

Motion in 1 Dimension



Physics Clicker Quizzes

Position
Displacement
Speed
Velocity

You and your dog go for a walk to the park. On the way, your dog takes many side trips to chase squirrels or examine fire hydrants. When you arrive at the park, do you and your dog have the same displacement?



Yes
No

A Yes

Yes you have the same displacement. Since you and your dog had the same initial position and the same final position, then you have (by definition) the same displacement.

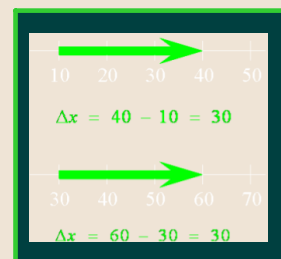
Follow-up:
Have you and your dog traveled the same distance?

Does the displacement of an object depend on the specific location of the origin of the coordinate system?

Yes
No

B No

No. Since the displacement is the **difference** between two coordinates, the origin does not matter.



If the position of a car is zero, does its speed have to be zero?



- A Yes
- B No
- C It depends on the position

B No

No, the speed does not depend on position, it depends on the **change** of position. Since we know that the displacement does not depend on the origin of the coordinate system, an object can easily start at $x = -3$ and be moving by the time it gets to $x = 0$.

Does the **odometer** in a car measure distance, displacement, or both?



- A Distance
- B Displacement
- C Both

A Distance

If you go on a long trip and then return home, your odometer does not measure zero, but it records the total miles that you traveled. That means the odometer records **distance**.

Follow-up:
How would you measure displacement in your car?

Does the **speedometer** in a car measure velocity, speed, both, or neither?



- A Velocity
- B Speed
- C Both
- D Neither

B Speed

The speedometer **clearly measures speed**, not velocity. Velocity is a vector (depends on direction), but the speedometer does not care what direction you are traveling. It only measures the magnitude of the velocity, which is the speed.

Follow-up:
How would you measure velocity in your car?

You drive for 30 minutes at 30 mi/hr and then for another 30 minutes at 50 mi/hr. What is your average speed for the whole trip?

- A MORE THAN 40 miles/hour
- B EQUAL TO 40 miles/hour
- C LESS THAN 40 miles/hour

B Equal to 40 miles/hour

It is 40 mi/hr in this case. Since the average speed is distance/time and you spend the same amount of time at each speed, then your average speed would indeed be 40 mi/hr.

You drive 4 miles at 30 mi/hr and then another 4 miles at 50 mi/hr. What is your average speed for the whole 8-mile trip?

- A MORE THAN 40 miles/hour
- B EQUAL TO 40 miles/hour
- C LESS THAN 40 miles/hour

C LESS THAN 40 miles/hour

It is not 40 mi/hr! Remember that the average speed is distance/time. Since it takes longer to cover 4 miles at the slower speed, you are actually moving at 30 mi/hr for a longer period of time! Therefore, your average speed is closer to 30 mi/hr than it is to 50 mi/hr.

Acceleration Free Fall

If the velocity of a car is non-zero ($v \neq 0$), can the acceleration of the car be zero?



- A Yes
- B No
- C Depends on the velocity

A Yes

Sure it can! An object moving with *constant* velocity has a non-zero velocity, but it has **zero acceleration** since the velocity is not changing.

When throwing a ball straight up, which of the following is true about its velocity v and its acceleration a at the highest point in its path?

- A BOTH $v = 0$ and $a = 0$
- B $v \neq 0$, but $a = 0$
- C $v = 0$, but $a \neq 0$
- D BOTH $v \neq 0$ and $a \neq 0$
- E Not really sure

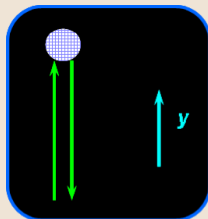


C $v = 0$, but $a \neq 0$

At the top, clearly $v = 0$ because the ball has momentarily stopped. But the velocity of the ball is *changing*, so its acceleration is **definitely not zero!**

Otherwise it would remain at rest at the top!!

Follow-up:
...and the value of a is...?



You throw a ball straight up into the air. After it leaves your hand, at what point in its flight does it have the maximum value of acceleration?

- A Its acceleration is constant everywhere
- B At the top of its trajectory
- C Halfway to the top of its trajectory
- D Just after it leaves your hand
- E Just before it returns to your hand on the way down

A Its acceleration is constant everywhere

The ball is in **free fall** once it is released. Therefore, it is entirely under the influence of gravity, and the **only acceleration it experiences is g** , which is constant at all points.

Alice and Meg are at the top of a building. Alice throws her ball downward. Meg simply drops her ball. Which ball has the greater acceleration just after release?

- A Alice's ball
- B It depends on how hard the ball was thrown
- C Neither -- they both have the same acceleration
- D Meg's ball

C Neither -- they both have the same acceleration

Both balls are in free fall once they are released, therefore they both feel the acceleration due to gravity (g). This acceleration is independent of the initial velocity of the ball.

Follow-up:

Which one has the greater velocity when they hit the ground?

You drop a rock off a bridge. When the rock has fallen 4 m, you drop a second rock. As the two rocks continue to fall, what happens to their separation?

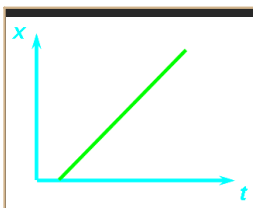
- A The separation increases as they fall
- B The separation stays constant at 4 m
- C The separation decreases as they fall
- D It is impossible to answer without more information

A The separation will increase as they fall

At any given time, the first rock always has a greater velocity than the second rock, therefore it will always be increasing its lead as it falls. Thus, the separation will increase.

Graphical Interpretation of Motion

The graph of position versus time for a car is given below. What can you say about the velocity of the car over time?



- A It speeds up all the time
- B It slows down all the time
- C It moves at constant velocity
- D Sometimes it speeds up and sometimes it slows down
- E Not really sure

C It moves at constant velocity

The car moves at a constant velocity because the x vs. t plot shows a straight line. The slope of a straight line is constant. Remember that the slope of x versus t is the velocity!

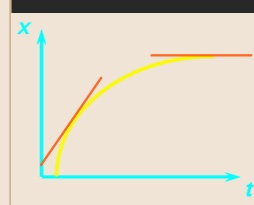
The graph of position vs. time for a car is given below. What can you say about the velocity of the car over time?



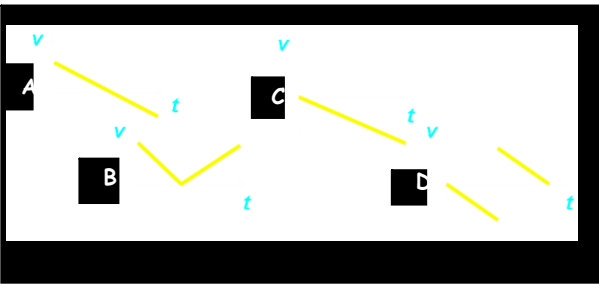
- A It speeds up all the time
- B It slows down all the time
- C It moves at constant velocity
- D Sometimes it speeds up and sometimes it slows down
- E Not really sure

B It slows down all the time

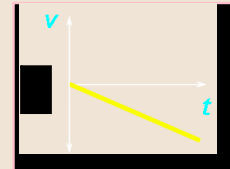
The car slows down all the time because the slope of the x vs. t graph is diminishing as time goes on. Remember that the slope of x vs. t is the velocity! At large t , the value of the position x does not change, indicating that the car must be at rest.



You drop a rubber ball. Right after it leaves your hand and before it hits the floor, which of the above plots represents the v vs. t graph for this motion? (Assume your y -axis is pointing up.)

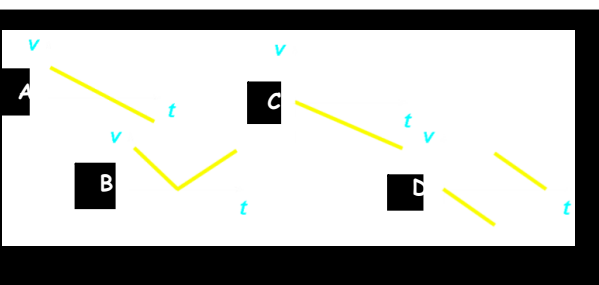


C

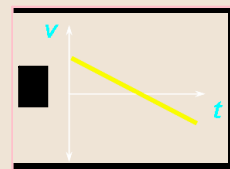


The ball is dropped from rest, so its **initial velocity is zero**. Since the y -axis is pointing upwards and the ball is falling downwards, its **velocity is negative** and becomes **more and more negative** as it accelerates downward.

You toss a ball straight up in the air and catch it again. Right after it leaves your hand and before you catch it, which of the above plots represents the v vs. t graph for this motion? (Assume your y -axis is pointing up.)



A



The ball has an **initial velocity that is positive** but diminishing as it slows. It stops at the top ($v = 0$), and then its **velocity becomes negative** and becomes **more and more negative** as it accelerates downward.

Follow-up:
 Which graph represents a ball dropped from rest from your hand, striking the floor and then bouncing back up?