◆ Essential Ideas

1. A rectangle has width $2x + 5$ and length $3x + 1$. What is the area, when the perimeter is 30?

2. The width of a rectangle is five less than the length. Write a formula for:
   a. the length in terms of the width;
   b. the width in terms of the length;
   c. the area in terms of the width;
   d. the perimeter in terms of the length.

3. The perimeter of a rectangle is 50.
   a. Find the dimensions that will give an area of 46.
   b. Find the dimensions that will give the largest possible area.

4. The circumference of a circle is 50. What is the area? (Hint: First find the radius.) Is it bigger or smaller than the area of the largest possible rectangle having perimeter 50?

5. ○
   a. Find the dimensions and the area of the largest possible rectangle that can be made with P feet of fencing.
   b. Find the area of the circle that is surrounded by P feet of fencing. (Hint: Start by expressing the radius in terms of P.)
   c. Which has greater area, the rectangle or the circle? Explain.

FARES

6. A bus company takes people from a small town to and from a large city where they work. The fare is $4.00 per day, round trip. The company wants to raise its fare and has done a survey to find out if this will cause people to stop riding the bus. They estimate that for every 50 cents that they raise the fare, they will lose approximately 1000 customers. They now have 14,000 customers. Do you think they should raise their fare? If so, by how much? Explain.

7. A spaceship company charges its customers a basic fare of $50 million per light year for trips outside the solar system. However, to encourage long trips, it reduces the fare by $1 million for every light year a customer travels. For example, if a tourist travels five light years, her fare is reduced by $5 million. Her cost will be $45 million per light year for five light years, or $225 million. What is the most a person could ever pay for a trip on this spaceship? Explain.

PARABOLAS AND INTERCEPTS

8. Which graphs have the same x-intercepts? Explain.
   a. $y = x(8 - x)$ b. $y = 2x(8 - x)$
   c. $y = x(2 - x)$ d. $y = x(8 - 2x)$
   e. $y = 3x(8 - 4x)$ f. $y = x(16 - 2x)$

9. Graph the following three functions on the same axes. Label x-intercepts, y-intercept, and the vertex of each parabola.
   a. $y = x(25 - 2x)$ b. $y = x(25 - x)$
   c. $y = 2x(25 - x)$

10. Pick one of the three functions in problem 9 and describe a real situation that would lead to the function. Tell what the variables represent. Make up at least two questions about the real situation that could be answered by looking at the graph you made in problem 9.

11. Write the equation of a parabola having x-intercepts at:
a. $(0, 0)$ and $(2, 0)$; b. $(-4, 0)$ and $(0, 0)$;
c. $(-4, 0)$ and $(1, 0)$.

12. Compare the graphs of $y = 4x(x - 1)$, $y = 2x(2x - 2)$, and $y = x(4x - 4)$. Explain what you observe.

13. a. Find the equation of a parabola that has no x-intercepts.
b. Find the equation of a parabola that has only one x-intercept.
c. Find the equation of a graph that has three x-intercepts.

14. How many x-intercepts? Explain.
a. $y = 2x + 1$ b. $y = x(4 - x)$
c. $y = x^2 + 1$ d. $y = 3(x + 1)^2$

15. How many x-intercepts? Explain.
a. $y = 8x - x^2$ b. $y = x^2 - x + 2$
c. $y = 2x^2 + 12x + 18$

16. How many x-intercepts? Explain.
a. $y = a(x - H)^2$ b. $y = a(x - H)^2 + 3$
c. $y = a(x - H)^2 - 3$

THE VERTEX

17. a. Write the equation of any parabola that crosses the x-axis at $(2, 0)$ and $(4, 0)$.
b. Write the equation of any other parabola that crosses the x-axis at these two points.
c. Find the coordinates of the vertices of both parabolas. Compare them. What is the same? What is different?

18. a. Write the equation of any parabola that crosses the x-axis at $(0, 0)$ and $(3, 0)$.
b. Write the equation of a parabola that crosses the x-axis at $(0, 0)$ and $(3, 0)$ and has 9 as the y-coordinate of its vertex.

c. Find an equation of any other parabola that has 9 as the y-coordinate of its vertex.
d. Compare the three equations. What is the same? What is different?

19. Write three equivalent equations for the parabola that crosses the x-axis at $(2, 0)$ and $(0, 0)$ and has 6 as the y-coordinate of its vertex.

20. Find the equation of a parabola having:
a. intercepts: $(6, 0)$, $(-2, 0)$, $(0, 4)$;
b. vertex $(-1, -4)$; one intercept at $(1, 0)$;
c. vertex $(-2, 0)$; one intercept at $(0, 2)$.

21. Find the coordinates of the vertex of the graph of:
a. $y = -2(x - 5)(x + 8)$;
b. $y = (x + 3)^2 - 6$;
c. $y = x^2 + 4x - 7$.

22. Find the equation of a parabola that has a vertex having the following coordinates:
a. $(2, 8)$ b. $(8, 64)$

23. ♀
a. Write the equation of a parabola that has x-intercepts $(p, 0)$ and $(-r, 0)$. How can you check that your answer is correct?
b. What are the coordinates of the vertex?

QUADRATIC EQUATIONS

24. Solve.
a. $(x - 8)^2 + 6 = 0$ b. $(x - 8)^2 - 6 = 0$
c. $(x + 8)^2 + 6 = 0$ d. $(x + 8)^2 - 6 = 0$

Solve.

25. $x^2 - 6 = 0$ 26. $x^2 - 6x = 0$

27. $x^2 - 6x = -9$ 28. $x^2 + 6x = -9$

29. $x^2 + 6x - 4 = 0$ 30. $-4x + 2 = -x^2$

31. $-x^2 = 8x + 7$ 32. $8x - x^2 = 7$