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8-5 Study Guide and Intervention

Using the Distributive Property

Use the Distributive Property to Factor The Distributive Property has been used to multiply a polynomial by a monomial. It can also be used to express a polynomial in factored form. Compare the two columns in the table below.

Multiplying	Factoring
$3(a + b) = 3a + 3b$	$3a + 3b = 3(a + b)$
$x(y - z) = xy - xz$	$xy - xz = x(y - z)$
$6y(2x + 1) = 6y(2x) + 6y(1)$ $= 12xy + 6y$	$12xy + 6y = 6y(2x) + 6y(1)$ $= 6y(2x + 1)$

Example 1 **Use the Distributive Property to factor $12mp + 80m^2$.**

Find the GCF of $12mp$ and $80m^2$.

$12mp = 2 \cdot 2 \cdot 3 \cdot m \cdot p$

$80m^2 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 5 \cdot m \cdot m$

GCF $= 2 \cdot 2 \cdot m$ or $4m$

Write each term as the product of the GCF and its remaining factors.

$$\begin{aligned} 12mp + 80m^2 &= 4m(3 \cdot p) + 4m(2 \cdot 2 \cdot 5 \cdot m) \\ &= 4m(3p) + 4m(20m) \\ &= 4m(3p + 20m) \end{aligned}$$

Thus $12mp + 80m^2 = 4m(3p + 20m)$.

Example 2 **Factor $6ax + 3ay + 2bx + by$ by grouping.**

$$\begin{aligned} &6ax + 3ay + 2bx + by \\ &\quad = (6ax + 3ay) + (2bx + by) \\ &\quad = 3a(2x + y) + b(2x + y) \\ &\quad = (3a + b)(2x + y) \end{aligned}$$

Check using the FOIL method.

$$\begin{aligned} &(3a + b)(2x + y) \\ &\quad = 3a(2x) + (3a)(y) + (b)(2x) + (b)(y) \\ &\quad = 6ax + 3ay + 2bx + by \checkmark \end{aligned}$$

Exercises

Factor each polynomial.

1. $24x + 48y$
   $24(x + 2y)$
2. $30mp^2 + m^2p - 6p$
   $p(30mp + m^2 - 6)$
3. $q^4 - 18q^3 + 22q$
   $q(q^3 - 18q^2 + 22)$
4. $9x^2 - 3x$
   $3x(3x - 1)$
5. $4m + 6p - 8mp$
   $2(2m + 3p - 4mp)$
6. $45r^3 - 15r^2$
   $15r^2(3r - 1)$
7. $14t^3 - 42t^5 - 49t^4$
   $7t^3(2 - 6t^2 - 7t)$
8. $55p^2 - 11p^4 + 44p^5$
   $11p^2(5 - p^2 + 4p^3)$
9. $14y^3 - 28y^2 + y$
   $y(14y^2 - 28y + 1)$
10. $4x + 12x^2 + 16x^3$
    $4x(1 + 3x + 4x^2)$
11. $4a^2b + 28ab^2 + 7ab$
    $ab(4a + 28b + 7)$
12. $6y + 12x - 8z$
    $2(3y + 6x - 4z)$
13. $x^2 + 2x + x + 2$
    $(x + 1)(x + 2)$
14. $6y^2 - 4y + 3y - 2$
    $(2y + 1)(3y - 2)$
15. $4m^2 + 4mp + 3mp + 3p^2$
    $(4m + 3p)(m + p)$
16. $12ax + 3xz + 4ay + yz$
    $(3x + y)(4a + z)$
17. $12a^2 + 3a - 8a - 2$
    $(4a + 1)(3a - 2)$
18. $xa + ya + x + y$
    $(x + y)(a + 1)$

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8-5 Study Guide and Intervention *(continued)*

Using the Distributive Property

Solve Equations by Factoring The following property, along with factoring, can be used to solve certain equations.

Zero Product Property	For any real numbers a and b, if $ab = 0$, then either $a = 0$, $b = 0$, or both a and b equal 0.

Example **Solve $9x^2 + x = 0$. Then check the solutions.**

Write the equation so that it is of the form $ab = 0$.

$9x^2 + x = 0$	Original equation
$x(9x + 1) = 0$	Factor the GCF of $9x^2 + x$, which is x.
$x = 0$ or $9x + 1 = 0$	Zero Product Property
$x = 0 \qquad x = -\frac{1}{9}$	Solve each equation.

The solution set is $\left\{0, -\frac{1}{9}\right\}$.

Check Substitute 0 and $-\frac{1}{9}$ for x in the original equation.

$9x^2 + x = 0$ $\qquad$ $9x^2 + x = 0$

$9(0)^2 + 0 \stackrel{?}{=} 0$ $\qquad$ $9\left(-\frac{1}{9}\right)^2 + \left(-\frac{1}{9}\right) \stackrel{?}{=} 0$

$0 = 0$ ✓ $\qquad$ $\frac{1}{9} + \left(-\frac{1}{9}\right) \stackrel{?}{=} 0$

$0 = 0$ ✓

Exercises

Solve each equation. Check your solutions.

1. $x(x + 3) = 0$
{0, −3}

2. $3m(m - 4) = 0$
{0, 4}

3. $(r - 3)(r + 2) = 0$
{−2, 3}

4. $3x(2x - 1) = 0$
$\left\{0, \frac{1}{2}\right\}$

5. $(4m + 8)(m - 3) = 0$
{−2, 3}

6. $5t^2 = 25t$
{0, 5}

7. $(4c + 2)(2c - 7) = 0$
$\left\{-\frac{1}{2}, \frac{7}{2}\right\}$

8. $5p - 15p^2 = 0$
$\left\{0, \frac{1}{3}\right\}$

9. $4y^2 = 28y$
{0, 7}

10. $12x^2 = -6x$
$\left\{-\frac{1}{2}, 0\right\}$

11. $(4a + 3)(8a + 7) = 0$
$\left\{-\frac{7}{8}, -\frac{3}{4}\right\}$

12. $8y = 12y^2$
$\left\{0, \frac{2}{3}\right\}$

13. $x^2 = -2x$
{−2, 0}

14. $(6y - 4)(y + 3) = 0$
$\left\{-3, \frac{2}{3}\right\}$

15. $4m^2 = 4m$
{0, 1}

16. $12x = 3x^2$
{0, 4}

17. $12a^2 = -3a$
$\left\{-\frac{1}{4}, 0\right\}$

18. $(12a + 4)(3a - 1) = 0$
$\left\{-\frac{1}{3}, \frac{1}{3}\right\}$