NAME

Module 11 Simplifying Algebraic Expressions with Polynomials
Lesson 4 Multiplying Monomials and Binomials

Find the product.

1. $4h \cdot 2h$

   $8h^2$

2. $(-2t^3)(-5t^2)$

   $10t^5$

3. $\frac{2}{3}w \cdot (-9w^3)$

   $-6w^4$

4. $3x^2y \cdot 2xy^3$

   $6x^3y^4$

5. $(4m^2n^3)(-5m^3)$

   $-20m^5n^3$

6. $5b(b^3 - 6b)$

   $5b^4 - 30b^2$

7. $-4g^3h^2(4gh^2 - g^2h^3)$

   $-16g^4h^4 + 4g^5h^5$

8. $(x + 4)(x + 6)$

   $x^2 + 10x + 24$

9. $(w - 8)(w + 3)$

   $w^2 - 5w - 24$

10. $(r - 11)(r + 11)$

    $r^2 - 121$

11. $(g + 7)^2$

    $g^2 + 14g + 49$

12. $(b - 6)^2$

    $b^2 - 12b + 36$

Journal

1. A friend missed class today and wants to know how to multiply two monomials. Explain in words how to find the product $(-4x^2)(-6x^4)$.
2. What is the product $(x + a)^2$? Write a rule for finding the square of a binomial that contains an addition symbol and use the rule to find the product $(x + 3)^2$.
3. What is the product $(x - a)^2$? Write a rule for finding the square of a binomial that contains a subtraction symbol and use the rule to find the product $(x - 6)^2$.
4. A student claimed the simplified product of any two binomials is a trinomial. Is the student correct? Give an example to support this answer.
5. Find the product $(x + 5)(x + 4)$, showing each step. How are the constants 5 and 4 in the binomial factors related to the coefficient of the middle term in the product? How are the constants 5 and 4 in the binomial factors related to the last term in the product? If $(x + a)(x + b) = x^2 + cx + d$, how are a, b, and c related? How are a, b, and d related?

Cumulative Review

Simplify.

1. $3x^2 - 5x^2$

   $-2x^2$

2. $4 - 9b + 3$

   $7 - 9b$ or $-9b + 7$

3. $5m + 2m^2 - m$

   $2m^2 + 4m$

4. $3(x - 4) + 1$

   $3x - 11$

5. $2(x + 3) - 5x$

   $-3x + 6$

6. $w^3 \cdot w^5 \cdot w$

   w^9

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

   $2x - 12$

8. $3(b + 1) + 4(2 - b)$

   $11 - b$ or $-b + 11$

9. $3h - 4h^2 + h^3 - 7h + 5h^2$

   $h^3 + h^2 - 4h$

10. $8x^2y - 3xy + 2x^2y - 4xy^2 - 2xy$

    $10x^2y - 5xy - 4xy^2$

Manipulatives

Use algebra tiles to represent the product $(2x - 3)(x + 1)$.

1. Represent the factor $2x - 3$ to the left of the vertical gridline and represent the factor $x + 1$ above the horizontal gridline. See Figure 1. Solid figures represent negatives and hollow figures represent positives. A small square represents the number one, a rectangle represents x, and a large square represents x^2.
2. The factor $2x - 3$ is represented by two x-rectangles and three small negative one-squares. The factor $x + 1$ is represented by one x-rectangle and one small one-square.
3. The product is represented below and to the right of the gridlines. An x-rectangle times an x-rectangle is a large x^2-square. An x-rectangle times a small negative one-square equals a $-x$-rectangle. A small one-square times an x-rectangle equals an x-rectangle. A small one-square times a small negative one-square equals a small negative one-square. See Figure 2.
4. Combine small squares with small squares, rectangles with rectangles, and large squares with large squares (combine like terms). There are two x^2-squares: $x^2 + x^2 = 2x^2$. There are two x-rectangles and three $-x$-rectangles. Pair a positive rectangle with a negative rectangle (this is called a zero pair because their sum is zero) and remove that pair of tiles. Then, remove another positive rectangle and negative rectangle (another zero pair). The only remaining rectangle is one $-x$-rectangle: $2x - 3x = -x$. There are three small negative one-squares: $-1 - 1 - 1 = -3$. After combining all like terms, you have the simplified product: $2x^2 - x - 3$. See Figure 3.

Figure 1

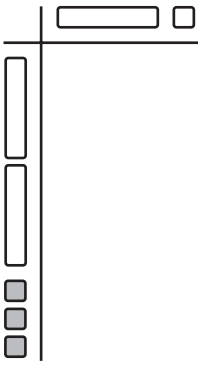


Figure 2

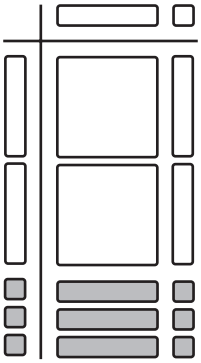
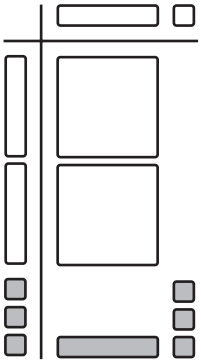


Figure 3



Use algebra tiles to find the following products.

1. $3x(x + 3)$

$3x^2 + 9x$

2. $(x + 2)(x - 2)$

$x^2 - 4$

3. $(x + 1)(x + 4)$

$x^2 + 5x + 4$

4. $5(2x^2 + 3x)$

$10x^2 + 15x$

Possible Journal Answers

1. To find the product of $-4x^2$ and $-6x^4$, first find the product of the coefficients: $(-4)(-6) = 24$. Next, find the product of the powers of x: $x^2 \cdot x^4 = x^{2+4} = x^6$. So, the product of $-4x^2$ and $-6x^4$ is $24x^6$.
2. $(x + a)^2 = (x + a)(x + a) = x^2 + xa + ax + a^2 = x^2 + 2ax + a^2$
   The square of a binomial containing an addition symbol is the square of the first term; plus twice the product of the first term and the second term; plus the square of the second term.
   $(x + 3)^2 = x^2 + 2(3)x + 3^2 = x^2 + 6x + 9$
3. $(x - a)^2 = (x - a)(x - a) = x^2 - xa - ax + a^2 = x^2 - 2ax + a^2$
   The square of a binomial containing a subtraction symbol is the square of the first term; minus twice the product of the first term and the second term; plus the square of the second term.
   $(x - 6)^2 = x^2 - 2(6)x + 6^2 = x^2 - 12x + 36$
4. No, the student is not correct. The simplified product of two binomials is not always a trinomial. For example, $(x + 3)(x - 3) = x^2 + 3x - 3x - 9 = x^2 - 9$.
5. $(x + 5)(x + 4) = x^2 + 4x + 5x + 20 = x^2 + 9x + 20$
   The coefficient of the middle term, nine, is the sum of five and four. The last term, 20, is the product of five and four. If $(x + a)(x + b) = x^2 + cx + d$, then $a + b = c$, and $ab = d$.