

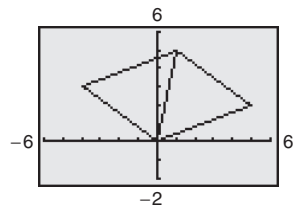
Chapter 6 Project Adding Vectors Graphically

The pseudocode at the right can be translated into a program for a graphing utility. (The program for several models of calculators can be found at this textbook's *Online Study Center*.) The program graphs two vectors

$$\mathbf{u} = a\mathbf{i} + b\mathbf{j} \quad \text{and} \quad \mathbf{v} = c\mathbf{i} + d\mathbf{j}$$

in standard position. Then, using the parallelogram law for vector addition, the program also sketches the vector sum $\mathbf{u} + \mathbf{v}$. Before running the program, you should set values that produce an appropriate viewing window.

- a. Use the program to graph the sum of the vectors $\mathbf{u} = 5\mathbf{i} + 2\mathbf{j}$ and $\mathbf{v} = -4\mathbf{i} + 3\mathbf{j}$. Set your viewing window as indicated in the graph below. Identify the vectors \mathbf{u} , \mathbf{v} , and $\mathbf{u} + \mathbf{v}$ in the graph.



- b. An airplane has a bearing of 300° at a speed of 400 miles per hour. The airplane encounters wind of velocity 75 miles per hour in the direction $N 40^\circ E$. Use the program to find the resultant speed and direction of the airplane.

Program

- Input a .
- Input b .
- Input c .
- Input d .
- Draw a line from $(0, 0)$ to (a, b) .
- Draw a line from $(0, 0)$ to (c, d) .
- Add $a + c$ and store in e .
- Add $b + d$ and store in f .
- Draw a line from $(0, 0)$ to (e, f) .
- Draw a line from (a, b) to (e, f) .
- Draw a line from (c, d) to (e, f) .
- Pause to view graph.
- End program.

Questions for Further Exploration

In Questions 1–4, use the program to graph the sum of the vectors. Use the result to estimate graphically the components of the sum. Then check your result algebraically. (Use $-9 \leq x \leq 9$ and $-6 \leq y \leq 6$.)

1. $\mathbf{u} = 3\mathbf{i} + 4\mathbf{j}$, $\mathbf{v} = -5\mathbf{i} + \mathbf{j}$
2. $\mathbf{u} = 5\mathbf{i} - 4\mathbf{j}$, $\mathbf{v} = 3\mathbf{i} + 2\mathbf{j}$
3. $\mathbf{u} = -4\mathbf{i} + 4\mathbf{j}$, $\mathbf{v} = -2\mathbf{i} - 6\mathbf{j}$
4. $\mathbf{u} = 7\mathbf{i} + 3\mathbf{j}$, $\mathbf{v} = -2\mathbf{i} - 6\mathbf{j}$
5. After encountering the wind, is the airplane in part (b) above traveling at a faster speed or a slower speed? Explain.

6. Consider the airplane described in part (b). What wind velocity, in the direction of $N 40^\circ E$, will produce a resultant direction of 310° ? Explain how to use the above program to obtain the answer *experimentally*. Then explain how to obtain the answer algebraically.
7. Consider the airplane described in part (b). What wind direction, at a speed of 75 miles per hour, will produce a resultant direction of 310° ? Explain how to use the above program to obtain the answer *experimentally*. Then explain how to obtain the answer algebraically.