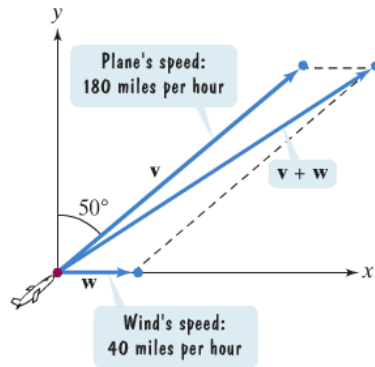


## Pre-Calculus Applications of Vectors Worksheet

Round all answers to the nearest tenth.

1.

The figure shows a small plane flying at a speed of 180 miles per hour on a bearing of  $N50^\circ E$ . The wind is blowing from west to east at 40 miles per hour. The figure indicates that  $\mathbf{v}$  represents the velocity of the plane in still air and  $\mathbf{w}$  represents the velocity of the wind.

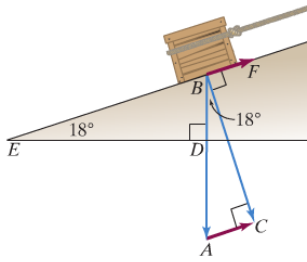


- Express  $\mathbf{v}$  and  $\mathbf{w}$  in terms of their magnitudes and direction angles.
- Find the resultant vector,  $\mathbf{v} + \mathbf{w}$ .
- The magnitude of  $\mathbf{v} + \mathbf{w}$ , called the **ground speed** of the plane, gives its speed relative to the ground. Approximate the ground speed to the nearest mile per hour.
- The direction angle of  $\mathbf{v} + \mathbf{w}$  gives the plane's true course relative to the ground. Approximate the true course to the nearest tenth of a degree. What is the plane's true bearing?

- An airplane is traveling at a fixed altitude with a negligible wind factor. The airplane is headed  $N 30^\circ W$  at a speed of 500 miles per hour. As the airplane reaches a certain point, it encounters a wind with a velocity of 70 mph in the direction of  $N 45^\circ E$ . What are the resultant speed and direction of the airplane?
- An airplane's velocity with respect to the air is 580 mph and it is headed  $N 58^\circ W$ . The wind, at the altitude of the plane, is from the southwest and has a velocity of 60 mph. What are the resultant speed and direction of the airplane?
- Two forces, one of 35 pounds and the other 50 pounds, act on the same object. The angle between the forces is  $30^\circ$ . Find the magnitude of the resultant vector of these two forces.
- Two forces, one of 100 pounds and the other 150 pounds act on the same object, at angles of  $20^\circ$  and  $60^\circ$ , respectively, with the positive x-axis. Find the direction and magnitude of the resultant of these forces.
- Lisa and Gina are pulling Aaron in his little red wagon. Gina pulls  $N 10^\circ E$  with a force of 160 N (newtons). Lisa pulls  $N 30^\circ W$  with a force of 190 N (newtons). What is the magnitude and direction of the resultant?
- A plane's heading is  $160^\circ$  (which implies to measure from North) and its air speed is 350 mph. If a west wind (which implies a wind from the west) is blowing at 20 mph, what are the resultant speed and direction of the airplane?
- A jet is heading due north (which implies to the North) with an airspeed of 500 mph, and the wind is blowing to the southeast at 50 mph. What is the resultant speed of the jet?

9.

The figure shows a box being pulled up a ramp inclined at  $18^\circ$  from the horizontal.



If the box weighs 100 pounds, find the magnitude of the force needed to pull it up the ramp.  
If a force of 30 pounds is needed to pull the box up the ramp, find the weight of the box.

Use the following information to solve Exercises 75–76.

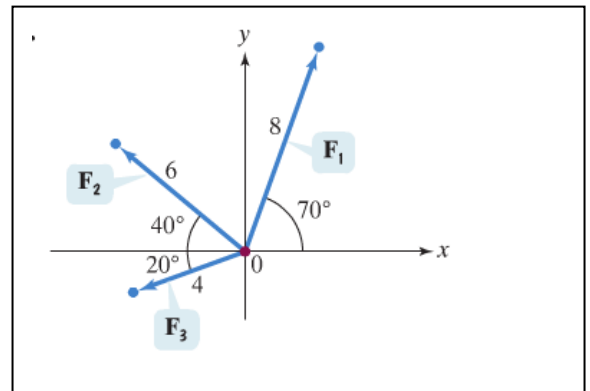
$\overrightarrow{BA}$  = force of gravity

$\|\overrightarrow{BA}\|$  = weight of the box

$\|\overrightarrow{AC}\|$  = magnitude of the force needed to pull the box up the ramp

$\|\overrightarrow{BC}\|$  = magnitude of the force of the box against the ramp

10. Melanie and Amy are trying to push a 40 N box up a  $23^\circ$  ramp. Find the minimum amount of force that they needed to use in order to keep the box from sliding down the ramp.
11. A force of 600 pounds is required to pull a boat and trailer up a ramp inclined at  $15^\circ$  from the horizontal. Find the combined weight of the boat and trailer. Assume no friction is involved.
- 12.
- a. Find the magnitude of the force required to keep a 3500-pound car from sliding down a hill inclined at  $5.5^\circ$  from the horizontal.
  - b. Find the magnitude of the force of the car against the hill.
- 13.
- a. Find the magnitude of the force required to keep a 280-pound barrel from sliding down a ramp inclined at  $12.5^\circ$  from the horizontal.
  - b. Find the magnitude of the force of the barrel against the ramp.
14. A plane is flying at a speed of 320 mph on a bearing N  $70^\circ$  E. Its resultant speed is 370 mph and resultant direction is  $60^\circ$ . Find the speed and direction of the wind.
15. The given forces (in newtons) are acting on an object (see diagram). Find the direction and magnitude of the resultant of these forces.



16. Three forces of 75 pounds, 100 pounds, and 125 pounds act on the same object at angles of  $-30^\circ$ ,  $45^\circ$ , and  $135^\circ$  respectively, with the positive x-axis. Find the direction and magnitude of the resultant of these forces.

**Formula for WORK:  $W = F \cdot d \cdot \cos\theta$**

17. A heavy bag is dragged 10 feet across the floor, using 85 pounds. Find the work done if the direction of the force is  $60^\circ$  above the horizontal.
18. A wagon is pulled along level ground by exerting a force of 25 pounds on a handle that makes an angle of  $32^\circ$  with the horizontal. How much work is done pulling the wagon 100 feet?

**Vector Worksheet Answers:**

1. a.  $\mathbf{v} = \langle 180 \cos 40^\circ, 180 \sin 40^\circ \rangle$     $\mathbf{w} = \langle 40 \cos 0^\circ, 40 \sin 0^\circ \rangle$   
b.  $\mathbf{v} + \mathbf{w} = \langle 177.9, 115.7 \rangle$   
c. 212.2 mph  
d. N  $57.0^\circ$  E
2. 522.5 mph, N  $22.6^\circ$  W
3. 569.5 mph, N  $52.1^\circ$  W
4. 82.2 pounds
5. 235.5 pounds,  $44.2^\circ$  (with respect to the positive x-axis)
6. 329.1 N, N  $11.8^\circ$  W
7. 357.33 mph;  $156.99^\circ$  from North or S  $23.02^\circ$  E
8. 465.99 mph
9. 30.9 pounds (up the ramp); 97.1 lbs
10. 15.6 N (Newtons)
11. 2318.2 lbs
12. a) 335.5 lbs   b) 3483.9 lbs
13. a) 60.6 lbs   b) 273.4 lbs
14. 78.1 mph, N  $14.6^\circ$  E
15. 11.5 Newtons,  $119.3^\circ$  (with respect to the positive x-axis)
16. 130.5 pounds,  $68.8^\circ$  (with respect to the positive x-axis)
17. 425 foot-pounds
18. 2120 foot-pounds