To factor a polynomial completely, first factor out the GCF of the polynomial's terms. Then factor the remaining polynomial until it is written as the product of polynomials that cannot be factored further.

Problem 4 Factoring Out a Monomial First

What is the factored form of $18x^2 - 33x + 12$?

Plan

How can you simplify this problem?
Factor out the GCF of the trinomial's terms. The trinomial that remains is similar to those in Problems 1–3.

Think

Factor out the GCF.

Write

$18x^2 - 33x + 12 = 3(6x^2 - 11x + 4)$

Factor $6x^2 - 11x + 4$. Since $ac = 24$ and $b = -11$, find negative factors of 24 that have sum -11.

Factors of 24	$-1, -24$	$-2, -12$	$-3, -8$	$-4, -6$
Sum of Factors	-25	-14	-11 ✔	-10

Rewrite the term bx. Then use the Distributive Property to finish factoring.

$3(6x^2 - 3x - 8x + 4)$
$3[3x(2x - 1) - 4(2x - 1)]$
$3(3x - 4)(2x - 1)$

Got It? **4.** What is the factored form of $8x^2 - 36x - 20$?

Lesson Check

Do you know HOW?

Factor each expression.

1. $3x^2 + 16x + 5$
2. $10q^2 + 9q + 2$
3. $4w^2 + 4w - 3$
4. The area of a rectangle is $6x^2 - 11x - 72$. What are the possible dimensions of the rectangle? Use factoring.

Do you UNDERSTAND? MATHEMATICAL PRACTICES

5. **Reasoning** Explain why you cannot factor the trinomial $2x^2 + 7x + 10$.
6. **Reasoning** To factor $8x^2 + bx + 3$, a student correctly rewrites the trinomial as $8x^2 + px + qx + 3$. What is the value of pq?
7. **Compare and Contrast** How is factoring a trinomial $ax^2 + bx + c$ when $a \neq 1$ different from factoring a trinomial when $a = 1$? How is it similar?

Practice and Problem-Solving Exercises MATHEMATICAL PRACTICES

Practice **Factor each expression.** See Problem 1.

8. $2x^2 + 13x + 6$
9. $3d^2 + 23d + 14$
10. $4n^2 - 8n + 3$
11. $4p^2 + 7p + 3$
12. $6r^2 - 23r + 20$
13. $8g^2 - 14g + 3$

Factor each expression. See Problem 2.

14. $5z^2 + 19z - 4$ **15.** $2k^2 - 13k - 24$ **16.** $6t^2 + 7t - 5$

17. $3x^2 + 23x - 36$ **18.** $4w^2 - 5w - 6$ **19.** $4d^2 - 4d - 35$

20. Interior Design The area of a rectangular kitchen tile is $8x^2 + 30x + 7$. What are the possible dimensions of the tile? Use factoring. See Problem 3.

21. Crafts The area of a rectangular knitted blanket is $15x^2 - 14x - 8$. What are the possible dimensions of the blanket? Use factoring.

Factor each expression completely. See Problem 4.

22. $12p^2 + 20p - 8$ **23.** $8v^2 + 34v - 30$ **24.** $6s^2 + 57s + 72$

25. $20w^2 - 45w + 10$ **26.** $12x^2 - 46x - 8$ **27.** $9r^2 + 3r - 30$

B Apply

Open-Ended **Find two different values that complete each expression so that the trinomial can be factored into the product of two binomials. Factor your trinomials.**

28. $4s^2 + \blacksquare s + 10$ **29.** $15v^2 + \blacksquare v - 24$ **30.** $35m^2 + \blacksquare m - 16$

31. $9g^2 + \blacksquare g + 4$ **32.** $6n^2 + \blacksquare n + 28$ **33.** $8r^2 + \blacksquare r - 42$

34. Error Analysis Describe and correct the error made in factoring the expression at the right.

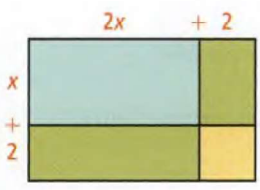
$$3x^2 - 16x - 12 = 3x^2 + 4x - 20x - 12$$
$$= x(3x + 4) - 4(5x + 3)$$
$$= (x - 4)(3x + 4)(5x + 3)$$

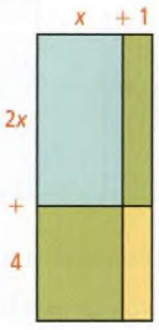
35. Think About a Plan A triangle has area $9x^2 - 9x - 10$. The base of the triangle is $3x - 5$. What is the height of the triangle?

- What is the formula for the area of a triangle?
- How does factoring the given trinomial help you solve the problem?

36. Carpentry The top of a rectangular table has an area of $18x^2 + 69x + 60$. The width of the table is $3x + 4$. What is the length of the table?

37. a. Write each area as a product of two binomials.





b. Are the products equal?

c. Writing Explain how the two products you found in part (a) can equal the same trinomial.

Factor each expression.

38. $54x^2 + 87x + 28$ **39.** $66k^2 + 57k + 12$ **40.** $14z^2 - 53z + 14$

41. $28h^2 + 28h - 56$ **42.** $21y^2 + 72y - 48$ **43.** $55n^2 - 52n + 12$

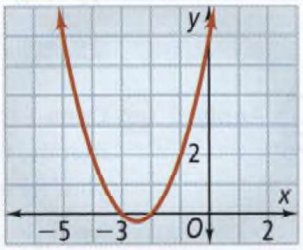
44. $36p^2 + 114p - 20$ **45.** $63g^2 - 89g + 30$ **46.** $99v^2 - 92v + 9$

47. Reasoning If a and c in $ax^2 + bx + c$ are prime numbers and the trinomial is factorable, how many positive values are possible for b? Explain your reasoning.

Challenge **Factor each expression.**

48. $56x^3 + 43x^2 + 5x$ **49.** $49p^2 + 63pq - 36q^2$ **50.** $108g^2h - 162gh + 54h$

51. The graph of the function $y = x^2 + 5x + 6$ is shown at the right.



a. What are the x-intercepts?

b. Factor $x^2 + 5x + 6$.

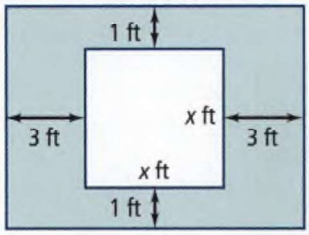
c. Reasoning Describe the relationship between the binomial factors you found in part (b) and the x-intercepts.

Apply What You've Learned

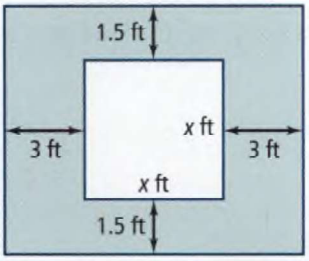
MATHEMATICAL PRACTICES
MP 7

Look back at the information on page 485 about Kelly's and Roberto's plan to combine their plots in a community garden. Kelly's and Roberto's plans for their original plots are shown again below. In the Apply What You've Learned in Lesson 8-3, you wrote trinomials for the area of Kelly's original plot and the area of Roberto's original plot.

Kelly's Plan



Roberto's Plan



a. Write a trinomial that represents the total area of the two original plots.

b. Factor the trinomial you wrote in part (a).

c. What do the factors in your answer to part (b) represent in relation to the new plot? Explain how you know.