1. Honeybee & Hive [414200]

A honeybee leaves the hive, flies in a straight line to a flower 5 km away in 15 min, and then takes 15 minutes to return (also in a straight line).

a.) Please find the distance travelled and displacement for the entire trip:
distance travelled: \[10\] km
displacement: \[0\] km

b.) Please find the average speed and average velocity for the entire trip:
average speed: \[0.333\] km/min
average velocity: \[0\] km/min

c.) If the bee had not flown in a straight line— but instead with an unknown motion— to the flower and back, which could not be determined: the average speed or average velocity? Explain.

The average speed could not be determined. Because the total length of travel (distance) is unknown for non-straight line motion. But the displacement are not related to the detail motion. It is determined by the initial and final positions. So the average velocity is not changed and can still be determined.

3. Walker3 2.P.020. [544535]

You drive in a straight line at 16.0 m/s for 10.0 miles, then at 30.0 m/s for another 10.0 miles.

(a) How does your average speed compare with 23.0 m/s?
- \(\bigcirc\) \(v_{avg} = 23.0\) m/s
- \(\bigcirc\) \(v_{avg} > 23.0\) m/s
- \(\bigcirc\) \(v_{avg} < 23.0\) m/s

Explain.

See textbook page 20, Conceptual checkpoint 2-1.

Key: Because you must drive for a longer time at the lower speed to travel the same distance, your average speed is less than 23.0 m/s

(b) Verify your answer to part (a) by calculating the average velocity.

\[20.9\] m/s
20. **Picture the Problem**: You travel in a straight line at two different speeds during the specified time interval.

**Strategy**: Determine the average speed by first calculating the total distance traveled and then dividing it by the time elapsed.

**Solution**: 1. (a) The distance intervals are the same but the time intervals are different. You will spend more time at the lower speed than at the higher speed. Since the average speed is a time weighted average, it will be less than 25.0

\[ s_{av} = \frac{d_1 + d_2}{\Delta t_1 + \Delta t_2} = \frac{d_1 + d_2}{s_1 + s_2} = \frac{20.0 \text{ mi}}{\left( \frac{10.0 \text{ mi}}{20.0 \text{ m/s}} + \frac{10.0 \text{ mi}}{30.0 \text{ m/s}} \right)} \]

\[ s_{av} = 24.0 \text{ m/s} \]

**Insight**: Notice that in this case it is not necessary to convert miles to meters in both the numerator and denominator because the units cancel out and leave m/s in the numerator.

4. **Walker3 2.P.029. [544572]**

At the starting gun, a runner accelerates at 1.3 m/s² for 5.0 s. The runner's acceleration is zero for the rest of the race.

(a) What is the speed of the runner at \( t = 0.6 \text{ s} \)?

\[ 0.78 \text{ m/s} \]

(b) What is the speed of the runner at the end of the race?

\[ 6.5 \text{ m/s} \]

29. **Picture the Problem**: The runner accelerates uniformly along a straight track.

**Strategy**: The change in velocity is the average acceleration multiplied by the elapsed time.

**Solution**: 1. (a) Multiply the acceleration by the time:

\[ v = v_0 + at = 0 \text{ m/s} + (1.9 \text{ m/s}^2)(2.0 \text{ s}) = 3.8 \text{ m/s} \]

2. (b) Multiply the acceleration by the time:

\[ v = v_0 + at = 0 \text{ m/s} + (1.9 \text{ m/s}^2)(5.2 \text{ s}) = 9.9 \text{ m/s} \]

**Insight**: World class sprinters have top speeds over 10 m/s, so this athlete isn't bad, but it took him a whole 5.2 seconds to get up to speed. He should work on his acceleration!
5. Walker 3.2.031. [544670]

A car is traveling due north at 22.0 m/s.

(a) Find the velocity of the car after 5.00 s if its acceleration is 1.60 m/s\(^2\) due north

(b) Find the velocity of the car after 5.00 s if its acceleration is instead 1.95 m/s\(^2\) due south.

31. **Picture the Problem:** The car travels in a straight line due north, either speeding up or slowing down, depending upon the direction of the acceleration.

**Strategy:** Use the definition of acceleration to determine the final velocity over the specified time interval.

**Solution:**

1. (a) Evaluate equation 2-7 directly: \(v = v_0 + at = 18.1 \text{ m/s} + (1.30 \text{ m/s}^2)(7.50 \text{ s}) = 27.9 \text{ m/s north}\)

2. (b) Evaluate equation 2-7 directly: \(v = v_0 + at = 18.1 \text{ m/s} + (-1.15 \text{ m/s}^2)(7.50 \text{ s}) = 9.48 \text{ m/s north}\)

**Insight:** In physics we almost never talk about deceleration. Instead, we call it *negative acceleration*. In this problem south is considered the negative direction, and in part (b) the car is slowing down or undergoing negative acceleration.
6. **Walker3 2.P.021. [544684]**

An expectant father paces back and forth, producing the position-versus-time graph shown in Figure 2-29. (The horizontal axis is marked in increments of 3 s, and the vertical axis is marked in increments of 2 m.)

![Position-Time Graph](image)

**Figure 2-29**

Without performing a calculation, indicate whether the father's velocity is positive, negative, or zero during the segments of the graph labeled A, B, C, and D.

(a) velocity during A is [Select] [positive]
(b) velocity during B is [Select] [zero]
(c) velocity during C is [Select] [positive]
(d) velocity during D is [Select] [negative]

Calculate the numerical value of the father's velocity for the following segments. Your results should verify your answers to part (a)-(d).

- (e) during A: 1.33 m/s
- (f) during B: 0 m/s
- (g) during C: 0.667 m/s
- (h) during D: -1 m/s
21. **Picture the Problem:** Following the motion specified in the position-versus-time graph, the father walks forward, stops, walks forward again, and then walks backward.

**Strategy:** Determine the direction of the velocity from the slope of the graph. Then determine the magnitude of the velocity by calculating the slope of the graph at each specified point.

**Solution:** (a) The slope at A is positive so the velocity is positive. (b) The velocity at B is zero. (c) The velocity at C is positive. (d) The velocity at D is negative.

2. (e) Find the slope of the graph at A:
   \[ v_\text{A} = \frac{\Delta x}{\Delta t} = \frac{2.0 \text{ m}}{1.0 \text{ s}} = 2.0 \text{ m/s} \]

3. (f) Find the slope of the graph at B:
   \[ v_\text{B} = \frac{\Delta x}{\Delta t} = \frac{0.0 \text{ m}}{1.0 \text{ s}} = 0.0 \text{ m/s} \]

4. (g) Find the slope of the graph at C:
   \[ v_\text{C} = \frac{\Delta x}{\Delta t} = \frac{1.0 \text{ m}}{1.0 \text{ s}} = 1.0 \text{ m/s} \]

5. (h) Find the slope of the graph at D:
   \[ v_\text{D} = \frac{\Delta x}{\Delta t} = \frac{-3.0 \text{ m}}{2.0 \text{ s}} = -1.5 \text{ m/s} \]

**Insight:** The signs of each answer in (e) through (h) match those predicted in parts (a) through (d). With practice you can form both a qualitative and quantitative “movie” of the motion in your head simply by examining the position-versus-time graph.