

## Chapter 3 Vectors

**Example Problems****3.1 Adding Vectors**

- Example 1:
  - You are riding in a bus that is moving slowly through heavy traffic at a speed of 4.0 m/s. While the bus is in motion you walk towards the front of the bus at 2.0 m/s relative to the bus. What is your speed relative to the street?

*Draw a picture*

*Show your work*

- Example 2:
  - You are riding a high speed train traveling 50 m/s. While the train is in motion you walk towards the back of the train at 2 m/s relative to the train. What is the magnitude of your velocity relative to the tracks in meters per second?

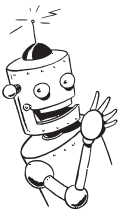
*Draw a picture*

*Show your work*

- Example 3:
  - A seal swims toward an inlet with a speed of 5.0 m/s as a current of 1.0 m/s flows in the opposite direction. How long will it take the seal to swim 100 m?

*Draw a picture*

*Show your work*



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- Example 4:

- Car A is traveling at 27 m/s towards car B traveling at 51 m/s in the opposite direction. How fast does car A appear to be traveling to an observer in car B and how fast does car B appear to an observer in car A?

*Draw a picture*

*Show your work*

- Example 5:

- A car A is traveling at a speed of 35 m/s and car B is traveling in the same direction at a speed of 38 m/s, both with respect to a fixed point on the road. How fast and in what direction does car A appear to be traveling to an observer located in car B? How fast and in what direction does car B appear to be traveling to an observer located in car A?

*Draw a picture*

*Show your work*

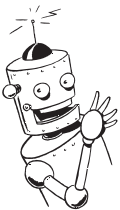
- Example 6:

- A boat is traveling north. The people on the boat measure the water to be moving past the boat at a velocity of 5 m/s in the opposite direction to the south. A stationary viewer on the shore measures the velocity of the boat to be moving 2 m/s north. What is the actual velocity of the water as seen from the shore in meters per second?

*Draw a picture*

*Show your work*

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Chapter 3 Vectors

# Student Problems

## 3.1 Adding Vectors

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

1. A car moves 65 km due east, then 45 km due west. What is its total displacement?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units

2. A monkey is flying to New York for her big Broadway debut. If the plane heads out of Los Angeles with a velocity of 220 m/s relative to the ground, and encounters a wind blowing head-on at 45 m/s. What is the velocity of the plane, relative to the ground? What is the velocity of the plane relative to the ground if the wind is not a head wind but instead a tail wind blowing with the plane's direction of motion?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

3. A train is travels at a speed of 25.0 m/s relative to the ground. What is your velocity relative to the ground if you walk towards the back of the train at a speed of 1.5 m/s relative to the train? What is your velocity if you walk towards the front of the train at a speed of 1.5 m/s?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

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4. An airplane, moving at 375 m/s relative to the ground, fires a missile at a speed of 782 m/s relative to the plane. What is the speed of the shell relative to the ground?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

5. A rocket in outer space that is moving at a speed of 1.25 km/s relative to an observer fires its motor. Hot gases are expelled out the rear at 2.75 km/s relative to the rocket. What is the speed of the gases relative to the observer?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units

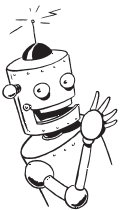
6. A monkey is rowing his boat upriver at a speed of 2.5 m/s relative to the water. Viewers on the shore see the monkey is moving at only 0.5 m/s relative to the shore. What is the speed of the river?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units

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## Chapter 3 Vectors

**Example Problems****3.2 Resultant of Vectors**

- Example 1:
  - A car is driven 125 km due west, then 65 km due south. What is the magnitude of its displacement in kilometers?

*Draw a picture*

*Show your work*

- Example 2:
  - A hiker walks 4,500 m in one direction, then makes a  $90^\circ$  turn to the right and walks another 6,400 m. What is the magnitude of her displacement in meters?

*Draw a picture*

*Show your work*

- Example 3:
  - A ship leaves its home port expecting to travel to a port 500.0 km due south. Before it moves even 1 km, a severe storm blows it 100.0 km due east. How far is the ship from its destination? In what direction must it travel to reach its destination?

*Draw a picture*

*Show your work*



### Chapter 3 Vectors

- Example 4:

- An airplane flies due south at 175 km/h with respect to the air. There is a wind blowing at 85 km/h to the east relative to the ground. What are the plane's speed with respect to the ground in kilometers per hour?

*Draw a picture*

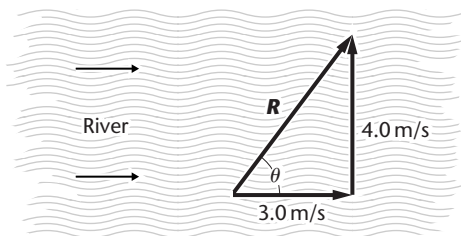
*Show your work*

- Example 5:

- You row a boat perpendicular to the shore of a river that flows at 3.0 m/s. The velocity of your boat is 4.0 m/s relative to the water. What is the velocity of your boat relative to the shore?

*Draw a picture*

*Show your work*

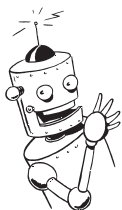


Example 6:

- A motorboat heads across a river at 10 m/s relative to the water. The river is flowing north at 6.0 m/s. What is the velocity of the motorboat with respect to the shore?

*Draw a picture*

*Show your work*



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# Student Problems

## 3.2 Resultant of Vectors

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

7. A monkey drives 68.0 km due west, then turns and travels 127.0 km due south. What is the magnitude of its displacement in kilometers?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units

8. An airplane flies due north at 350 km/h relative to the air. There is a wind blowing at 27 km/h to the east relative to the ground. What is the plane's speed relative to the ground in kilometers per hour?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units

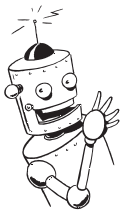
9. A powerboat heads due west at 13 m/s relative to the water that flows due south at 5.0 m/s. What is the boats velocity relative to the shore?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units

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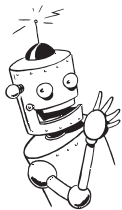
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10. You are running in the rain. The rain is falling at a speed of 3 m/s and you are running at a rate of 4 m/s. Calculate the speed of raindrops as it is hitting your face.

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ ← units





## Chapter 3 Vectors

**Example Problems****3.3 Vector Components**

- Example 1:
  - A spear is thrown by a monkey with an initial velocity of 30 m/s at an angle of  $34^\circ$  with the ground? What are the vertical and horizontal components of the spear's velocity?

*Draw a picture*

*Show your work*

- Example 2:
  - Robbie Knievel is about to make another world record distance jump. He leaves the jump ramp at 45 m/s. The ramp has an angle of  $22^\circ$  with horizontal. What are the vertical and horizontal components of Robbie's velocity off the ramp?

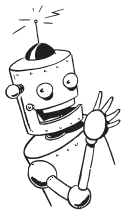
*Draw a picture*

*Show your work*

- Example 3:
  - A baseball player hits a ball with a velocity of 60 m/s at an angle of  $20^\circ$  with vertical. What are the vertical and horizontal components of the ball as it leaves the player's bat?

*Draw a picture*

*Show your work*



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- Example 4:
  - Waldo Walenda, one of The Flying Walenda's, was swinging on a trapeze. He let go of the trapeze when it was traveling  $20.0 \text{ m/s}$  at a  $40.0^\circ$  angle with the vertical. What are the vertical and horizontal components of Waldo's velocity as he leaves the trapeze.

*Draw a picture*

*Show your work*

- Example 5:
  - A monkey is mowing his back yard with a push mower. The monkey pushes downward with a force of  $20.0 \text{ N}$  at an angle of  $30.0^\circ$  to the horizontal. What are the horizontal and vertical components of the force exerted by the monkey?

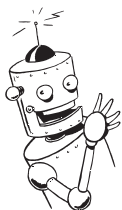
*Draw a picture*

*Show your work*

- Example 6:
  - A monkey pulls his sister in her wagon with a force of  $65 \text{ N}$  at an angle of  $50.0^\circ$  to the vertical. What are the horizontal and vertical components of the force exerted by the monkey?

*Draw a picture*

*Show your work*



Chapter 3 Vectors

# Student Problems

## 3.3 Vector Components

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

11. A golf ball, hit from the tee with a velocity of 66.2 m/s at an angle  $25^\circ$  to horizontal..  
What are the horizontal and vertical components of the golf balls velocity?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

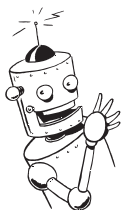
12. A monkey shovels snow after a storm by exerting a force of 30.0 N on her shovel at an angle of  $60.0^\circ$  to the horizontal. What are the horizontal and vertical components of the force exerted by the monkey?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

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13. A gorilla pulls a sled loaded with logs to his cabin in the woods. If the gorilla pulls with a force of 800. N in a direction  $20.0^\circ$  above the horizontal, what are the horizontal and vertical components of the force exerted by the gorilla?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

14. A monkey dives off the 3-m springboard and initially bounces up with a velocity of 8.0 m/s at an angle of  $80.^\circ$  to the horizontal. What are the horizontal and vertical components of the monkey's velocity?

*Draw a picture*

*Show your work*

a) \_\_\_\_\_ b) \_\_\_\_\_

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