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Contents at a Glance

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Introduction

Whether you want some extra practice for your college or high school physics class, you want to refresh your memory about a course you took long ago, or you're simply curious about the way the universe works, you've found the right book. After all, the best way to learn physics is to do physics, and the hundreds of problems in this book give you plenty of opportunity to do physics. You can practice as much as you like and become a pro at figuring out the right way to start out all sorts of problems that you'd expect to see in the first semester of a one-year physics course.

Why doesn't the moon crash into the earth? How is it possible to sleep on a bed of nails? Why does the water level in your glass stay the same when the ice melts? By working through the many problems in this book, you'll be better able to explain these and other mysteries of the universe to your friends.

What You'll Find

The Physics I practice problems in this book are divided into 15 chapters, beginning with foundational practice (such as calculating displacement and working with vectors); moving on to forces, energy, and momentum; and wrapping up with thermodynamics. Some of the questions require you to reference a diagram, but that instruction is always clear within the questions.

Chapter 16 contains the solutions to all of the practice problems, as well as detailed explanations that help you understand how to come up with the correct answer. If you get a particular question wrong, though, don't just read the answer explanation and move on. Instead, try solving the question again because you know that now you won't make the same mistake that got you to the original wrong answer in the first place. (After all, sometimes knowing what *not* to do is a great start in discovering what *to* do.)

Whatever you do, stay positive. The harder questions in this book aren't meant to discourage you. Rather, they're meant to prove to you just how well you can understand the many challenging concepts presented in a typical Physics I class.

How This Workbook Is Organized

This workbook is divided into two main parts: the questions and the answers.

Part I: The Questions

The questions in this book cover the following topics:

- **Math basics:** To learn physics, you need to know a little bit of math. (Just a little!) Chapter 1 checks your knowledge of basic algebra, trigonometry, units, and significant digits.
- **Kinematics:** The basic quantities you use to describe motion are displacement, velocity, and acceleration. In Chapter 2 you practice one-dimensional motion problems. Chapter 3 deals with the two-dimensional case.
- **Forces:** Newton's laws relate forces and motion. Chapter 4 has you applying Newton's laws; Chapter 5 questions you on friction and gravitational force.
- **Angular motion:** The linear quantities you use to describe motion and forces have angular analogues. Chapter 6 checks your knowledge of angular velocity and angular acceleration. In Chapter 7 you practice solving circular motion problems. Chapter 11 deals with torque, angular momentum, and rotational kinetic energy.
- **Energy and momentum:** You can discover a lot about the world around you by studying conserved quantities such as energy and momentum. Chapter 9 features work- and energy-related problems; Chapter 10 focuses on momentum and collisions.
- **Simple harmonic motion:** Periodic motion occurs repeatedly in nature, which is why Chapter 12 has you practice working with springs and pendula.
- **Liquids, gases, and thermodynamics:** Dealing with macroscopic properties is often easier than keeping track of the motion of each molecule. Chapter 8 focuses on density, pressure, and flow rates of liquids and gases. In Chapter 13 you examine temperature, heat, and heat transfer. Chapter 14 questions you on the ideal gas law, and Chapter 15 gets you applying the laws of thermodynamics to heat engines, heat pumps, and other situations.

Part II: The Answers

Here's where you can find detailed answer explanations for every question in this book. Find out how to set up and work through all the problems so that you arrive at the correct solution.

Beyond the Book

Your purchase of this book gives you so much more than just several hundred problems you can work on to improve your understanding of physics. It also comes with a free, one-year subscription to hundreds of practice questions online. Not only can you access this digital content anytime you want, on whichever device is available to you, but you can also track your progress and view personalized reports that show you which concepts you need to study the most.

What you'll find

The online practice that comes free with this book offers you the same questions and answers that are available here along with hundreds more. And online, they're in a multiple-choice format. What's great about this format is that it allows you to zero in on the details that can make or break your solution. Sometimes one (or more) of the incorrect answer options is the result of a calculation error. When you catch yourself making such a common error, you'll know not to take the same approach with similar problems on a graded test, when the right answers really count.

Of course, the real beauty of the online problems is the ability to customize your practice. In other words, you get to choose the types of problems and the number of problems you want to tackle. The online program tracks how many questions you answer correctly versus incorrectly so you can get an immediate sense of which topics need more of your attention.

This product also comes with an online Cheat Sheet that helps you increase your odds of performing well in your Physics I class. Check out the free Cheat Sheet at `www.dummies.com/cheatsheet/physics1practice`. (No access code required. You can benefit from this info before you even register.)

How to register

To gain access to the online practice, all you have to do is register. Just follow these simple steps:

1. **Register your book or ebook at Dummies.com to get your PIN. Go to `www.dummies.com/go/getaccess`.**
2. **Select your product from the dropdown list on that page.**
3. **Follow the prompts to validate your product, and then check your email for a confirmation message that includes your PIN and instructions for logging in.**

If you do not receive this email within two hours, please check your spam folder before contacting us through our Technical Support website at `http://support.wiley.com` or by phone at 877-762-2974.

Now you're ready to go! You can come back to the practice material as often as you want — simply log on with the username and password you created during your initial login. No need to enter the access code a second time.

Your registration is good for one year from the day you activate your PIN.

Where to Go for Additional Help

The solutions to the practice problems in this book are meant to walk you through how to get the right answers; they're not meant to teach the material. If certain physics concepts are unfamiliar to you, you can find help at `www.dummies.com`. Just type "physics I" into the search box to turn up a wealth of physics-related articles.

If you need more detailed instruction, check out *Physics I For Dummies,* 2nd Edition; *Physics I Workbook For Dummies,* 2nd Edition; and *Physics Essentials For Dummies,* all written by Steven Holzner and published by Wiley.

Part I
The Questions

Visit `www.dummies.com` for free access to great *For Dummies* content online.

In this part . . .

You've probably heard the expression "practice makes perfect." Well, working on hundreds of physics practice problems may not get you solving every physics problem perfectly every time, but it'll definitely help you get more comfortable with the following topics:

- Reviewing math basics (Chapter 1)
- Solving one-dimensional (Chapter 2) and two-dimensional (Chapter 3) motion problems
- Working with forces (Chapters 4 and 5)
- Focusing on energy and momentum (Chapters 9 and 10)
- Understanding angular motion (Chapters 6, 7, and 11)
- Dealing with liquids (Chapter 8), gases (Chapter 14), and thermodynamics (Chapters 13 and 15)

Chapter 1

Reviewing Math Fundamentals and Physics Measurements

Physics explains how the world works. You can use physics to predict how objects move and interact. This process often involves some basic algebra and trigonometry. To check these predictions, you can make a measurement. Sometimes you need to convert units to compare different measurements.

The Problems You'll Work On

Here are some of the things you'll do in this chapter:

- Solving for an unknown variable with basic algebra
- Using basic trigonometry to determine side lengths and angles
- Converting between different types of units
- Writing numbers in scientific notation
- Understanding unit prefixes in the metric system
- Rounding to the correct number of significant digits

What to Watch Out For

Be sure to remember the following:

- Making sure your answer has the right units
- Using conversion factors correctly
- Checking that your answers make sense physically

Equipping Yourself with Basic Algebra

1–3

1. Solve the equation $y = 2m + 3$ for m.

2. You are given that $I = \frac{1}{2}mr^2$ and $m = m_0 + m_1$. Solve this expression for $m_0 + m_1$.

3. Solve the equation $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$ for v.

Tackling a Little Trigonometry

4–5

4. If $\cos\theta = 0.8$ and the hypotenuse of a right triangle is 8 meters long, how long is the adjacent side of the right triangle?

5. A pool is 2.0 meters deep. You dive in at an angle of 35 degrees to the surface of the water. If you continue in this direction, how far from the edge of the pool will you hit the bottom?

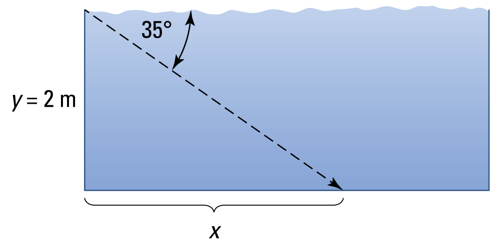

Illustration by Thomson Digital

Converting between Units

6–10

6. A jet plane flies at about 10,000 meters. If 1 meter is 3.3 feet, how high does the plane fly in feet?

7. When you drive into Canada, the speed limit sign says 100 kilometers per hour. What is the speed limit in miles per hour? One mile consists of 1.6 kilometers.

8. You hire 5 painters to paint your house, which has a surface of 200 square meters. If each painter can paint 10 square meters per hour, how long does it take for them to paint the entire house?

9. Your dog eats a quarter pound of dog food each day. How often (in days) do you have to buy a 10-pound bag of dog food?

10. Your grandmother can knit a sweater in 3 days if she works 8 hours per day. She uses one bobbin of yarn every 2 hours, and each bobbin has 10 yards of yarn. How long is all the yarn in the sweater?

Practicing Scientific Notation

11–14

11. The speed of light is about 300,000,000 meters per second. Write this speed in scientific notation.

12. A femtosecond is 1 millionth of 1 billionth of a second. What is a femtosecond in scientific notation?

13. The radius of the sun is $r = 6.955 \times 10^8$ meters. Using the formula $V = \frac{4}{3}\pi r^3$ for the volume of a sphere of radius r, what is the volume of the sun in scientific notation?

14. Assume there are 7 billion people on Earth. If each person has a mass of 70 kilograms and the Earth has a mass of 6×10^{24} kilograms, what fraction of the mass of Earth is due to humans?

Understanding Unit Prefixes

15–16

15. A recipe calls for 500 milligrams of salt. You're serving a large group, so you want to triple the portions of the recipe. How many grams of salt are required?

16. How many milliwatts are in 1 megawatt? Give the answer in scientific notation.

Spotting the Number of Significant Digits

17–20

17. How many significant digits are in the number 303.4?

18. Calculate the sum $21.21 + 4.8 + 2.33$ to the correct number of significant digits.

19. How many significant digits are in the number 5,003?

20. How many significant digits can you retain for $\sqrt{45.365+29.821}$?

Rounding to the Correct Number of Digits

21–25

21. Calculate the sum 98.374 + 28.56 to the correct number of significant digits.

22. A physicist adds 0.25 gallons of paint to a container that already holds 10 gallons of paint. Given the significant digits of the quantities added, how much paint can she say is in the container?

23. Evaluate the equation $t = (5.01 \times 4.4) + (3.2 \times 18)$ to the correct number of significant digits, and express the answer using the appropriate notation.

24. You measure the height of your apartment to be 2.6 meters high. If the apartment building has 8 floors, what is the height of the apartment building?

25. What is the result of $63.005 \times \left(18.54 + \frac{65}{4}\right)$ to the correct number of significant digits?

Chapter 2

Moving along with Kinematics

To describe motion, you can use terms like displacement, speed, velocity, and acceleration. *Displacement* is a distance in a particular direction. *Speed* is the distance traveled in a certain amount of time. If you combine speed with a direction, you get *velocity*. *Acceleration* measures how quickly velocity changes.

The Problems You'll Work On

In this chapter you'll move through the following topics:

- Finding the displacement in one and two dimensions
- Using velocity to determine the displacement
- Taking the average of the instantaneous speed
- Determining the change in velocity using acceleration
- Relating displacement, velocity, acceleration, and time

What to Watch Out For

You'll speed through these questions if you keep the following in mind:

- Using the distance traveled, not the displacement, to determine average speed
- Remembering that velocity is the change in displacement in a certain amount of time
- Remembering that acceleration is the change in velocity in a certain amount of time

Determining Displacement Using Positions in One Dimension

26–29

26. You leave your apartment and walk 2 blocks north, only to realize that you forgot your keys. You turn around and walk back 2 blocks south to get them. What is your total displacement?

27. A car is driven north for 5 miles, then south for 3 miles, and then north again for 2 miles. What is its displacement?

28. A pair of figure skaters skates together for 10 meters. Then the man launches his partner through the air. She lands 15 meters ahead of where the pair began skating. What is her displacement with respect to the launching point when she lands?

29. An elevator is at the ground floor. It goes once to the first floor, twice to the second floor, three times to the third floor, and then four times to the fourth floor. What is the displacement of the elevator when Ms. Smith gets on at the third floor?

Getting Displacement in Two Dimensions with Axes

30–35

30. You move a marker on a board from one point (2 centimeters, 4 centimeters) to another point (5 centimeters, 8 centimeters). What is the magnitude of the displacement of the marker?

31. To get to your friend's house, you walk 4 blocks north and 1 block east. What is the direction of your displacement with respect to the direction east?

32. A basketball player shoots the ball, releasing it at 8 feet above the floor and 5 feet from the basket. The ball goes straight through the basket, which is 10 feet above the floor. What is the magnitude of the displacement of the ball from the point at which it is released and the point at which it passes through the hoop?

33. A chess board is 8 squares by 8 squares. You move your bishop from one square (3, 1) to another square (7, 5). What is the magnitude (in squares) and angle of the displacement?

34. A child is scooting around on his toy truck. He scoots 5 meters down the hall, then turns 90 degrees to the right and scoots 3 meters, then turns again 90 degrees to the right and scoots 2 more meters. What is his displacement over this trip?

35. You want to shoot a laser beam from the edge of a stage to a disco ball hanging from the ceiling. The stage is 1 meter above the floor, the disco ball is 1 meter below the ceiling, and the height of the ceiling is 4 meters. The horizontal distance from the edge of the stage where the laser is mounted to the point directly under the disco ball is 5 meters. At what angle above the horizontal should you aim the laser?

Traveling with Average Speed and at Instantaneous Speed

36–40

36. You run from your house to the grocery store in 1.0 minute, and the store is 300 meters from your house. What is your average speed in meters per second for the trip?

37. In a traffic jam, you drive at 10 miles per hour for 10 minutes, at 20 miles per hour for 1 minute, at 15 miles per hour for 5 minutes, at 30 miles per hour for 2 minutes, and at 5 miles per hour for 15 minutes. What is your maximum instantaneous speed?

38. A ball is dropped from the top floor of your five-floor apartment building. You're on the bottom floor and see the ball go past your small window. If you measure the ball's speed at this point, is it the average speed, the instantaneous speed, both the average and the instantaneous speed, or neither the average nor the instantaneous speed?

39. The average speed of a car being driven in London is 11 miles per hour. If you have to drive 15 miles from your home to work in London, how long do you expect it to take?

40. The average speed of runner A is 10 percent greater than that of runner B. If runner B is given a 10-meter head start in a 100-meter dash, which runner will finish first?

Distinguishing between Average Speed and Average Velocity

41–45

41. You travel north for 80 miles and then east for 30 miles. What is the magnitude of your average velocity if the entire trip takes 4 hours?

42. You travel north for 80 miles and then east for 30 miles. What is your average speed if the entire trip takes 4 hours?

43. You travel 35 miles north and 20 miles east. If the trip takes 30 minutes, what is the magnitude (in miles per hour) and direction of your average velocity?

44. A postman walks 10 blocks north, then 3 blocks east, and then south for an unknown number of blocks. The time for his trip is 1.0 hour, and each block is 100 meters long. If his average speed is 1.0 meter per second, what is the magnitude of his average velocity in meters per second?

45. You travel 40 miles north, then 30 miles east, then 20 miles north, and then 10 miles south. If your trip takes 2 hours, what is your average speed?

Speeding Up and Down with Acceleration

46–50

46. It takes you 2.0 seconds to accelerate from a standstill to a running speed of 7.0 meters per second. What is the magnitude of your acceleration?

47. The acceleration due to gravity at the surface of Earth is about 9.8 meters per second per second. If you drop a small heavy ball from the fourth floor of a building, how fast is the ball moving after 0.5 seconds?

48. Your infant daughter has a maximum crawling velocity of 0.3 meters per second. If she accelerates at 2 meters per second per second, how long does it take her to reach her maximum velocity when she starts from rest?

49. A plane's takeoff speed is 300 kilometers per hour. If it accelerates at 2.9 meters per second per second, how long is it on the runway after starting its takeoff roll?

50. You ride your bicycle at 10 meters per second and accelerate at –2.3 meters per second per second for 10 seconds. What is your final velocity?

Finding Displacement with Acceleration and Time

51–54

51. Starting from rest, you accelerate at 2 meters per second per second for 2 seconds to get up to full speed on your bicycle. How far do you travel during this time?

52. A car accelerates northward at 4.0 meters per second per second over a distance of 30 meters. If it starts at rest, for how long does it accelerate?

53. Starting from rest, a motorcycle rider covers 200 meters in 10 seconds. What was his acceleration?

54. A tennis player serves a ball at 100 miles per hour. If the ball accelerates over a period of 0.05 seconds from essentially a standstill, how far (in meters) does the ball travel during its acceleration? One mile consists of 1,609 meters.

Finding Displacement with Acceleration and Velocities

55–58

55. You're driving at 20 meters per second northbound and brake to slow to 10 meters per second. During that time, you cover 50 meters. What was your acceleration?

56. You ski along at 3.0 meters per second, and your friend whizzes by at a greater speed. You have to accelerate at 2.0 meters per second per second for 20 meters to attain the same speed. At what speed was your friend skiing?

57. A baseball pitcher throws a fastball at 90 miles per hour. He accelerates the ball over a distance of 2.0 meters. What is the acceleration of the ball?

58. In a spaceship, you accelerate from 200 meters per second to 500 meters per second at 10 meters per second per second. How many kilometers do you travel during this acceleration?

Finding Acceleration with Displacement and Time

59–62

59. A speed skater accelerates from a standstill to full speed over a distance of 12 meters. If she takes 2.6 seconds to do this, what is the magnitude of her acceleration?

60. Your car can accelerate at 3.4 meters per second per second. You are stopped at a red light and have 20 meters to accelerate onto the freeway when the light turns green. How long will it take you to accelerate over this distance?

61. You're driving at 18 meters per second when you apply the brake for 4 seconds. If the magnitude of your acceleration is 2.8 meters per second per second, how far did you travel in this time?

62. A ferry boat is traveling east at 1.3 meters per second when the captain notices a boat in its path. The captain engages the reverse motors so that the ferry accelerates to the west at 0.2 meters per second per second. After 20 seconds of this acceleration, what is the boat's position with respect to its initial position?

Finding Acceleration with Velocities and Displacement

63–66

63. A cheetah can accelerate from 0 miles per hour to 60 miles per hour in 20 meters. What is the magnitude of its acceleration?

64. A speedboat can accelerate from an initial velocity of 3.0 meters per second to a final velocity that is 3 times greater over a distance of 42 meters. What is the magnitude of its acceleration?

65. You drop a feather from your balcony, which is 4.5 meters above the ground. After falling 0.20 meters, it moves at the speed of 0.30 meters per second. What is the magnitude of its acceleration?

66. A boat moving north at 2.3 meters per second undergoes constant acceleration until its speed is 1.2 meters per second northward. With respect to its initial position, its final position is 200 meters northward. What is its acceleration?

Finding Velocities with Acceleration and Displacement

67–70

67. A boat accelerates at 0.34 meters per second per second northward over a distance of 100 meters. If its initial velocity is 2.0 meters per second northward, what is its final velocity?

68. A train brakes to a stop over a distance of 3,000 meters. If its acceleration is 0.1 meter per second per second, what is its initial speed?

69. To pass another race car, a driver doubles his speed by accelerating at 4.5 meters per second per second for 50 meters. What are his initial and final speeds?

70. From a position 120 meters above a pigeon, a falcon dives at 9.1 meters per second per second, starting from rest. After diving 25 meters, the falcon stops accelerating. What is the falcon's speed when it strikes the pigeon?

Chapter 3

Moving in a Two-Dimensional World

The basic quantities you use to describe motion in two dimensions — displacement, velocity, and acceleration — are vectors. A *vector* is an object that has both a magnitude and a direction. When you have an equation that relates two vectors, you can break each vector into parts, called *components*. You end up with two equations, which are usually much easier to solve.

The Problems You'll Work On

In this chapter on two-dimensional vectors and two-dimensional motion, you work with the following situations:

- Adding and subtracting vectors
- Multiplying a vector by a scalar
- Taking apart a vector to find its components
- Determining the magnitude and direction of a vector from its components
- Finding displacement, velocity, and acceleration in two dimensions
- Calculating the range and time of flight of projectiles

What to Watch Out For

While you zig and zag your way through the problems in this chapter, avoid running into obstacles by:

- Identifying the correct quadrant when finding the direction of a vector
- Finding the components before trying to add or subtract two vectors
- Breaking the displacement, velocity, and acceleration vectors into components to turn one difficult problem into two simple problems
- Remembering that the vertical component of velocity is zero at the apex
- Recognizing that the horizontal component of acceleration is zero for freely falling objects

Getting to Know Vectors

71–72

71. How many numbers are required to specify a two-dimensional vector?

72. Marcus <u>drives</u> <u>45 kilometers</u> at a <u>bearing</u> of <u>11 degrees</u> <u>north of west</u>. Which of the underlined words or phrases represents the magnitude of a vector?

Adding and Subtracting Vectors

73–75

73. Vector **U** points west, and vector **V** points north. In which direction does the resultant vector point?

74. If vectors **A**, **B**, and **C** all point to the right, and their lengths are 3 centimeters, 5 centimeters, and 2 centimeters, how many centimeters long is the resultant vector formed by adding the three vectors together?

75. Initially facing a flagpole, Jake turns to his left and walks 12 meters forward. He then turns completely around and walks 14 meters in the opposite direction. How many meters farther away from the flagpole would Jake have ended had he started his journey by turning to the right and walking 14 meters and then turning completely around and walking the final 12 meters?

Adding Vectors and Subtracting Vectors on the Grid

76–79

76. If $\mathbf{A} = (2, 4)$ and $\mathbf{B} = (3, 8)$, what is the value of $\mathbf{A} + \mathbf{B}$?

77. If $\mathbf{V} = (6, -4)$, what is the value of $\frac{1}{2}\mathbf{V}$?

78. Given that $\mathbf{A} = (-2, 2)$ and $\mathbf{B} = (3, 1)$, calculate $3\mathbf{A} + 5\mathbf{B}$.

79. Given the three vectors $\mathbf{A}(7, -3)$, $\mathbf{B}(0, 4)$, and $\mathbf{C}(-3, -3)$, solve for $\mathbf{D}$ if $2\mathbf{A} - 3\mathbf{B} = \mathbf{D} - 3\mathbf{C}$.

Breaking Vectors into Components

80–83

80. Vector **A** has a magnitude of 28 centimeters and points at an angle 80 degrees relative to the *x*-axis. What is the value of A_y? Round your answer to the nearest tenth of a centimeter.

81. Vector **C** has a length of 8 meters and points 40 degrees below the *x*-axis. What is the vertical component of **C**, rounded to the nearest tenth of a meter?

82. Jeffrey drags a box 15 meters across the floor by pulling it with a rope. He exerts a force of 150 newtons at an angle of 35 degrees above the horizontal. If work is the product of the distance traveled times the component of the force in the direction of motion, how much work does Jeffrey do on the box? Round to the nearest ten newton-meters.

83. Three forces pull on a chair with magnitudes of 100, 60, and 140, at angles of 20 degrees, 80 degrees, and 150 degrees to the positive *x*-axis, respectively. What is the component form of the resultant force on the chair? Round your answer to the nearest whole number.

Reassembling a Vector from Its Components

84–87

84. What are the magnitude and direction of the vector $\mathbf{W} = (6, 3)$? Round your answers to the nearest tenth place and give your angle (direction) in units of degrees.

85. Given vectors $\mathbf{A} = (3, -3)$ and $\mathbf{W} = (-2, 4)$, what angle would vector **C** make with the *x*-axis if $\mathbf{C} = \mathbf{A} + \mathbf{W}$? Round your answer to the nearest tenth of a degree.

86. If you walk 12 paces north, 11 paces east, 6 paces south, and 20 paces west, what is the magnitude (in paces) and direction (in degrees relative to the positive *x*-axis) of the resultant vector formed from the four individual vectors? Round your results to the nearest integer.

87. After a lengthy car ride from a deserted airfield to Seneca Airport, Candace finds herself 250 kilometers north and 100 kilometers west of the airfield. At Seneca, Candace boards a small aircraft that flies an unknown distance in a southwesterly direction and lands at Westsmith Airport. The next day, Candace flies directly from Westsmith to the airfield from which she started her journey. If the flight from Westsmith was 300 kilometers in distance and flew in a direction 15 degrees south of east, how many kilometers was Candace's flight from Seneca to Westsmith? Round your answer to the nearest integer.

Describing Displacement, Velocity, and Acceleration in Two Dimensions

88–96

88. Hans drives 70 degrees north of east at a speed of 50 meters per second. How fast is Hans traveling northward? Round your answer to the nearest integer.

89. If you walk 25 meters in a direction 30 degrees north of west and then 15 meters in a direction 30 degrees north of east, how many meters did you walk in the north-south direction?

90. Jake wants to reach a postal bin at the opposite corner of a rectangular parking lot. It's located 34 meters away in a direction 70 degrees north of east. Unfortunately, the lot's concrete was recently resurfaced and is still wet, meaning that Jake has to walk around the lot's edges to reach the bin. How many meters does he have to walk? Round your answer to the nearest whole meter.

91. If $\mathbf{D} = \mathbf{A} + \mathbf{B} + \mathbf{C}$, use the following information to determine the components of **D**. Use ordered-pair notation rounded to the nearest tenth of a meter for your answer. (All angles are measured relative to the x-axis.)

A: 45 meters at 20 degrees

B: 18 meters at 65 degrees

C: 32 meters at –20 degrees

92. To walk from the corner of Broadway and Park Place to the corner of Church and Barkley in Central City, a person must walk 150 meters west and then 50 meters south. How many meters shorter would a direct route be? Round your answer to the nearest meter.

93. If Jimmy walks 5 meters east and then 5 meters south, what angle does the resultant displacement vector make with the positive x-axis (assuming the positive x-axis points east)?