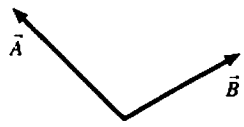
3 Vectors and Coordinate Systems

3.1 Vectors

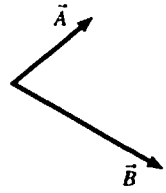
3.2 Properties of Vectors

Exercises 1–3: Draw and label the vector sum $\vec{A} + \vec{B}$.

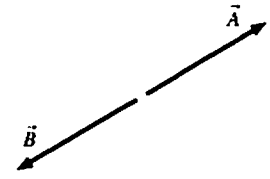
1.



2.



3.

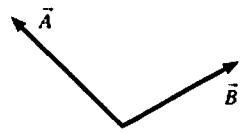


4. Use a figure and the properties of vector addition to show that vector addition is associative. That is, show that

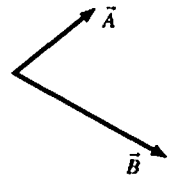
$$(\vec{A} + \vec{B}) + \vec{C} = \vec{A} + (\vec{B} + \vec{C})$$

Exercises 5–7: Draw and label the vector difference $\vec{A} - \vec{B}$.

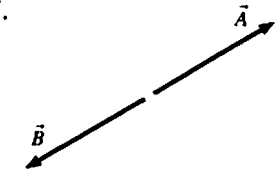
5.



6.



7.



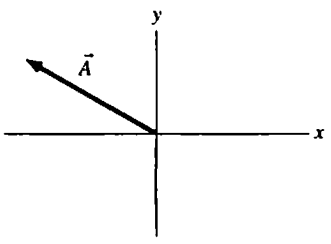
8. Draw and label the vector $2\vec{A}$ and the vector $\frac{1}{2}\vec{A}$.

9. Given vectors $\vec{A}$ and $\vec{B}$ below, find the vector $\vec{C} = 2\vec{A} - 3\vec{B}$.

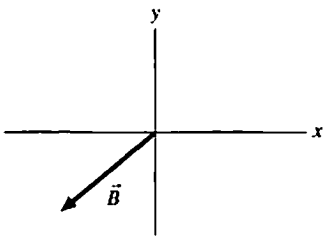
3.3 Coordinate Systems and Vector Components

Exercises 10–12: Draw and label the x- and y-component vectors of the vector shown.

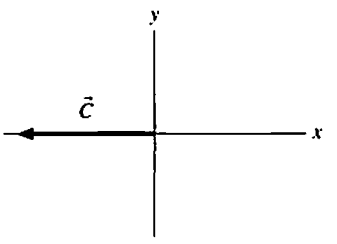
10.



11.

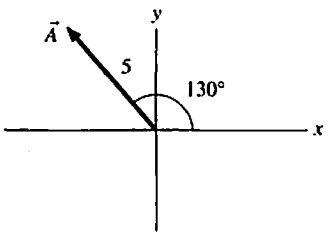


12.



Exercises 13–15: Determine the numerical values of the x- and y-components of each vector.

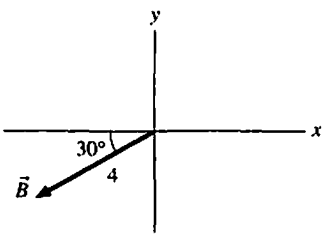
13.



$A_x =$ _____

$A_y =$ _____

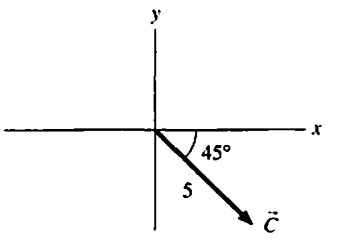
14.



$B_x =$ _____

$B_y =$ _____

15.

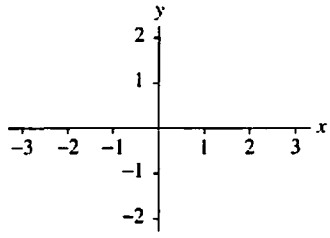


$C_x =$ _____

$C_y =$ _____

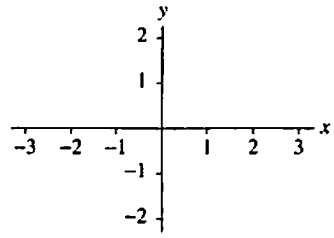
Exercises 16–18: Draw and label the vector with these components. Then determine the magnitude of the vector.

16. $A_x = 3, A_y = -2$



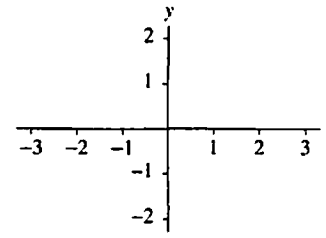
$A =$ _____

17. $B_x = -2, B_y = 2$



$B =$ _____

18. $C_x = 0, C_y = -2$

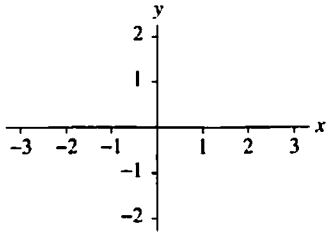


$C =$ _____

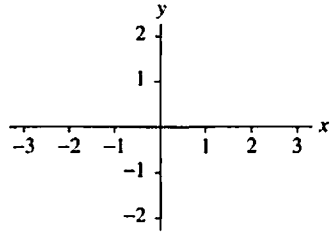
3.4 Vector Algebra

Exercises 19–21: Draw and label the vectors on the axes.

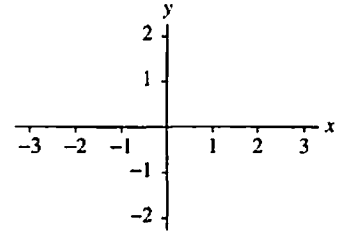
19. $\vec{A} = -\hat{\imath} + 2\hat{\jmath}$



20. $\vec{B} = -2\hat{\jmath}$

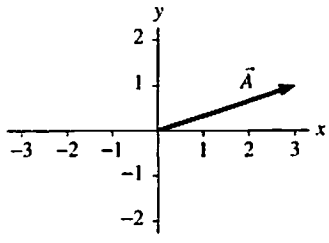


21. $\vec{C} = 3\hat{\imath} - 2\hat{\jmath}$



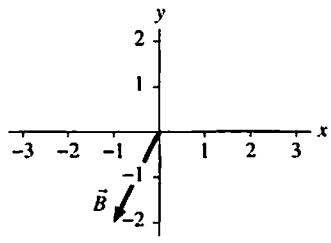
Exercises 22–24: Write the vector in component form (e.g., $3\hat{\imath} + 2\hat{\jmath}$).

22.



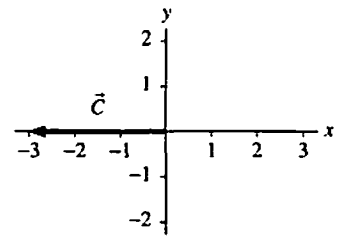
$\vec{A} =$ _____

23.



$\vec{B} =$ _____

24.



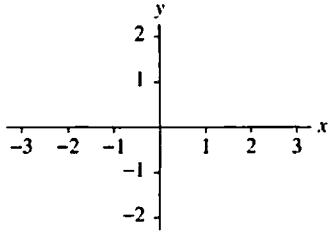
$\vec{C} =$ _____

25. What is the vector sum $\vec{D} = \vec{A} + \vec{B} + \vec{C}$ of the three vectors defined in Exercises 22–24? Write your answer in *component* form.

Exercises 26–28: For each vector:

- Draw the vector on the axes provided.
- Draw and label an angle θ to describe the direction of the vector.
- Find the magnitude and the angle of the vector.

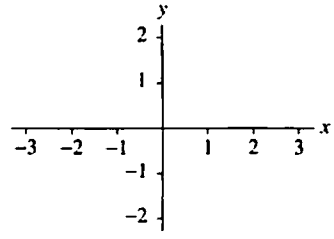
26. $\vec{A} = 2\hat{\imath} + 2\hat{\jmath}$



$A =$ _____

$\theta =$ _____

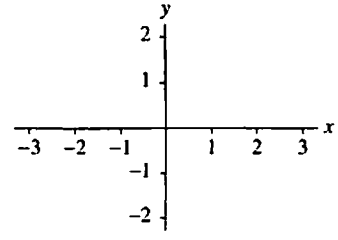
27. $\vec{B} = -2\hat{\imath} + 2\hat{\jmath}$



$B =$ _____

$\theta =$ _____

28. $\vec{C} = 3\hat{\imath} + \hat{\jmath}$

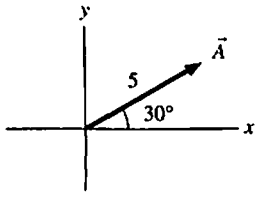


$C =$ _____

$\theta =$ _____

Exercises 29–31: Define vector $\vec{A}$ = (5, 30° above the horizontal). Determine the components A_x and A_y in the three coordinate systems shown below. Show your work below the figure.

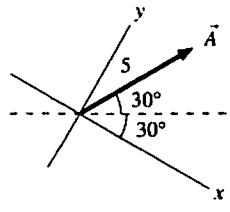
29.



$A_x =$ _____

$A_y =$ _____

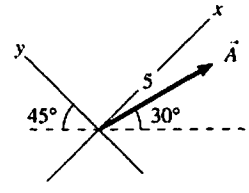
30.



$A_x =$ _____

$A_y =$ _____

31.



$A_x =$ _____

$A_y =$ _____