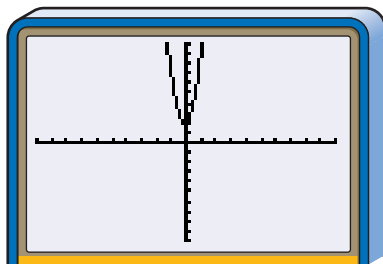


Example 5 Solve $6x^2 + x + 2 = 0$.**Method 1: Graphing**Graph $y = 6x^2 + x + 2$.

[−10, 10] scl:1 by [−50, 50] scl:1

The graph does not touch the x -axis, so there are no real roots for this equation. You cannot determine the roots from the graph.

Method 3: Completing the Square

$$6x^2 + x + 2 = 0$$

$$x^2 + \frac{1}{6}x + \frac{1}{3} = 0$$

$$x^2 + \frac{1}{6}x = -\frac{1}{3}$$

$$x^2 + \frac{1}{6}x + \frac{1}{144} = -\frac{1}{3} + \frac{1}{144}$$

$$\left(x + \frac{1}{12}\right)^2 = -\frac{47}{144}$$

$$x + \frac{1}{12} = \pm i \frac{\sqrt{47}}{12}$$

$$x = -\frac{1}{12} \pm i \frac{\sqrt{47}}{12}$$

$$x = \frac{-1 \pm i\sqrt{47}}{12}$$

Completing the square works, but this method requires a lot of steps.

The roots of the equation are $\frac{-1 \pm i\sqrt{47}}{12}$.

Method 2: Factoring

Find the discriminant.

$$b^2 - 4ac = 1^2 - 4(6)(2) \text{ or } -47$$

The discriminant is less than zero, so factoring cannot be used to solve the equation.

Method 4: Quadratic Formula

For this equation, $a = 6$,
 $b = 1$, $c = 2$.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-1 \pm \sqrt{1^2 - 4(6)(2)}}{2(6)}$$

$$x = \frac{-1 \pm \sqrt{-47}}{12}$$

$$x = \frac{-1 \pm i\sqrt{47}}{12}$$

The Quadratic Formula works and requires fewer steps than completing the square.

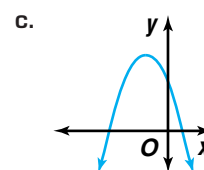
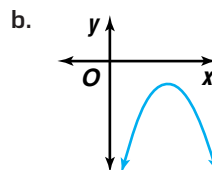
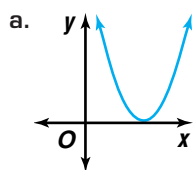
CHECK FOR UNDERSTANDING**Communicating Mathematics**

Read and study the lesson to answer each question.

- Write** a short paragraph explaining how to solve $t^2 - 6t - 4 = 0$ by completing the square.
- Discuss** which method of solving $5p^2 - 13p + 7 = 0$ would be most appropriate. Explain. Then solve.



3. **Describe** the discriminant of the equation represented by each graph.



4. **Math Journal** Solve $x^2 + 4x - 5 = 0$ using each of the four methods discussed in this lesson. Which method do you prefer? Explain.

Guided Practice Solve each equation by completing the square.

5. $x^2 + 8x - 20 = 0$

6. $2a^2 + 11a - 21 = 0$

Find the discriminant of each equation and describe the nature of the roots of the equation. Then solve the equation by using the Quadratic Formula.

7. $m^2 + 12m + 36 = 0$

8. $t^2 - 6t + 13 = 0$

Solve each equation.

9. $p^2 - 6p + 5 = 0$

10. $r^2 - 4r + 10 = 0$

11. **Electricity** On a cold day, a 12-volt car battery has a resistance of 0.02 ohms. The power available to start the motor is modeled by the equation $P = 12I - 0.02I^2$, where I is the current in amperes. What current is needed to produce 1600 watts of power to start the motor?

EXERCISES

Practice

Solve each equation by completing the square.

12. $z^2 - 2z - 24 = 0$

13. $p^2 - 3p - 88 = 0$

14. $x^2 - 10x + 21 = 0$

15. $d^2 - \frac{3}{4}d + \frac{1}{8} = 0$

16. $3g^2 - 12g = -4$

17. $t^2 - 3t - 7 = 0$

18. What value of c makes $x^2 - x + c$ a perfect square?

19. Describe the nature of the roots of the equation $4n^2 + 6n + 25$. Explain.

Find the discriminant of each equation and describe the nature of the roots of the equation. Then solve the equation by using the Quadratic Formula.

20. $6m^2 + 7m - 3 = 0$

21. $s^2 - 5s + 9 = 0$

22. $36d^2 - 84d + 49 = 0$

23. $4x^2 - 2x + 9 = 0$

24. $3p^2 + 4p = 8$

25. $2k^2 + 5k = 9$

26. What is the conjugate of $-7 - i\sqrt{5}$?

27. Name the conjugate of $5 - 2i$.



Solve each equation.

28. $3s^2 - 5s + 9 = 0$

29. $x^2 - 3x - 28 = 0$

30. $4w^2 + 19w - 5 = 0$

31. $4r^2 - r = 5$

32. $p^2 + 2p + 8 = 0$

33. $x^2 - 2x\sqrt{6} - 2 = 0$

Applications and Problem Solving

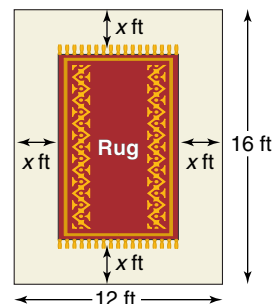


34. **Health** Normal systolic blood pressure is a function of age. For a woman, the normal systolic pressure P in millimeters of mercury (mm Hg) is modeled by $P = 0.01A^2 + 0.05A + 107$, where A is age in years.

- Use this model to determine the normal systolic pressure of a 25-year-old woman.
- Use this model to determine the age of a woman whose normal systolic pressure is 125 mm Hg.
- Sketch the graph of the function. Describe what happens to the normal systolic pressure as a woman gets older.

35. **Critical Thinking** Consider the equation $x^2 + 8x + c = 0$. What can you say about the value of c if the equation has two imaginary roots?

36. **Interior Design** Abey Numkena is an interior designer. She has been asked to locate an oriental rug for a new corporate office. As a rule, the rug should cover $\frac{1}{2}$ of the total floor area with a uniform width surrounding the rug.



- If the dimensions of the room are 12 feet by 16 feet, write an equation to model the situation.
- Graph the related function.
- What are the dimensions of the rug?

37. **Entertainment** In an action movie, a stuntwoman jumps off a building that is 50 feet tall with an upward initial velocity of 5 feet per second. The distance $d(t)$ traveled by a free falling object can be modeled by the formula $d(t) = v_0t - \frac{1}{2}gt^2$, where v_0 is the initial velocity and g represents the acceleration due to gravity. The acceleration due to gravity is 32 feet per second squared.

- Draw a graph that relates the woman's distance traveled with the time since the jump.
- Name the x -intercepts of the graph.
- What is the meaning of the x -intercepts of the graph?
- Write an equation that could be used to determine when the stuntwoman will reach the safety pad on the ground. (*Hint:* The ground is -50 feet from the starting point.)
- How long will it take the stuntwoman to reach the safety pad on the ground?

38. **Critical Thinking** Derive the quadratic formula by completing the square if $ax^2 + bx + c = 0$, $a \neq 0$.

Mixed Review

39. State the number of complex roots of the equation $18a^2 + 3a - 1 = 0$. Then find the roots and graph the related function. (Lesson 4-1)
40. Graph $y < |x| - 2$. (Lesson 3-5)
41. Find the inverse of $f(x) = (x - 9)^2$. (Lesson 3-4)
42. Solve the system of equations, $3x + 4y = 375$ and $5x + 2y = 345$. (Lesson 2-1)
43. **Sales** The Computer Factory is selling a 300 MHz computer system for \$595 and a 350 MHz computer system for \$619. At this rate, what would be the cost of a 400 MHz computer system? (Lesson 1-4)
44. Find the slope of the line whose equation is $3y + 8x = 12$. (Lesson 1-3)
45. **SAT/ACT Practice** The trinomial $x^2 + x - 20$ is exactly divisible by which binomial?
A $x - 4$ B $x + 4$ C $x + 6$ D $x - 10$ E $x - 5$

CAREER CHOICES

Environmental Engineering



Would you like a career where you will constantly be learning and have the opportunity to work both outdoors and indoors?

Environmental engineering has become an important profession in the past

twenty-five years.

As an environmental engineer, you might design, build, or maintain systems for controlling wastes produced by cities or industry. These wastes can include solid waste, waste water, hazardous waste, or air pollutants. You could work for a private company, a consulting firm, or the Environmental Protection Agency. Opportunities for advancement in this field include becoming a supervisor or consultant. You might even have the opportunity to identify a new specialty area in the field of environmental engineering!

CAREER OVERVIEW

Degree Required:

Bachelor's degree in environmental engineering

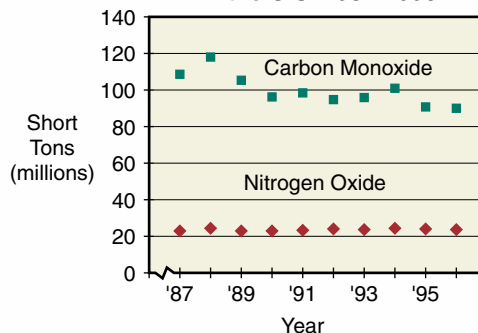
Related Courses:

biology, chemistry, mathematics

Outlook:

number of jobs expected to increase though the year 2006

Emissions of Two Air Pollutants in the U.S. 1987-1996



Source: The World Almanac



For more information about environmental engineering, visit: www.amc.glencoe.com

