

Velocity is a vector measuring the rate at which an object's position changes with time. It gives both direction (through its sign) and magnitude in the size of the value associated with it. The magnitude of velocity is what we call *speed* and is typically written,  $\text{speed} = |v|$ . Therefore, when we speak about speed we ignore the direction an object is moving in and focus only on how quickly its distance is changing with time.

Similarly, displacement is a vector, concerned with location relative to a particular starting point, while distance is concerned not with the position of the end result but with the ground traveled in getting there.

The problems below give some opportunities to develop your insight with velocity and speed.

1. The velocity of an African Swallow (in feet per second) as it flies north-south, is shown in the graph below. Use the graph to answer the following questions.

(a) What is the maximum velocity of the bird on this interval?

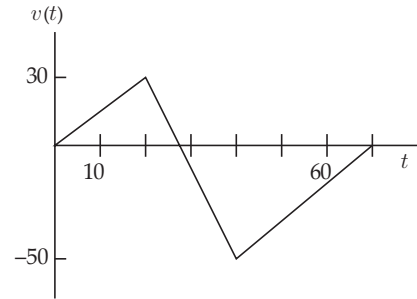
(b) What is the maximum speed of the bird on this interval?

(c) How has the Swallow's position changed over the first 70 seconds relative to its starting position? (Think displacement)

(d) How far has the bird traveled over the first 70 seconds?

(e) What is the average velocity of the bird over this interval?

(f) What is the average speed of the bird over this interval?



2. The velocity of a bicycle (in miles per hour) as it rides east-west, is shown in the graph below. Use the graph to answer the following questions.

(a) What is the average velocity of the bike over the first 6 hours?

(b) What is the average speed of the bike over the first 6 hours?

(c) Discuss the displacement of the bicycle versus the total distance it has traveled over the first 6 hours.

