More about Velocity and Speed

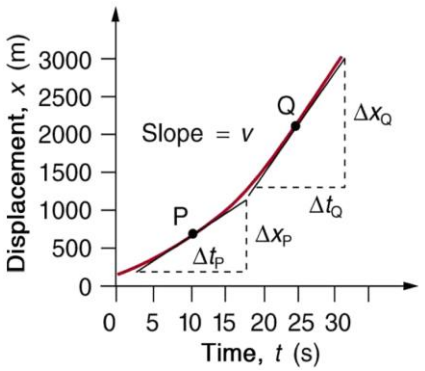
- Velocity is the _____ of a distance vs time graph.

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x - x_0}{t - t_0}$$

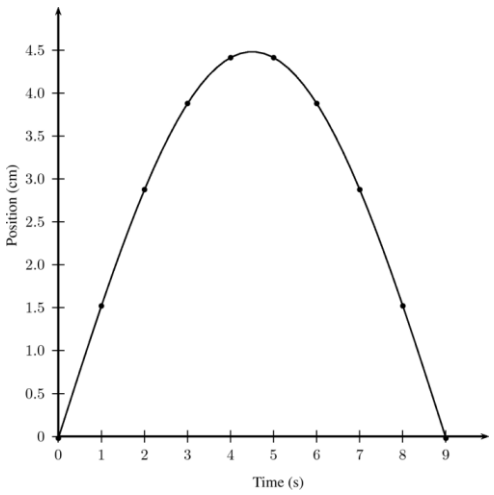
- Often this is rewritten as

$$x = \bar{v}t + x_0$$

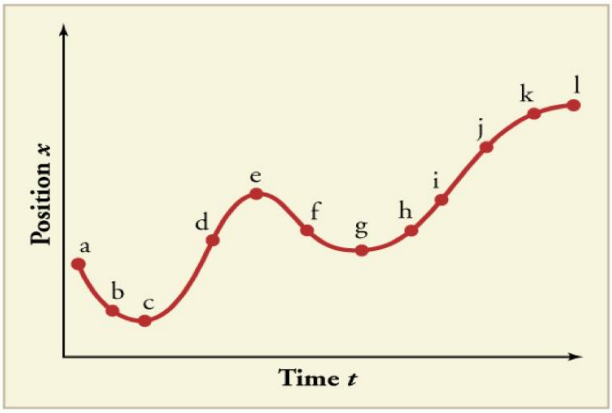
- If the graph is not a _____ line, then use the slope of a _____ line drawn to that point.
- Velocity is a vector (has direction) $v = \frac{displacement}{time}$
- Speed is a scalar (no direction) $v = \frac{distance}{time}$
- Units of both are m/s



The graph shows the height of a ball thrown straight up vs time. Find the velocity of the ball at 2 seconds.



(a) Sketch a graph of velocity–time corresponding to the graph of displacement–time given in the graph. (b) Identify the time or times (etc.) at which the instantaneous velocity is greatest. (c) At which times is it zero? (d) At which times is it negative?



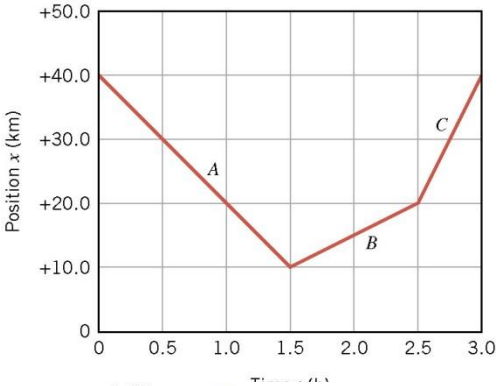
Physics 01-03 Velocity and Graphs **Name: _____**

The spine-tailed swift is the fastest bird in powered flight. On one flight, a particular bird flies 306 m east, then turns around and flies 406.5 m back west. This flight takes 15 s. What is the bird's average velocity?

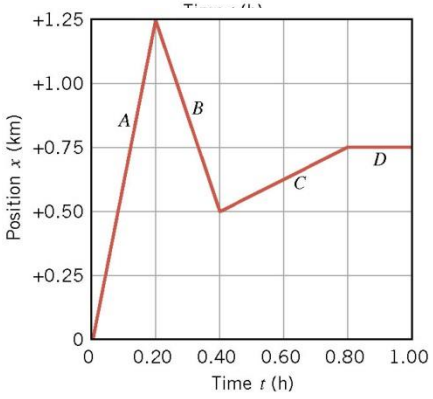
Average speed?

Which of these would we use to say how fast the bird is?

Homework



1. What is the meaning of obtaining a negative velocity?
2. (a)Draw a quick sketch of position–time graph of a ball being thrown up so that it goes up, then comes back down. (b) Describe the graph using mathematical terms.
3. A bus makes a trip according to the position–time graph shown in the drawing. What is the average velocity (magnitude and direction) of the bus during each of the segments labeled A, B, and C? Express your answers in km/h. (Cutnell 2.48)
   -20 km/h, 10 km/h, 40 km/h



4. A person who walks for exercise produces the position–time graph given with this problem. (a) Without doing any calculations, decide which segments of the graph (A, B, C, or D) indicate positive, negative, and zero average velocities. (b) Calculate the average velocity for each segment to verify your answers to part (a). (Cutnell 2.60) **6.3 km/h, -3.8 km/h, 0.63 km/h, 0 km/h**
5. What is the difference between speed and velocity?
6. (a) Does a car's odometer measure distance or displacement? (b) Does its speedometer measure speed or velocity?
7. If you divide the total distance traveled on a car trip (as determined by the odometer) by the time for the trip, (a) are you calculating the average speed or the magnitude of the average velocity? (b) Under what circumstances are these two quantities the same?
8. Land west of the San Andreas fault in southern California is moving at an average velocity of about 6 cm/y northwest relative to land east of the fault. Los Angeles is west of the fault and may thus someday be at the same latitude as San Francisco, which is east of the fault. How far in the future will this occur if the displacement to be made is 590 km northwest, assuming the motion remains constant? (OpenStax 2.8) **1×10^7 yrs**
9. Conversations with astronauts on the lunar surface were characterized by a kind of echo in which the earthbound person's voice was so loud in the astronaut's space helmet that it was picked up by the astronaut's microphone and transmitted back to Earth. It is reasonable to assume that the echo time equals the time necessary for the radio wave to travel from the Earth to the Moon and back (that is, neglecting any time delays in the electronic equipment). Calculate the distance from Earth to the Moon given that the echo time was 2.56 s and that radio waves travel at the speed of light (3.00×10^8 m/s). (OpenStax 2.13) **384,000 km**
10. A football quarterback runs 15.0 m straight forward 2.50 s. He is then hit and pushed 3.00 m straight backward in 1.75 s. He breaks the tackle and runs straight forward another 21.0 m in 5.20 s. Calculate his average velocity (a) for each of the three intervals and (b) for the entire motion. (OpenStax 2.14) **6.00 m/s, -1.71 m/s, 4.04 m/s, 3.49 m/s**
11. As the Earth rotates through one revolution, a person standing on the equator traces out a circular path whose radius is equal to the radius of the earth (6.38×10^6 m). What is the average speed of this person in meters per second? Miles per hour? (Cutnell 2.5) **464 m/s, 1040 mph**