

Example: Multiply a Polynomial by a MonomialFind $-2x^2(3x^2 - 7x + 10)$.**Method 1** Horizontal

$$\begin{aligned}
 & -2x^2(3x^2 - 7x + 10) \\
 &= -2x^2(3x^2) - (-2x^2)(7x) + (-2x^2)(10) \quad \text{Distributive Property} \\
 &= -6x^4 - (-14x^3) + (-20x^2) \quad \text{Multiply.} \\
 &= -6x^4 + 14x^3 - 20x^2 \quad \text{Simplify.}
 \end{aligned}$$

Method 2 Vertical

$$\begin{array}{r}
 3x^2 - 7x + 10 \\
 (\times) \quad -2x^2 \quad \text{Distributive Property} \\
 \hline
 -6x^4 + 14x^3 - 20x^2 \quad \text{Multiply.}
 \end{array}$$

Check your progress:

1) $5a^2(-4a^2 + 2a - 7)$

$$-20a^4 + 10a^3 - 35a^2$$

Example: Simplify ExpressionsSimplify $4(3d^2 + 5d) - d(d^2 - 7d + 12)$.

$$\begin{aligned}
 & 4(3d^2 + 5d) - d(d^2 - 7d + 12) \\
 &= 4(3d^2) + 4(5d) + (-d)(d^2) - (-d)(7d) + (-d)(12) \quad \text{Distributive Property} \\
 &= 12d^2 + 20d + (-d^3) - (-7d^2) + (-12d) \quad \text{Product of Powers} \\
 &= 12d^2 + 20d - d^3 + 7d^2 - 12d \quad \text{Simplify.} \\
 &= -d^3 + (12d^2 + 7d^2) + (20d - 12d) \quad \text{Commutative and Associative Properties} \\
 &= -d^3 + 19d^2 + 8d \quad \text{Combine like terms.}
 \end{aligned}$$

Check your progress:

1) $3(5x^2 + 2x - 4) - x(7x^2 + 2x - 3)$

$$15x^2 + 6x - 12 - 7x^3 - 2x^2 + 3$$

$$-7x^3 - 13x^2 + 6x - 9$$

Example:

PHONE SERVICE Greg pays a fee of \$20 a month for local calls. Long-distance rates are 6¢ per minute for in-state calls and 5¢ per minute for out-of-state calls. Suppose Greg makes 300 minutes of long-distance phone calls in January and m of those minutes are for in-state calls.

a. Find an expression for Greg's phone bill for January.

Words	Bill = service fee + in-state minutes • 6¢ per minute + out-of-state minutes • 5¢ per minute.
Variables	If m = number of minutes of in-state calls, then $300 - m$ = number of minutes of out-of-state calls. Let B = phone bill for the month of January.
Equation	$B = 20 + m \cdot 0.06 + (300 - m) \cdot 0.05$

$$B = 20 + m \cdot 0.06 + (300 - m) \cdot 0.05 \quad \text{Write the equation.}$$

$$= 20 + 0.06m + 300(0.05) - m(0.05) \quad \text{Distributive Property}$$

$$= 20 + 0.06m + 15 - 0.05m \quad \text{Simplify.}$$

$$= 35 + 0.01m \quad \text{Simplify.}$$

Greg's bill for January is $35 + 0.01m$, for m minutes of in-state calls.

Greg's bill for January is $35 + 0.01m$, for m minutes of in-state calls.

- b. Evaluate the expression to find the cost if Greg had 37 minutes of in-state calls in January.**

$$\begin{aligned} 35 + 0.01m &= 35 + 0.01(37) & m &= 37 \\ &= 35 + 0.37 & \text{Multiply.} \\ &= 35.37 & \text{Add.} \end{aligned} \quad \text{Greg's bill was \$35.37.}$$

Check your progress:

- 1) A parking garage charges \$30 per month plus \$0.50 per daytime hour and \$0.25 per hour during nights and weekends. Suppose Juana parks in the garage for 47 hours in January and h of those are night and weekend hours. Find an expression for her January bill. Then find the cost if Juana had 12 hours of night and weekend hours.

$$\begin{aligned} 30 + 0.50D + 0.25N & \quad N = h \quad \quad D = 47 - h \\ 30 + 0.50(47 - h) + 0.25h & \\ 30 + 0.50(47 - 12) + 0.25(12) &= 30 + 0.50(35) + 3 = 30 + 17.5 + 3 = 50.5 \\ & \$50.50 \end{aligned}$$

Example: Polynomials on Both Sides

Solve $y(y - 12) + y(y + 2) + 25 = 2y(y + 5) - 15$.

$$\begin{aligned} y(y - 12) + y(y + 2) + 25 &= 2y(y + 5) - 15 & \text{Original equation} \\ y^2 - 12y + y^2 + 2y + 25 &= 2y^2 + 10y - 15 & \text{Distributive Property} \\ 2y^2 - 10y + 25 &= 2y^2 + 10y - 15 & \text{Combine like terms.} \\ -10y + 25 &= 10y - 15 & \text{Subtract } 2y^2 \text{ from each side.} \\ -20y + 25 &= -15 & \text{Subtract } 10y \text{ from each side.} \\ -20y &= -40 & \text{Subtract 25 from each side.} \\ y &= 2 & \text{Divide each side by } -20. \end{aligned}$$

$$\begin{aligned} \text{CHECK } y(y - 12) + y(y + 2) + 25 &= 2y(y + 5) - 15 & \text{Original equation} \\ 2(2 - 12) + 2(2 + 2) + 25 &\stackrel{?}{=} 2(2)(2 + 5) - 15 & y = 2 \\ 2(-10) + 2(4) + 25 &\stackrel{?}{=} 4(7) - 15 & \text{Simplify.} \\ -20 + 8 + 25 &\stackrel{?}{=} 28 - 15 & \text{Multiply.} \\ 13 &= 13 \quad \checkmark & \text{Add and subtract.} \end{aligned}$$

Check your progress:

- 1) $2x(x + 4) + 7 = (x + 8) + 2x(x + 1) + 12$

$$\begin{aligned} 2x^2 + 8x + 7 &= x + 8 + 2x^2 + 2x + 12 \\ 2x^2 + 8x + 7 &= 2x^2 + 3x + 20 \\ 8x + 7 &= 3x + 20 \\ 5x + 7 &= 20 \\ 5x &= 13 \\ x &= \frac{13}{5} \end{aligned}$$

Practice**Find the product.**

1) $-3y(5y + 2)$

$-15y^2 - 6y$

2) $9b^2(2b^3 - 3b^2 + b - 8)$

$18b^5 - 18b^4 + 9b^3 - 72b^2$

3) $2x(4a^4 - 3ax + 6x^2)$

$8a^4x - 6ax^2 + 12x^3$

4) $-4xy(5x^2 - 12xy + 7y^2)$

$-20x^3y + 48x^2y^2 - 28xy^3$

Simplify.

5) $t(5t - 9) - 2t$

$5t^2 - 9t - 2t$

$5t^2 - 11t$

6) $x(3x + 4) + 2(7x - 3)$

$3x^2 + 4x + 14x - 6$

$3x^2 + 18x - 6$

7) $5n(4n^3 + 6n^2 - 2n + 3) - 4(n^2 + 7n)$

$20n^4 + 30n^3 - 10n^2 + 15n - 4n^2 - 28n$

$20n^4 + 30n^3 - 14n^2 - 13n$

8) $4y^2(y^2 - 2y + 5) + 3y(2y^2 - 2)$

$4y^4 - 8y^3 + 20y^2 + 6y^3 - 6y$

$4y^4 - 2y^3 + 20y^2 - 6y$

Complete.

- 9) Matthew's grandmother left him \$10,000 for college. Matthew puts some of the money into a savings account earning 3% interest per year. With the rest, he buys a certificate of deposit (CD) earning 5% per year.

- a. If Matthew puts x dollars into the savings account, write an expression to represent the amount of the CD.

$10,000 - x$

- b. Write an equation for the total amount of money T Matthew will have saved for college after one year.

$T = 1.03(x) + 1.05(10000 - x)$

- c. If Matthew puts \$3000 in savings, how much money will he have in one year?

$$T = 1.03(3000) + 1.05(10000 - 3000) = 1.03(3000) + 1.05(7000) = 3090 + 7350$$

$$= 10440$$

$\$10,440$

Solve the equation.

10) $-2(w + 1) + w = 7$

$-2w - 2 + w = 7$

$-w - 2 = 7$

$-w = 9$

$w = -9$

11) $3(y - 2) + 2y = 4y + 14$

$3y - 6 + 2y = 4y + 14$

$5y - 6 = 4y + 14$

$y - 6 = 14$

$y = 20$

$$12) a(a + 3) + a(a + 6) + 35 = a(a - 5) + a(a + 7)$$

$$a^2 + 3a + a^2 + 6a + 35 = a^2 - 5a + a^2 + 7a$$

$$2a^2 + 9a + 35 = 2a^2 + 2a$$

$$9a + 35 = 2a$$

$$35 = -7a$$

$$-5 = a$$

$$13) n(n - 4) + n(n + 8) = n(n - 13) + n(n + 1) + 16$$

$$n^2 - 4n + n^2 + 8n = n^2 - 13n + n^2 + n + 16$$

$$2n^2 + 4n = 2n^2 - 12n + 16$$

$$4n = -12n + 16$$

$$16n = 16$$

$$n = 1$$