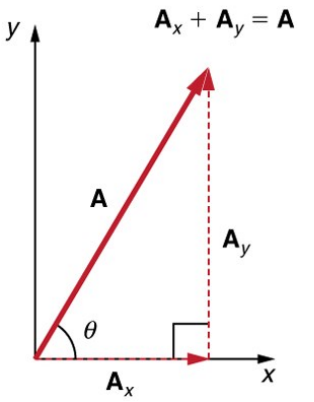
Physics 1-08 Vector Addition *Name:* _____

Vectors



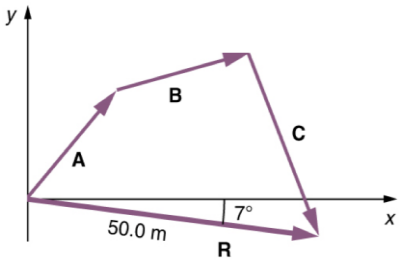
- Vectors are measurements with _____ and _____.
  - They are represented by _____.
  - The length of the arrow is the _____.
  - The direction of the arrow is the _____.
- Can be represented in _____ form
  - Make a _____ using the vector as the _____
  - Use _____ and _____ to find the horizontal (x) component and the vertical (y) component
  - Assign _____ signs to any component going _____ or _____
- $\sin(\theta) = \frac{opposite}{hypotenuse}$ $\cos(\theta) = \frac{adjacent}{hypotenuse}$ $\tan(\theta) = \frac{opposite}{adjacent}$

A football player kicks a ball at 15 m/s at 30° above the ground. Find the horizontal and vertical components of this velocity.

Scalar Multiplication

- Multiplying a vector by a _____ number
- Draw the vector that many times in a _____
- Or multiply the _____ by that number
- A negative vector means multiply by -1, so it goes in the _____ direction

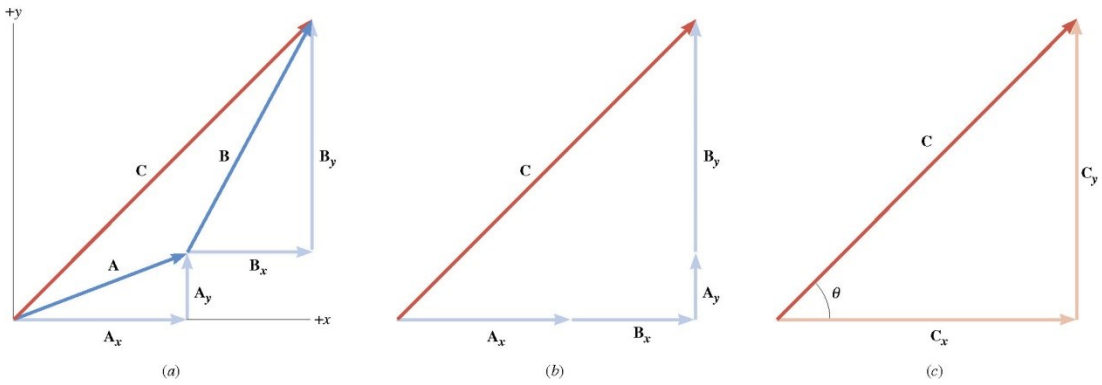
Vector Addition - Graphical Method



- Draw the _____ vector.
- Draw the second vector where the _____ (tip-to-tail).
- Draw the resultant vector from where the _____ vector begins to where the _____ vector ends.
- _____ the resultant's length and direction.

Vector Addition - Component Method

Vectors can be described by its _____ to show how far it goes in the x and y directions. To add vectors, you simply add the _____ and _____ to get total (_____) x and y components.



1. Find the _____ for _____ the vectors to be added
2. _____ all the _____ components
3. _____ all the _____ components
4. Use the _____ Theorem to find the _____ of the resultant
5. Use _____ to find the _____ (the direction is always found at the _____ of the resultant)

Note: Drawing pictures and triangles helps immensely.

Add the following vectors. $\boldsymbol{C} = 15\ m$ at 25° N of E; $\boldsymbol{D} = 20\ m$ at 60° S of E

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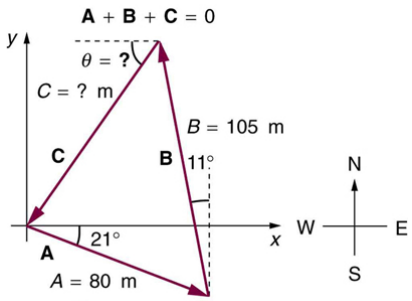
A jogger runs 145 m in the direction 20.0° east of north and then 105 m in a direction 35.0° south of east. Determine the magnitude and direction of jogger's position from her starting point.

Practice Work

1. (a) Is it possible for one component of a vector to be zero, while the vector itself is not zero? (b) Is it possible for a vector to be zero, while one component is not zero? Explain.
2. Can two nonzero perpendicular vectors be added together so their sum is zero? Explain.
3. Can three or more vectors with unequal magnitudes be added together so their sum is zero? If so, show by means of a tip-to-tail arrangement of the vectors how this could occur.
4. An ostrich is running at a speed of 17.0 m/s in a direction of 68.0° north of west. What is the magnitude of ostrich's velocity component that is directed (a) due north and (b) due west? (RW) **15.8 m/s, 6.37 m/s**
5. An ocean liner leaves New York City and travels 18.0° north of east for 155 km. How far east and how far north has it gone? In other words, what are the magnitudes of the components of the ship's displacement vector in the directions (a) due east and (b) due north? (Cutnell 1.33) **147 km, 47.9 km**
6. A new landowner has a triangular piece of flat land she wishes to fence. Starting at the west corner, she measures the first side to be 80.0 m long and the next to be 105 m. These sides are represented as displacement vectors A and B in Figure 3.61. She then correctly calculates the length and orientation of the third side C. What is her result? (Hint: Since A + B + C = 0, then A + B = −C.) (OpenStax 3.20) **92.3 m at 53.7° S of W**



7. Suppose you first walk 12.0 m in a direction 20° west of north and then 20.0 m in a direction 40.0° south of west. How far are you from your starting point, and what is the compass direction of a line connecting your starting point to your final position? (OpenStax 3.5) **19.5 m at 4.65° S of W**
8. A golfer, putting on a green, requires three strokes to "hole the ball." During the first putt, the ball rolls 5.0 m due east. For the second putt, the ball travels 2.1 m at an angle of 20.0° north of east. The third putt is 0.50 m due north. What displacement (magnitude and direction relative to due east) would have been needed to "hole the ball" on the very first putt? (Cutnell 1.41) **7.1 m at 9.9° N of E**
9. You are on a treasure hunt and your map says, "Walk due west for 52 paces, then walk 30.0° north of west for 42 paces, and finally walk due north for 25 paces." What is the magnitude of the component of your displacement (a) due north and (b) due west? (Cutnell 1.42) **46 paces, 88 paces**
10. On a safari, a team of naturalists sets out toward a research station located 4.8 km away in a direction 42° north of east. After traveling in a straight line for 2.4 km, they stop and discover that they have been traveling 22° north of east, because their guide misread his compass. What are (a) the magnitude and (b) the direction (relative to due east) of the displacement vector now required to bring the team to the research station? (Cutnell 1.45) **2.7 km at 60° N of E**
11. While snorkeling in the ocean, you swim directly towards shore at 2 m/s. The current of the water pushes you directly sideways at 3 m/s. What is your resultant velocity (magnitude and direction relative to your intended path of straight towards shore)? (RW) **3.6 m/s at 56.3°**
12. An airplane flies at 200 km/h at 30.0° N of W. The wind blows it at 30 km/h at 45.0° E of N. What is the resultant velocity of the airplane (magnitude and direction)? (RW) **194 km/h at 38.6° N of W**
13. You are trying to row a boat directly across a river that is 50.0 m wide. You can row at 3.1 m/s in a direction directly across the river perpendicular to the shore. The current is 4.8 m/s parallel to shore. (a) What is your velocity relative to the shore? (b) How much time does it take to get to the other side of the river? (c) How far downstream do you land? (RW) **5.71 m/s at 32.9° downstream from shore, 16.1 s, 77.4 m**