Position = x_1 , Final Position = x_2

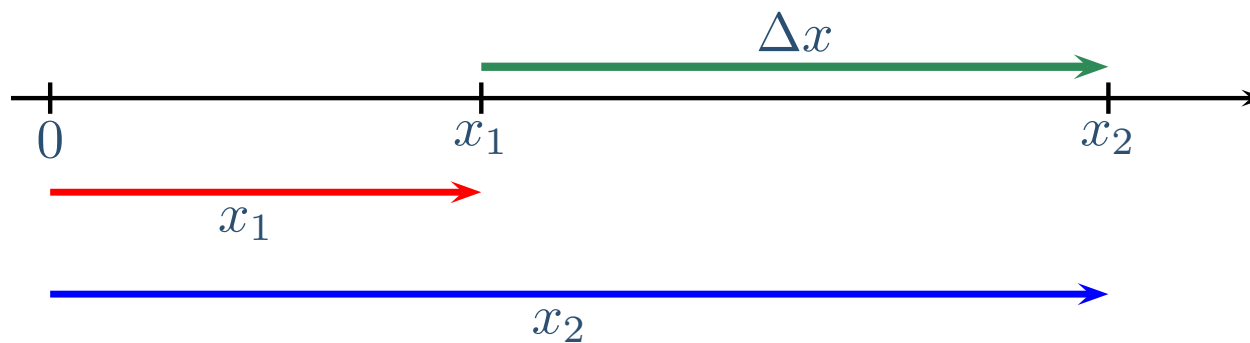


Displacement

Moving objects change their position, so we introduce displacement.

Displacement = change in position = Δx (Delta x)

Initial Position = x_1 , Final Position = x_2



$$\Delta x = x_2 - x_1$$

Distance

Distance, d = always positive number which gives how far an object has traveled.

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

(a) 39 cm

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

(a) 39 cm

(b) -39 cm

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

(a) 39 cm

(b) -39 cm

(c) 4.35 m

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

(a) 39 cm

(b) -39 cm

(c) 4.35 m

(d) -4.35 m

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

(a) 39 cm

(b) -39 cm

(c) 4.35 m

(d) -4.35 m

(e) -4 m

Displacement Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. If the eagle dives straight down and grabs the fish, what the eagle's displacement? Use the typical convention that up is positive.

(a) 39 cm

(b) -39 cm

(c) 4.35 m

(d) -4.35 m

(e) -4 m

When adding or subtracting, quantities must have the same unit

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what is the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

(a) $\Delta x = 0, d = 8.7\text{ m}$

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

(a) $\Delta x = 0, d = 8.7\text{ m}$

(b) $\Delta x = 0, d = 4.35\text{ m}$

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

(a) $\Delta x = 0, d = 8.7\text{ m}$

(b) $\Delta x = 0, d = 4.35\text{ m}$

(c) $\Delta x = 8.7\text{ m}, d = 8.7\text{ m}$

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

(a) $\Delta x = 0, d = 8.7\text{ m}$

(b) $\Delta x = 0, d = 4.35\text{ m}$

(c) $\Delta x = 8.7\text{ m}, d = 8.7\text{ m}$

(d) $\Delta x = 8.7\text{ m}, d = 0$

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

(a) $\Delta x = 0, d = 8.7\text{ m}$

(b) $\Delta x = 0, d = 4.35\text{ m}$

(c) $\Delta x = 8.7\text{ m}, d = 8.7\text{ m}$

(d) $\Delta x = 8.7\text{ m}, d = 0$

(e) $\Delta x = 0, d = 0$

Distance Exercise

An eagle is flying 4 m above a lake when it spies a fish that is 35 cm below the surface. The eagle dives straight down, grabs the fish, and then flies straight back up to where it started. For the entire trip, what the eagle's displacement Δx and distance d traveled? Use the typical convention that up is positive.

(a) $\Delta x = 0, d = 8.7\text{ m}$

(b) $\Delta x = 0, d = 4.35\text{ m}$

(c) $\Delta x = 8.7\text{ m}, d = 8.7\text{ m}$

(d) $\Delta x = 8.7\text{ m}, d = 0$

(e) $\Delta x = 0, d = 0$

Average Velocity

Faster moving objects travel farther than slower ones in a given period of time.

Average Velocity

Faster moving objects travel farther than slower ones in a given period of time.

speed = How fast

Average Velocity

Faster moving objects travel farther than slower ones in a given period of time.

speed = How fast

Average speed: $sp_{av} = \frac{\textit{distance}}{\textit{elapsed time}} = \frac{d}{\Delta t}$ $\Delta t = t_2 - t_1$

Average Velocity

Faster moving objects travel farther than slower ones in a given period of time.

speed = How fast

Average speed: $sp_{av} = \frac{\text{distance}}{\text{elapsed time}} = \frac{d}{\Delta t}$ $\Delta t = t_2 - t_1$

Units: When we multiply or divide units, we make a *new* compound unit. Here, we can use any distance and time combination. Typically, we'll use m/s = meters per second.

Average Velocity

Faster moving objects travel farther than slower ones in a given period of time.

speed = How fast

Average speed:
$$sp_{av} = \frac{\text{distance}}{\text{elapsed time}} = \frac{d}{\Delta t} \quad \Delta t = t_2 - t_1$$

Units: When we multiply or divide units, we make a *new* compound unit. Here, we can use any distance and time combination. Typically, we'll use m/s = meters per second.

velocity = How fast and the direction of motion

Average Velocity

Faster moving objects travel farther than slower ones in a given period of time.

speed = How fast

Average speed:
$$sp_{av} = \frac{\text{distance}}{\text{elapsed time}} = \frac{d}{\Delta t} \quad \Delta t = t_2 - t_1$$

Units: When we multiply or divide units, we make a *new* compound unit. Here, we can use any distance and time combination. Typically, we'll use m/s = meters per second.

velocity = How fast and the direction of motion

Average velocity:
$$v_{av} = \frac{\text{displacement}}{\text{elapsed time}} = \frac{\Delta x}{\Delta t}$$