Unit 2: Kinematics in 1D

2 - Speed and Velocity

® Speed (v): distance travelled per time.

- Speed is a scalar

Average speed → $v = \frac{d}{t}$

® Velocity (v): change in position per time

- Velocity is a vector

Average velocity → $\vec{v} = \frac{\vec{d}}{t}$ $\vec{v} = \frac{\Delta d}{t}$

Where Δ means "change in"

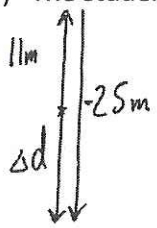
Δ = final - initial

Ex: A student travels 11 m north and then turns around and travels 25 m south. If the total time of travel is 12 s, find:

a) The student's average speed.

$v = \frac{d}{t} = \frac{(11m + 25m)}{12s} = \frac{36m}{12s} = 3.0\ m/s$

b) The student's average velocity.



$\vec{v} = \frac{\vec{d}}{t} = \frac{11 + (-25)}{12s}$

$= \frac{-14m}{12s}$

$= -1.2\ m/s = 1.2\ m/s\ S$

1) How long does it take a car traveling at 45km/h to travel 100.0 m?

45 km/h ÷ 3.6 = 12.5 m/s

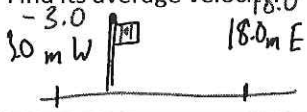
$t \cdot v = \frac{d}{\cancel{t}} \cdot \cancel{t}$ $\frac{\cancel{v} \cdot t}{\cancel{v}} = \frac{d}{v}$ $t = \frac{d}{v} = \frac{100.0m}{12.5m/s} = 8.0\ s$

2) How far does a skateboarder travel in 22 s if his average velocity is 12.0 m/s?

$t \cdot v = \frac{d}{t} \cdot t$ $v \cdot t = d$ $d = v \cdot t = (12.0\ m/s)(22s) = 264m$

$= 260m$

3) A shopping cart moves from a point 3.0 m West of a flagpole to a point 18.0 m East of the flagpole in 2.5 s. Find its average velocity.

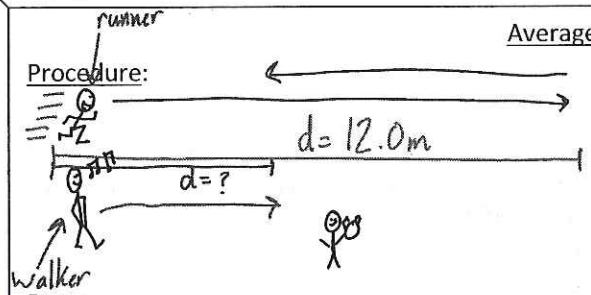


$\vec{v} = \frac{\Delta d}{t} = \frac{d_f - d_i}{t}$ $\frac{18.0 - (-3.0)}{2.5s}$

$= \frac{21.0m}{2.5s} = 8.4\ m/s = 8.4\ m/s\ E$

Average Velocity vs. Average Speed

Procedure:



Data:

Student 1	**Student 2**
Time:	Time:
distance:	distance:
displacement:	displacement:

Calculations:

Student 1 - Runner

Speed

Velocity

Student 2 - Walker

Speed

Velocity

Worksheet 1.2 - Average Velocity and Speed

1. A high school bus travels 240 km in 6.0 h. What is its average speed for the trip? (in km/h)

$240/6 = 40$ km/h

2. A spider travels across a driveway 3.6 m wide with a speed of 14 cm/s. How long will it take to cross the driveway?

$t = \frac{3.6}{14} = \frac{360\ cm}{14} = 25.7143\ s$

$= 26\ s$

3. Jay Umpshot, one of the many stars of the local basketball team, steals the ball and runs the length of the court in 8.5 sec at a speed of 5.0 m/s. How long is the court?

$d = v \cdot t = 8.5 \cdot 5$

$= 42.5\ m = 43\ m$

4. If a car is traveling at 25 m/s, how far does it travel in 1.0 hour?

$d = v \cdot t = 25\ m/s \cdot 1 = 90000\ m$

$= 25\ m/s \cdot 3600$

5. A caterpillar travels across the length of a 2.00 m porch in 6.5 minutes. What is the average velocity of the caterpillar in m/s?

$\vec{v} = \frac{\Delta d}{\Delta t}$

$\frac{2.00}{6.5} = \frac{2.00}{390} = 0.005\ m/s$

6. A motorist traveling on a straight stretch of open highway sets his cruise control at 90.0 km/h. How far will he travel in 15 minutes?

$90 \times \frac{1}{4} = 22.5\ km$ or $\frac{1.5\ km/\cancel{h}\ \cancel{min} \times 15}{\cancel{5}} = 22.5\ km$

7. A motorcycle travels 90.0 km/h. How many seconds will it take the motorcycle to cover 2.10×10^3 m?

$\frac{2.100}{90.1\ km/h}$ ~~$\frac{2.100\ km}{90\ km}$~~ ~~$= 23.3\ h$~~ $0.023\ h$.

8. A hiker is at the bottom of a canyon facing the canyon wall closest to her. She is 280.5 m from the wall and the sound of her voice travels at 340.0 m/s at that location. How long after she shouts will she hear her echo.

$t = \frac{280.5}{340}$

9. A woman from Pasadena makes a trip to a nearby shopping mall that is located 40.0 km from her home. On the trip to the mall she averages 80.0 km/h but gets a speeding ticket upon her arrival. On the return trip she averages just 40.0 km/h. What was her average speed for the entire trip?

40 km → ← 40 km

$d = 80\ km$

$t = 1.5\ hour$

$V = \frac{80}{1.5} = 53.3$

10. A cross-country rally car driver sets out on a 100.0 km race. At the halfway marker (50.0 km), her pit crew radios that she has averaged only 80.0 km/h. How fast must she drive over the remaining distance in order to average 100.0 km/h for the entire race?

11. A supersonic jet travels once around the earth at an average speed of 1.6×10^3 km/h. Its orbital **radius** is 6.5×10^3 km. How many hours does the trip take?

~~$\pi(1.6 \times 10^3)^2$~~

$t = \frac{\pi(6.5 \times 10^3) \cdot 2}{1.6 \times 10^3} = 26\ h$

1) 40. km/h 2) 26 s 3) 43 m 4) 9.0×10^4 m 5) 5.1×10^{-3} m/s 6) 23 000 m 7) 84.0 s 8) 1.650 s 9) 53.3 km/h 10) 133 km/h 11) 26 h