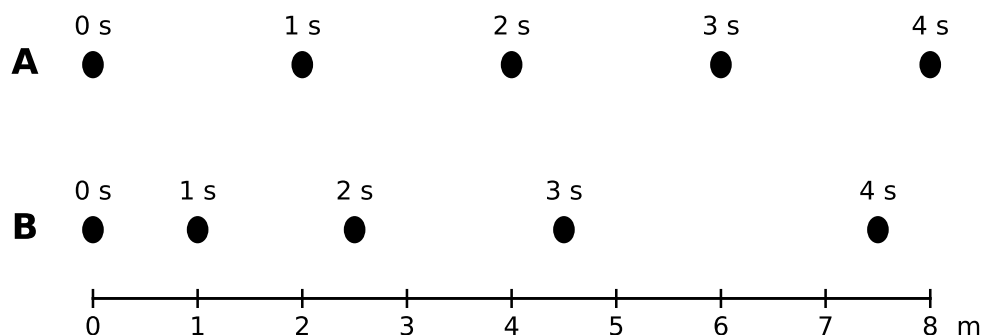


Part A: Concepts

1. A car drives around a circular track with its speedometer reading a steady 25 m/s the whole time. Is the car's speed constant? Is its velocity constant? Explain.

The **speed is constant** (25 m/s the whole time), but the **velocity is not**. Velocity includes direction, and the car's direction keeps changing as it goes around the circle.

2. The motion maps show two toy cars. Each dot marks a car's position once every second.



- Which car moves with a constant velocity? How can you tell?
- What is the velocity of car A? Use $v = d/t$ and call the direction to the right positive.
- Describe how car B's speed changes.

a. Car A. Its dots are evenly spaced, so it moves the same distance (2 m) in the same direction every second.

b. Knowns: $d = 8 \text{ m} - 0 \text{ m} = 8 \text{ m}$, $t = 4 \text{ s}$ **Equation:** $v = d/t$ **Substitute:** $v = 8 \text{ m} / 4 \text{ s}$ **Answer:** $v = 2 \text{ m/s to the right}$

c. Car B's dots spread farther apart each second, so it is **speeding up**.

Part B: Using $v = d/t$

Show knowns, the equation, and your substitution. Include units, and a direction for velocity and displacement.

3. A delivery drone flies 840 m north in 60.0 s. What is its average velocity?

Knowns: $d = 840 \text{ m north}$, $t = 60.0 \text{ s}$ **Equation:** $v = d/t$

Substitute: $v = 840 \text{ m} / 60.0 \text{ s}$ **Answer:** $v = 14.0 \text{ m/s north}$

4. Diego rolls on his skateboard at a constant velocity of 4.5 m/s west for 12 s. What is his displacement?

Knowns: $v = 4.5 \text{ m/s west}$, $t = 12 \text{ s}$ **Equation:** $d = vt$

Substitute: $d = (4.5 \text{ m/s})(12 \text{ s})$. The seconds cancel. **Answer:** $d = 54 \text{ m west}$

5. Maya walks to school at a steady 1.25 m/s. Her school is 900. m from her house. How long does the walk take, in seconds and in minutes?

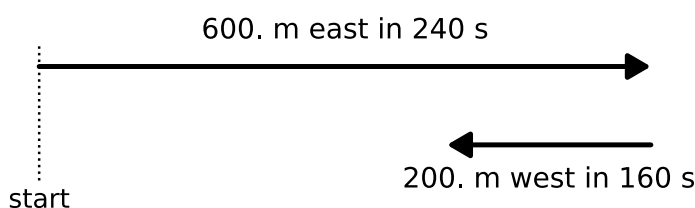
Knowns: $v = 1.25 \text{ m/s}$, $d = 900. \text{ m}$ **Equation:** $t = d/v$

Substitute: $t = 900. \text{ m} / 1.25 \text{ m/s}$. The meters cancel.

Answer: $t = 720. \text{ s}$ and $720. \text{ s} \times (1 \text{ min} / 60 \text{ s}) = 12.0 \text{ min}$

Part C: Average Speed vs. Average Velocity

6. Priya jogs 600. m east along a straight path in 240 s, then turns around and jogs 200. m west in 160 s.



- What total distance did she jog, and how much total time did it take?
 - What is her average speed?
 - What is her displacement?
 - What is her average velocity?
 - Why is her average velocity smaller than her average speed? If she had jogged all the way back to the start, what would her average velocity be?
- a.** Distance = $600. \text{ m} + 200. \text{ m} = 800. \text{ m}$; time = $240 \text{ s} + 160 \text{ s} = 400. \text{ s}$
- b.** Average speed = total distance $\div$ time = $800. \text{ m} / 400. \text{ s} = 2.00 \text{ m/s}$
- c.** East is positive: $d = (+600. \text{ m}) + (-200. \text{ m}) = 400. \text{ m east}$
- d.** $v = d/t = 400. \text{ m} / 400. \text{ s} = 1.00 \text{ m/s east}$
- e.** Speed uses the total distance, but velocity uses displacement. Because she turned around, her displacement (400. m) is smaller than the distance she covered (800. m). If she returned to the start, her displacement would be 0, so her **average velocity would be 0 m/s**.