

Multiplying a Polynomial by a Monomial

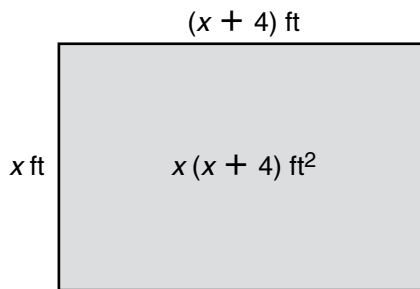
Objective Teach students to use the properties of exponents and the Distributive Property to multiply a polynomial by a monomial.

Note to the Teacher *In this lesson, students will use the Distributive Property to multiply a polynomial by a monomial.*

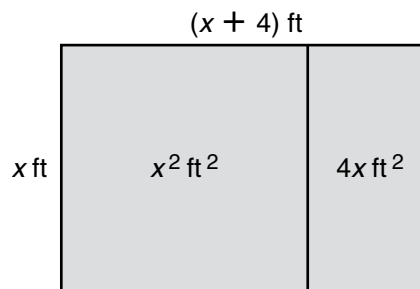
To illustrate the use of the Distributive Property, do the following example on the board.

Example 1 Find the area of a rectangle whose height is x feet and width is $x + 4$ feet.

Solution First, draw the figure that represents the situation.



Now draw the same figure and divide it as shown.



The area is $x^2 + 4x$ square feet.

This example illustrates the Distributive Property. That is, $a(b + c) = ab + ac$. Make sure students understand that this property holds true even when a , b , and c are monomials, so that $b + c$ represents a polynomial.

Here are several examples to work through as a class.

Example 2 Find $2x^3(x^2 + 3x + 4)$.

$$\begin{aligned}\text{Solution } 2x^3(x^2 + 3x + 4) &= 2x^3(x^2) + 2x^3(3x) + 2x^3(4) && \text{Distributive Property} \\ &= 2x^5 + 6x^4 + 8x^3\end{aligned}$$

Let's do another example where the polynomial contains more than one variable. Explain to students that, in this case, they will need to combine like terms before simplifying.

Example 3 Find $a^2b(3a^3b^2 - 2ab^4 + 3a^2b^2)$.

$$\begin{aligned}\text{Solution } a^2b(3a^3b^2 - 2ab^4 + 3a^2b^2) \\ &= a^2b(3a^3b^2) - a^2b(2ab^4) + a^2b(3a^2b^2) && \text{Distributive Property} \\ &= 3a^5b^3 - 2a^3b^5 + 3a^4b^3 && \text{Multiply monomials.}\end{aligned}$$

Sometimes, adding, subtracting, and multiplying monomials can be used to help solve a polynomial equation. Consider the following example.

Example 4 Solve $x(x - 2) + 5x - 9 = x(x + 1) - 4$.

Solution First, simplify each side of the equation.

$$\begin{aligned}x(x - 2) + 5x - 9 &= x(x + 1) - 4 \\ x(x) - x(2) + 5x - 9 &= x(x) + x(1) - 4 && \text{Distributive Property} \\ x^2 - 2x + 5x - 9 &= x^2 + x - 4 && \text{Multiply monomials.}\end{aligned}$$

Then combine like terms on the left side of the equation.

$$\begin{aligned}x^2 + (-2x + 5x) - 9 &= x^2 + x - 4 \\ x^2 + 3x - 9 &= x^2 + x - 4\end{aligned}$$

Now, solve for x .

$$\begin{aligned}3x - 9 &= x - 4 && \text{Subtract } x^2 \text{ from each side.} \\ 2x - 9 &= -4 && \text{Subtract } x \text{ from each side.} \\ 2x - 9 + 9 &= -4 + 9 && \text{Add 9 to each side.} \\ 2x &= 5 && \text{Simplify.} \\ x &= \frac{5}{2} && \text{Divide each side by 2.}\end{aligned}$$

The solution is $\frac{5}{2}$.

Note to the Teacher *Multiplication of a polynomial by a monomial is an important technique. It will immediately lead to the more general technique of multiplication of polynomials. Therefore it is very important students learn this skill well.*

