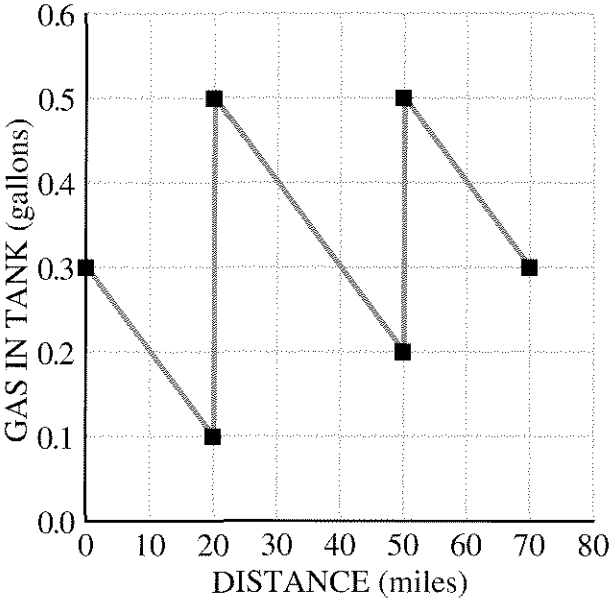
Essential Ideas

FUEL VS. DISTANCE

Gabe's scooter gets good mileage, but it has a small tank. The graph below shows how much gas was in his tank during one trip he took.



1. Write a paragraph describing Gabe's trip. Include the answers to these questions: How much gas did Gabe start with? How much did he end with? How many times did he stop for gas? How much gas did he use for the whole trip? How far did he travel before stopping each time? What is probably the capacity of his gas tank? How many miles did he get per gallon?
2. The gas station stops took ten minutes each. Gabe left home at 9 A.M. and arrived at his destination at 11:05 A.M. How fast does the scooter go?
3. In what ways might this graph be unrealistic?

EQUATIONS AND GRAPHS

4. Make a graph of several (x, y) pairs having the property that the sum of x and y is 16. Connect the points on your graph. Write the equation of your graph.
5. Write the equation of:
   a. a line through the origin containing the point (2, 5);
   b. another first-degree polynomial containing the point (2 ,5);
   c. a second-degree polynomial containing the point (2, 5).

These questions are about the graph of the equation $y = -x^2 + 2$.

6. Which of these points are on it?
   (3, -11) (-3, 11) (3, -7) (-3, -7)
7. The point $(-6, y)$ is on it. What is y?
8. The point $(x, -14)$ is on it. What are the two possible values of x?

For each of the equations below, if possible, find an (x, y) pair for which
   a. x is negative and y is positive;
   b. x is positive and y is negative;
   c. x and y are both negative.

9. $y = 4x$ **10.** $y = x^2 - 2$
11. $y = x(x - 1)$ **12.** $y = -2x + 6$
13. Which of the above four equations' graphs
   a. are straight lines?
   b. pass through the origin?
14. If possible, sketch the graph of a zero-degree, first-degree, second-degree, and third-degree polynomial function which passes through all quadrants but the first.

For problems 15 through 17:

a. Plot the points given in the table.

b. Study the table and your graph. Describe the relationship between the x-value and y-value of each pair.

c. Use the pattern you found to add more points to your table and graph.

d. Write an equation that tells how to get the y-value from the x-value.

15.

x	y
0	1
1	3
-1	-1
3	7

16.

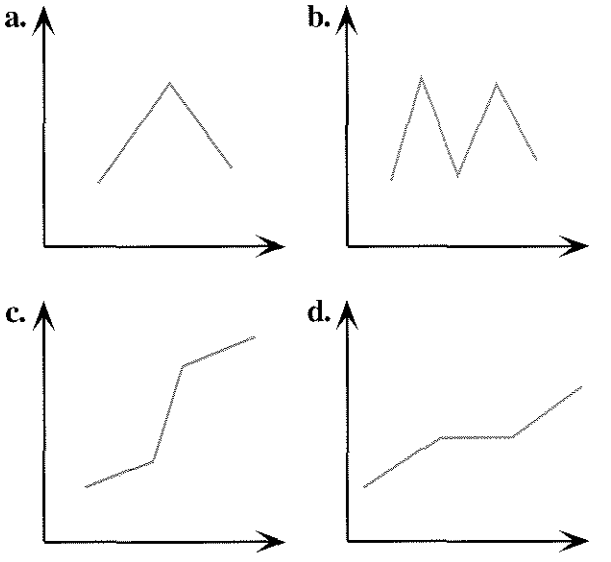
x	y
2	9
3	6
-3	-6
4.5	4
4	4.5

17.

x	y
3	8
-2	3
-1	0
0	-1
1/2	-3/4
2	3

DISTANCE VS. TIME

18. These graphs represent the motion of Paul's car. The vertical axis shows distance from his house, and the horizontal axis shows time. Write a short paragraph describing the trip summarized by each graph.



POSTAL PROBLEM

The post office puts size restrictions on first-class mail. Standard letters that are 1/4 inch thick or less must meet these requirements for width and height.

- The height is at least 3 and 1/2 in. and cannot exceed 6 and 1/8 in.
- The width is at least 5 in. and not more than 11 and 1/2 in.

19. The first condition can be written $3.5 \leq \text{height} \leq 6.125$. (This is called a *compound inequality*.) How would you write the second condition?

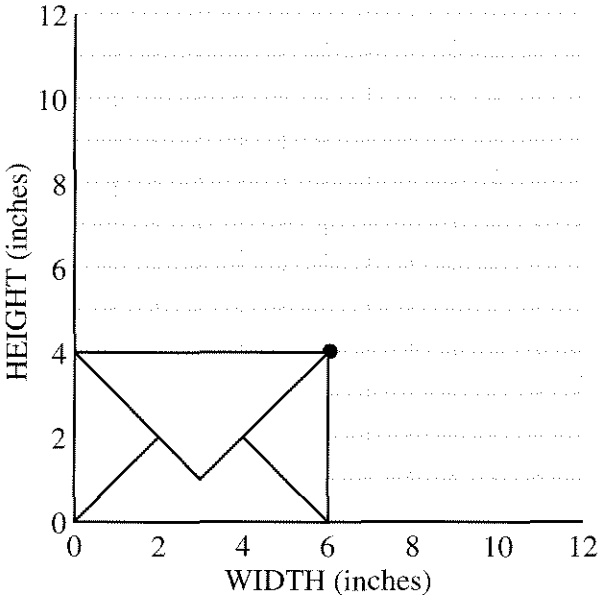
20. Sketch (to scale) and give the width, height, and area of each of these letters.

a. The letter having the least possible area

b. The letter having the greatest possible area

c. The tallest, thinnest letter

d. The shortest, widest letter



You can use a graph to show allowable dimensions of a letter. In the graph above, the point (6, 4) represents the dimensions of a letter that is 4 in. high and 6 in. wide.

21. Plot four points for the four envelopes you listed in problem 20. (Don't draw the envelopes!)

22. Write the equations of two horizontal and two vertical lines through those points.

23. The four points should form a rectangle. Find some points inside the rectangle, outside the rectangle, and on the rectangle. Which points represent allowable dimensions of letters? Explain, using examples.

In order to avoid extra fees, your letter must satisfy the following restriction.

- The width divided by the height must be between 1.3 and 2.5, inclusive.

24. Write a compound inequality for this restriction.

25. Find the ratio of the width to the height of each letter you listed in problem 20. Which ones meet the new requirement?

26. a. Experiment with your calculator until you find an allowable width and height that have a ratio of 1.3. On your graph, plot these dimensions. Draw a line through this point and the origin.

b. Find other points on the line. What is the ratio for each one? Explain.

c. Repeat (a) and (b) for the ratio 2.5.

27. Check the ratio for points between the two lines, above the upper line, and below the lower line.

28. Explain how to use the graph to find

a. dimensions that satisfy all the rules;

b. dimensions that satisfy the first two rules, but not the ratio rule;

c. dimensions that satisfy the ratio rule, but not the first two rules.

29. If the ratio of the width to the height is 1.3, what is the ratio of the height to the width?

30. Find the equation of the lines through the origin in your graph. Explain how they are examples of direct variation.