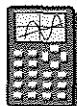# Standard Form

You will need:
- graph paper
- graphing calculator (optional)

Definitions: An equation of the form $Ax + By = C$ is called the *standard form* of a linear equation. A, B, and C are the *parameters* for the equation.

In this lesson you will investigate how the values of the parameters affect the graphs of linear equations in standard form.

INTERCEPTS

Do not use graphing calculators for this section. These equations of lines are in standard form. For each equation:

a. Find the parameters A, B, and C.

b. Find the x-intercept and the y-intercept.

c. Graph the line by plotting the intercepts.

1. $3x + 2y = 12$ 2. $3x - 2y = 18$

3. $x + y = 6$ 4. $x - y = 6$

5. $-3x + 4y = 10$

6. **Generalization**

a. Explain how to find the x-intercept and the y-intercept of the line whose equation is $Ax + By = C$.

b. A fast way to graph a line is by finding and plotting the intercepts. Show how to use this technique to graph a line of the form $Ax + By = C$. (Choose specific values for A, B, and C.)

7. a. Write the equation of a line that has x-intercept (6, 0). Graph it and find its y-intercept.

b. Write the equation of a line that has y-intercept (0, -4). Graph it and find its x-intercept.

c. Write the equation of a line that has y-intercept (0, 4) *and* x-intercept (-6, 0).

8. **Generalization** Show how to find the equation of a line having intercepts $(p, 0)$ and $(0, q)$.

THE CASE WHEN A = B

9. a. Graph $x + y = 10$.

b. On the same axes, graph $2x + 2y = 10$.

c. In the equations you graphed in parts (a) and (b), what are A, B, and C?

d. When you doubled A and B in the equation but left C the same, how did the graph change?

10. Draw the graphs of at least two other equations of the form $Ax + By = C$ for which A is equal to B and $C = 10$. Label the graphs with their equations.

11. ☞ Compare all the graphs you drew in problems 9-10. (What stayed the same, and what changed? How do the graphs compare in steepness?)

12. a. Graph $x + y = 4$.

b. On the same axes, graph $2x + 2y = 8$.

c. In the equations you graphed in parts (a) and (b), what are A, B, and C?

13. ☞

a. When you doubled A, B, and C, how did the graph change?

b. If you triple A, B, and C, what will the equation be? How do you think the graph will change? Explain.

VARYING A

14. a. Graph $x + 2y = 5$.

b. Graph $2x + 2y = 5$ on the same axes.

c. Draw several more graphs, changing the value of A, leaving B equal to 2, and C equal to 5. Use both positive and negative values for A.

15. ⚷— Compare all the graphs you drew in problem 14.

a. When you changed the value of A in the equation, what features of the graph changed and what stayed the same? Did the steepness change? Did the intercepts change?

b. How are the graphs having a positive value of A different from the graphs having a negative value of A?

c. Is it possible to pick a value of A so that the graph will be a horizontal line? A vertical line? Explain.

16. Show what you think the following graphs would look like. You don't have to graph them accurately, but you should make a rough sketch and explain your work.

a. $500x + 2y = 5$

b. $-500x + 2y = 5$

c. $0.01x + 2y = 5$

d. $-0.01x + 2y = 5$

VARYING B

17. a. Graph $2x + y = 8$.

b. Graph $2x + 2y = 8$ on the same axes.

c. Draw several more graphs, changing the value of B, leaving A equal to 2, and C equal to 8. Use both positive and negative values for B.

18. ⚷— Compare all the graphs you drew in problem 17.

a. When you changed the value of B in the equation, what features of the graph changed and what stayed the same? Did the steepness change? Did the intercepts change?

b. How are the graphs having a positive value of B different from the graphs having a negative value of B?

c. Is it possible to pick a value of B so that the graph will be a horizontal line? A vertical line? Explain.

19. Show what you think the following graphs would look like. You don't have to graph them accurately, but you should make a rough sketch and explain your work.

a. $2x + 100y = 8$

b. $2x - 100y = 8$

c. $2x + 0.02y = 8$

d. $2x - 0.02y = 8$

VARYING C

20. Where do you think the graph of $3x + 2y = 5$ will intersect the graph of $3x + 2y = 6$? You may want to check your prediction by graphing.

21. ⚷— Describe what will happen to the graph of $3x + 2y = 6$ when you change the value of C but keep A and B constant. What will change and what will stay the same? Make several graphs to convince yourself that your answers are correct.

22. **Report** Write a report summarizing what you learned in this lesson. Explain how the values of the parameters A, B, and C affect the graph of $Ax + By = C$, specifically its slope and intercept. Use examples.

DISCOVERY *DIFFERENCES OF PERFECT SQUARES*

23. **Project** The number 17 can be written as the difference of the squares of whole numbers, $9^2 - 8^2$. Which other whole numbers can be written as the difference of two squares of whole numbers? Which cannot? Look for patterns, and try to explain what you discover.

REVIEW *SIDES OF SQUARES*

24. The length of a side of a square is given. Find the area of the square.
    a. $\sqrt{2}$ b. $2 + \sqrt{2}$
    c. $2 - \sqrt{2}$ d. $2\sqrt{2}$
    e. $\sqrt{2}/2$ f. $2/\sqrt{2}$

25. The side lengths of two squares are given. Which of the two squares has the larger area? Explain how you know.
    a. $\sqrt{10} - \sqrt{5}$ and $\sqrt{5}$
    b. $2\sqrt{8}$ and $\sqrt{16}$

26. Which has the larger area, or are they the same?
    a. a rectangle with sides $\sqrt{2}$ and $\sqrt{5}$ or a square with side $\sqrt{10}$
    b. a rectangle with sides $\sqrt{4}$ and $\sqrt{8}$ or a square with side $2\sqrt{2}$

27. Which has the larger perimeter, or are they the same?
    a. a rectangle with sides $\sqrt{10}$ and $\sqrt{5}$ or a square with side $2\sqrt{5}$
    b. a rectangle with sides $2 + 2\sqrt{2}$ and $\sqrt{2}$ or a square with sides $2 + \sqrt{2}$