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Factoring Completely

Some polynomials require more than one step to factor completely. When every term in a polynomial has a common factor, factor out the common factor first. After factoring out the greatest common factor, see if the remaining expression is a perfect square trinomial or difference of squares. If neither of those situations exist, see if you can identify factor pairs.

Example 1 Factor $12x^2y + 8x^2 - 60xy - 40x$.

$$12x^2y + 8x^2 - 60xy - 40x \quad \text{Original polynomial.}$$

$$4x(3xy + 2x - 15y - 10) \quad \text{GCF factored out.}$$

$$4x(3y + 2)(x - 5) \quad \text{Polynomial fully factored by grouping.}$$

Example 2 Factor $18x^3 + 60x^2 + 50x$.

$$18x^3 + 60x^2 + 50x \quad \text{Original polynomial.}$$

$$2x(9x^2 + 30x + 25) \quad \text{GCF factored out; a perfect square trinomial is left.}$$

$$2x(3x + 5)^2 \quad \text{Polynomial fully factored.}$$

Example 3 Factor $5x^2y - 125y$.

$$5x^2y - 125y \quad \text{Original polynomial.}$$

$$5y(x^2 - 25) \quad \text{GCF factored out; a difference of squares is left.}$$

$$5y(x - 5)(x + 5) \quad \text{Polynomial fully factored.}$$

Example 4 Factor $6x^3 + 3x^2 - 18x$.

$$6x^3 + 3x^2 - 18x \quad \text{Original polynomial.}$$

$$3x(2x^2 + x - 6) \quad \text{GCF factored out.}$$

$$3x(2x - 3)(x + 2) \quad \text{Polynomial fully factored by identifying factor pairs.}$$

Today's Lesson

Factor completely.

1. $6x^2y + 4x^2 - 36xy - 24x$

2. $5x^2 + 10x + 5$

3. $2x^2y - 72y$

4. $9x^2 - 6x - 3$

Multiply or divide. 3.14

5. $\frac{22a^2b - 6b^2}{11a^2 - 3b} \cdot \frac{10a^2}{5a}$

6. $\frac{x^2 - 11x + 24}{x^2 + 6x - 7} \cdot \frac{x^2 + 9x + 14}{x + 6}$

7. $\frac{12a^2b + 3ab}{5a - 2} \div \frac{2b^2}{a - 2}$

8. $\frac{2x^2 + 4x - 6}{3x^2 + 9x} \div \frac{4x^2 - 40x + 36}{3x^2 - 27x}$

Reduce if possible. Find the excluded values. 3.14

9. $\frac{5x^2 + 5x}{x^2 - 1}$

10. $\frac{y^2 - 4}{y^2 - 4y + 4}$

11. $\frac{x^2 + x - 6}{x^2 + 8x + 15}$

Given that $f(x) = x^2 + x - 6$ and $g(x) = x - 2$, find the following. Note any domain exclusions. 3.13

12. $\left(\frac{f}{g}\right)(x)$

13. $\left(\frac{g}{f}\right)(x)$

14. $(g - f)(x)$

Solve the systems using elimination. 3.11

15.
$$\begin{cases} 4x + 2y + 5z = 10 \\ 2x + y + 3z = 4 \\ 3x + y + 4z = 5 \end{cases}$$

16.
$$\begin{cases} 5x - y + z = 22 \\ 2x - y - 2z = 10 \\ x + y + 4z = 2 \end{cases}$$

Divide using synthetic division. 3.6

17. $(3x^2 - 4x - 4) \div (x - 2)$

18. $(x^4 - 2x^2 + 3x - 72) \div (x - 3)$

19. $(6x^3 + 2x^2 - x + 38) \div (x + 2)$

Factor by identifying factor pairs. 3.1

20. $3x^2 + 11x - 4$

21. $6x^2 + 19x + 15$

22. $4x^2 + 8x - 5$

Factor by grouping. 3.1

23. $3xy + 3x + 2y + 2$

24. $2xy + 6y - 5x - 15$

25. $5xy + 45y + 2x + 18$

Solve the quadratic equations. 2.11

26. $(x + 5)^2 = 11$

27. $2x^2 - x = 0$

28. $x^2 = 44$

Simplify and combine. 2.6

29. $4\sqrt{40} + 5\sqrt{32} - \sqrt{50}$

30. $5\sqrt[3]{80} - 6\sqrt[3]{270} + \sqrt{160}$

31. $4\sqrt[3]{32} + 5\sqrt[3]{54}$

Simplify. 2.6

32. $\sqrt{144x^5y^4z}$

33. $\sqrt[10]{m^{25}n^5o^{10}}$

34. $\sqrt[3]{24x^9y^4z^{10}}$

Solve and graph the compound inequalities. 1.11

35. $x + 2 \geq 5$ or $-x + 3 > 2$

36. $-8 < 2x < 5$

37. $2 < \frac{1}{2}x < 3$

Write an equation to illustrate each property. 1.3

38. zero property of multiplication

39. commutative property of addition

40. commutative property of multiplication

41. associative property of multiplication

42. identity property of addition

43. distributive property of multiplication

44. inverse property of multiplication

45. inverse property of addition

46. associative property of addition

47. identity property of multiplication

Extra Practice

Factor completely.

48. $30x^2y - 30x^2 + 10xy - 10x$

49. $27a^3 + 90a^2 + 75a$

50. $108a^2b - 27b$

51. $48x^3 - 136x^2 + 56x$