

completed

Day 7: Motion

164.5 pts

#1 Motion Standards: The velocity of an object is the rate of change of its Position.

- a. Position is defined in relation to some choice of a standard REFERENCE point & a set of reference DIRECTIONS.
- b. AVERAGE speed is the total distance traveled divided by the total time elapsed & that the speed of an object along the path traveled can VARY.
- c. Solve problems involving distance, time, & average speed.
- d. The velocity of an object must be described by specifying both the DIRECTION & the SPEED of the object.
- e. Changes in Velocity may be due to changes in speed, direction, or both.
- f. Interpret graphs of position versus time & graphs of speed versus time for motion in a single direction.

Motion Vocabulary: Write the correct term letter next to the definition

1pt each / 14pts

<u>C</u> 1. The location of an object compared to a reference point	a. Acceleration
<u>E</u> 2. Speed in a given direction.	b. Force
<u>L</u> 3. the overall rate at which an object moves. Calculated by dividing distance by total time	c. Position
<u>A</u> 4. The rate at which velocity changes in a given period of time.	d. Speed
<u>K</u> 5. an object's change in position over time when compared with a reference point	e. Velocity
<u>B</u> 6. A push or pull.	f. Weight
<u>D</u> 7. The rate at which an object moves.	g. Inertia
<u>G</u> 8. The tendency of an object to resist change in motion.	h. Momentum
<u>J</u> 9. A "perpendicular" force that acts on the surface of a book resting on a table.	i. Newton
<u>I</u> 10. The metric unit for force.	j. Normal Force
<u>M</u> 11. acceleration in which velocity decreases	k. Motion
<u>N</u> 12. an object that appears to stay in place in relation to an object being observed for motion	l. Average speed
<u>F</u> 13. A measure of the gravitational force on an object.	m. Deceleration
<u>H</u> 14. Mass x Velocity	n. Reference point

Motion Equations: For each problem, state whether you would be finding the speed, average speed, velocity, or acceleration of the object. Answers will be used more than once.

1/2pt ea / 4pts

<u>AVG SPEED</u> A bear walks 5 km in 30 min., then 15 km in 90 min.	<u>VELOCITY</u> A truck travels 75 mi north in 2.5 hr
<u>(Velocity) SPEED</u> A plane traveled 3,000 mi from NYC to CA in 5 hrs.	<u>SPEED</u> A car traveled 543 km in 6 hours.
<u>ACCELER.</u> A falling raindrop goes from 10 m/s to 30 m/s in 2 sec	<u>SPEED</u> A dog runs 3800 meters in 2 min.
<u>AVG. SPD</u> A cyclist goes 32 km in the first 2 hrs, then 13 km the next hr.	<u>ACCELERATION</u> A car goes from rest to 60 mph in 9 sec.

Solving Speed Problems

1/2pt ea = / 35 pts

Example: What is the speed of a cheetah that travels 112.0 meters in 4.0 seconds?

Looking for: Speed of cheetah	Solution
Given: Distance = 112.0 meters Time = 4.0 seconds <u>D=SxT</u>	$\text{speed} = \frac{d}{t} = \frac{112.0 \text{ m}}{4.0 \text{ s}} = \frac{28 \text{ m}}{\text{s}} \quad T = \frac{D}{S}$ <p>The speed of the cheetah is 28 meters per second.</p>

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|--|--|
| 1. A bicyclist travels 60.0 km in 3.5 hours. What is the cyclist's average speed?
<u>$S = \frac{60 \text{ km}}{3.5 \text{ h}} = 17.1 \text{ km/h}$</u> | 2. What is the average speed of a car that traveled 300.0 miles in 5.5 hours?
<u>$S = \frac{300 \text{ mi}}{5.5 \text{ h}} = 54.5 \text{ mph}$</u> |
| 3. How much time would it take for the sound of thunder to travel 1,500 meters if sound travels at a speed of 330 m/s?
<u>$T = \frac{D}{S} = \frac{1500 \text{ m}}{330 \text{ m/s}} = 4.5 \text{ s}$</u> | 4. A snail can move approximately 0.30 meters per minute. How many meters can the snail cover in 15 minutes?
<u>$D = S \times T$
$.3 \text{ m/min} \times 15 \text{ min} = 4.5 \text{ m}$</u> |

5. Suppose you are walking home after school. The distance from school to your home is five km. On foot, you can get home in 25 min. However, if you rode a bike, you could get home in 10 minutes. **SHOW YOUR WORK TO GET CREDIT!**

What is your average speed while walking?
 $S = \frac{5 \text{ km}}{25 \text{ min}} = 0.2 \text{ km/min}$

What is your average speed while bicycling?
 $S = \frac{5 \text{ km}}{10 \text{ min}} = 0.5 \text{ km/min}$

How much faster you travel on your bicycle?
 $.5 - .2 = .3 \text{ km/min}$

Solving Velocity Problems

Remember: The velocity of an object is determined by measuring both the *speed & direction*.

If the speed of an object changes, then its velocity also changes.

If the direction in which an object is traveling changes, then its velocity changes.

A change in either speed, direction, or both causes a change in velocity.

The velocity of an object in motion is equal to the distance it travels per unit of time in a given direction.

Use $v = d/t$
to solve velocity

Example 1: What is the velocity of a car that travels 100.0 meters, northeast in 4.65 seconds?

Looking for: Velocity of the car. $T = D/V$
 $D = V \times T$

Solution

$$\text{velocity} = \frac{d}{t} = \frac{100.0 \text{ m}}{4.65 \text{ s}} = \frac{21.5 \text{ m}}{\text{s}}$$

The velocity of the car is 21.5 meters per second northeast.

Given:

Distance = 100.0 meters

Time = 4.65 seconds

1. An airplane flies 525 kilometers north in 1.25 hours. What is the airplane's velocity?

$$V = \frac{525 \text{ km}}{1.25 \text{ h}} = 420 \text{ kph North}$$

2. A soccer player kicks a ball 6.5 meters. How much time is needed for the ball to travel this distance if its velocity is 22 meters per second, south?

$$T = \frac{D}{V} = \frac{6.5 \text{ m}}{22 \text{ m/s}} = 0.29 \text{ Seconds}$$

3. A Girl Scout troop hiked 5.8 kilometers southeast in 1.5 hours. What was the troop's velocity?

$$V = \frac{5.8 \text{ km}}{1.5 \text{ h}} = 3.8 \text{ kph SE}$$

4. A family drives 881 miles from Houston, Texas to Santa Fe, New Mexico for vacation. How long will it take the family to reach their destination if they travel at a velocity of 55.0 miles per hour, northwest?

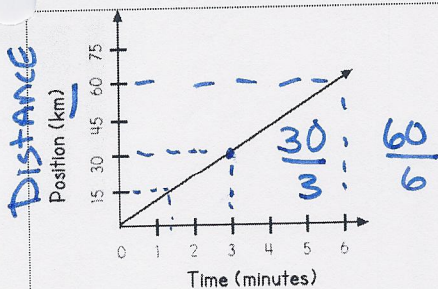
$$T = \frac{D}{V} = \frac{881 \text{ miles}}{55 \text{ mph}} = 16 \text{ h}$$

5. A shopping cart is pushed 15.6 meters west across a parking lot in 5.2 seconds. What is the velocity of the shopping cart?

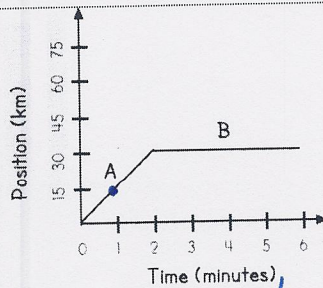
$$V = \frac{15.6 \text{ m}}{5.2 \text{ s}} = 3 \text{ m/s W}$$

Position – Time Graphs

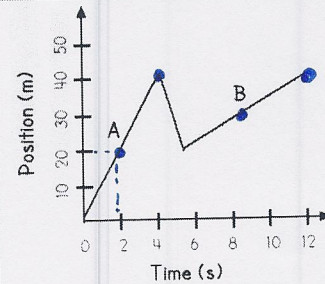
Use the graph to determine the speed or both speeds (A & B) of each object.



1. 10 km/min

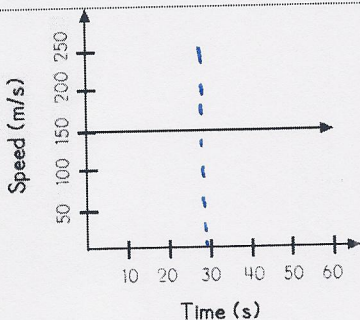


2. Point A = 15 km/min
Point B = 0 km/min

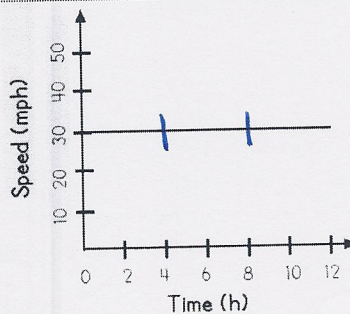


3. Point A = 10 m/s
Point B = 3.3-3.8 m/s

Speed – Time Graphs



4. How far did the vehicle travel during the first 30 seconds?
 $D = S \times t$
 $D = 150 \text{ m/s} \times 30 \text{ s} = 4500 \text{ m}$



5. How far did the vehicle travel during the time interval from 4 hours to 8 hours?
 $D = 30 \text{ mph} \times 4 \text{ h}$
 $= 120 \text{ miles}$

Show the formulas for acceleration

$$A = \frac{\text{Final velocity} - \text{Starting Vel}}{\text{Time it takes to change vel.}}$$

Show the formula for speed

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Motion Questions:

1. An athlete can run 9 kilometers in 1 hour. If the athlete runs at that same average speed for 30 minutes, how far will the athlete travel?

- a. 18 km b. 9 km **c. 4.5 km** d. 3.3 km

2. How much time is required for a bicycle to travel a distance of 100 m at an average speed of 2 m/s?

- a. 0.02 s **b. 50 s** c. 100 s d. 200 s

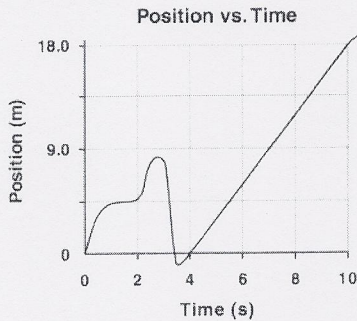
3. Which of the following represents the velocity of a moving object?

- a. 40 b. 40 m north c. 40 m/s **d. 40 m/s north**

4. Which characteristic of motion could change without changing the velocity of an object?

- a. the speed **b. the position** c. the direction d. the acceleration

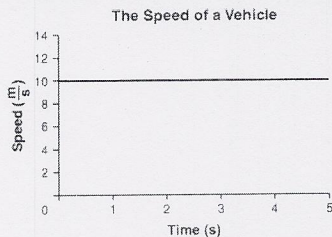
5. The graph below shows how the position of an object changes over time.



6. What is the speed of the object during the time interval from 4 seconds to 10 seconds?

- a. 2 m/s **b. 3 m/s** c. 8 m/s d. 6 m/s

The graph below shows the speed of a vehicle over time.



7. How far did the vehicle travel during the first two seconds?

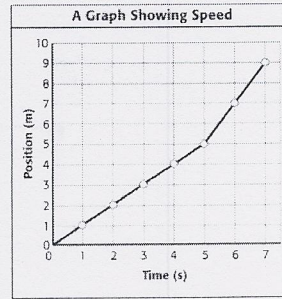
- a. 0.2 m b. 5 m c. 10 m **d. 20 m**

8. What term or phrase describes a point that appears to stay in place and can be used to detect the motion of an object?

- a. a reference point** b. a compass c. a ruler d. a beacon

9. What is the difference between speed and velocity?

- a. Velocity is expressed in m/s. Speed is expressed in m/s².
 b. Speed involves a constant rate of acceleration, and velocity does not.
c. Speed is measured by time and distance, but velocity also includes direction.
 d. Velocity involves moving in a direction in a straight line, and speed does not.



1 pts each
 ___/20 pts

10. The graph above shows a person walking. Which of the following sentences best describes the walker's speed?

- A She travels an average of 10 m/s.
 B She travels an average of 4 m/s.
 C Her rate of speed decreases after 5 seconds
D Her rate of speed increases after 5 seconds

11. The best way to describe the rate of motion of an object that changes speed several times is to calculate the object's

- A. average speed** B. constant speed
 C. instantaneous speed D. variable speed

12. Which of the following is a force?

- A. inertia **B. friction** C. velocity D. acceleration

13. The unit for _____ is m/s².

- A. weight **B. acceleration** C. inertia D. velocity

14. Which of the following is not used in calculating acceleration?

- A. initial velocity **B. average speed**
 C. time interval D. final velocity

15. A body accelerates if it _____.

- A. speeds up B. slows down
 C. changes direction **D. all of these**

16. The gravitational force between two objects depends on their _____.

- A. speed **B. masses** C. velocities D. shapes

17. _____ acts only between surfaces that are in contact.

- A. Inertia **B. Friction** C. Gravity D. A net force

18. In a head-on car crash, passengers not wearing seat belts continue to move forward with the same _____ that the car had prior to impact.

- A. momentum B. force C. potential energy **D. speed**

19. An object of large mass has _____ than an object of small mass.

- A. less inertia **B. more inertia**
 C. less weight D. greater acceleration

20. A constant velocity means acceleration is _____.

- a. positive b. negative c. increasing **d. zero**

Problem	Distance	Time	Speed
Example: A bicyclist travels 60.0 kilometers in 4 hours. What is the cyclist's average speed?	60 km	4 hours	$S = 60 \text{ km} / 4 \text{ h}$ $S = 15 \text{ km/h}$ $S = D/T$
1. What is the speed of a car that traveled 300.0 miles in 5.5 hrs?	300 m	5.5 hrs	$S = 300 / 5.5$ $S = 54.55 \text{ m/h}$
2. How much time would it take for the sound of thunder to travel 1,500 meters if sound travels at a speed of 330 m/s?	1,500 m	$T = ?$ $T = D/S$ $1500 / 330 = 5 \text{ s}$	$S = 300 \text{ m/s}$
3. Jen drives 20 miles southwest to her favorite mall. What is her velocity if she arrives at the mall in 8 minutes?	20 m South west	8 m	$V = 20 / 8$ $= 2.5 \text{ m/m Southwest}$
4. A person in a kayak paddles down river at an average speed of 10 km/h. After 3.25 hours, how far has she traveled?	$D = ?$ $D = S \times T$ $325 \times 10 = 32.5 \text{ K}$	$T = 3.25 \text{ hr}$	$S = 10 \text{ Km/h}$
5. How much time is required for a bicycle to travel a distance of 100 m at a speed of 2 m/s?	100 m	$T = ?$ $T = D/S$ $100 / 2 = 50 \text{ s}$	$S = 2 \text{ m/s}$

Average Speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

Problem	Distance	Time	Average Speed
Example: Joe drives 450 meters in 4 minutes, then 150 meters in 2 minutes. What is Joe's average speed?	$450 + 150 = 600 \text{ m}$	$4 + 2 = 6 \text{ min}$	$S = 600 \text{ m} / 6 \text{ min}$ $S = 100 \text{ m} / \text{min}$
6. A worm covers 5 cm in 10 seconds, then 25 cm in 155 seconds. What is its average speed?	$5 \text{ cm} + 25 \text{ cm} = 30 \text{ cm}$	$10 + 155 = 165 \text{ sec}$	$S = 30 \text{ cm} / 165 \text{ sec}$ $.18 \text{ cm/sec}$
7. Rita runs 1 mile in 5.4 minutes, then 2 miles in 12 minutes. What is her average speed?	$1 \text{ m} + 2 \text{ m} = 3 \text{ m}$	$5.4 + 12 \text{ min} = 17.4 \text{ min}$	$S = 3 \text{ m} / 17.4 \text{ min}$ $.17 \text{ m/min}$
8. A bird flies 80 km in 2 hours, then 120 km in 3.8 hours. What is its average speed?	$80 \text{ Km} + 120 \text{ Km} = 200 \text{ Km}$	$2 + 3.8 \text{ hr} = 5.8 \text{ hr}$	$S = 200 \text{ Km} / 5.8 \text{ hr}$ 34.48 Km/min

Acceleration = $\frac{V_f - V_i}{\text{Time}}$

Problem	Final Velocity	Initial Velocity	Time	Acceleration
Example: After traveling for 5.0 seconds, a runner reaches a speed of 10 m/s. What is the runner's acceleration?	10 m/s	0 m/s	5 s	$A = \frac{10 - 0 \text{ m/s}}{5 \text{ s}}$ $A = 2 \text{ m/s}^2$
9. A skater increases her velocity from 2.0 m/s to 10.0 m/s in 3.0 seconds. What is the skater's acceleration?	10 m/s	2.0 m/s	3 s	$A = \frac{10 - 2}{3}$ $A = 2.67 \text{ m/s}^2$
10. A parachute on a racing dragster opens & changes the speed of the car from 85 m/s to 45 m/s in a period of 4.5 seconds. What is the acceleration?	45 m/s	85 m/s	4.5 s	$A = \frac{45 - 85}{4.5}$ $A = -8.89 \text{ m/s}^2$
11. A car starting from rest accelerates at a rate of 8.0 m/s. What is its final speed at the end of 4.0 seconds?	8 m/s	0 m/s	4 s	$A = \frac{8 - 0}{4}$ $A = 2 \text{ m/s}^2$