## Warm Up:

Subtract $4x^5 - 8x + 2$ from $3x^4 + 10x - 9$. Write your answer in standard form.

$(3x^4+10x-9)-(4x^5-8x+2)$

$-4x^5+3x^4+18x-11$

Evaluate $h(x) = 0.4x^2 - 1.2x + 7.5$ for $x = 0$ and $x = 3$.

7.5

0

3

# 6-2 Multiplying Polynomials

## Objectives

Multiply polynomials.

Use binomial expansion to expand binomial expressions that are raised to positive integer powers.

# 6-2 Multiplying Polynomials

To multiply a polynomial by a monomial, use the Distributive Property and the Properties of Exponents.




**Find each product.**

**A.** $4y^2(y^2 + 3)$

$4y^2 \cdot y^2 + 4y^2 \cdot 3$

$4y^4 + 12y^2$

**B.** $fg(f^4 + 2f^3g - 3f^2g^2 + fg^3)$

$f^5g + 2f^4g^2 - 3f^3g^3 + f^2g^4$

**Find each product.**

**a.** $3cd^2(4c^2d - 6cd + 14cd^2)$

$12c^3d^3 - 18c^2d^3 + 42c^2d^4$

**b.** $x^2y(6y^3 + y^2 - 28y + 30)$

# 6-2 Multiplying Polynomials

To multiply any two polynomials, use the Distributive Property and multiply each term in the second polynomial by each term in the first.


Keep in mind that if one polynomial has $m$ terms and the other has $n$ terms, then the product has $mn$ terms before it is simplified.

**Find the product.**

$(a - 3)(2 - 5a + a^2)$

| | $2$ | $-5a$ | $a^2$ |
|---|---|---|---|
| $a$ | $2a$ | $-5a^2$ | $a^3$ |
| $-3$ | $-6$ | $15a$ | $-3a^2$ |

$a^3 - 8a^2 + 17a - 6$

**Find the product.**

$(y^2 - 7y + 5)(y^2 - y - 3)$

| | $y^2$ | $-y$ | $-3$ |
|---|---|---|---|
| $y^2$ | $y^4$ | $-y^3$ | $-3y^2$ |
| $-7y$ | $-7y^3$ | $7y^2$ | $21y$ |
| $5$ | $5y^2$ | $-5y$ | $-15$ |

$y^4 - 8y^3 + 9y^2 + 16y - 15$

**Find the product.**

$(3b - 2c)(3b^2 - bc - 2c^2)$

**Find the product.**

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

**Mr. Silva manages a manufacturing plant. From 1990 through 2005 the number of units produced (in thousands) can be modeled by $N(x) = 0.02x^2 + 0.2x + 3$. The average cost per unit (in dollars) can be modeled by $C(x) = -0.004x^2 - 0.1x + 3$. Write a polynomial $T(x)$ that can be used to model the total costs.**

**Find the product.** $4^3 = 4 \cdot 4 \cdot 4$

**$(a + 2b)^3$**

$(a+2b)(a+2b)(a+2b)$

$(a^2+4ab+4b^2)(a+2b)$

14641

**Find the product.**

$(x + 4)^4$

$(1)(x)^4(4)^0 + (4)(x)^3(4)^1 + (6)(x)^2(4)^2 + (4)(x)^1(4)^3 + (1)(x)^0(4)^4$

$1 \cdot x^4 \cdot 1 \quad 4 \cdot x^3 \cdot 4 \quad 6 \cdot x^2 \cdot 16 \quad 4 \cdot x \cdot 96 \quad 1 \cdot 1 \cdot 256$

$x^4 + 16x^3 + 96x^2 + 216x + 216$

**Find the product.** 1331

$(2x - 1)^3$

$(1)(2x)^3(-1)^0 + (3)(2x)^2(-1)^1 + (3)(2x)^1(-1)^2 + (1)(2x)^0(-1)^3$

$1 \cdot 8x^3 \cdot 1 \quad 3 \cdot 4x^2 \cdot -1 \quad 3 \cdot 2x \cdot 1 \quad 1 \cdot 1 \cdot -1$

$8x^3 - 12x^2 + 6x - 1$

# 6-2 Multiplying Polynomials

Notice the coefficients of the variables in the final product of $(a + b)^3$. these coefficients are the numbers from the third row of Pascal's triangle.

| Binomial Expansion | | Pascal's Triangle (Coefficients) |
|---|---|---|
| $(a + b)^0 =$ | $1$ | 1 |
| $(a + b)^1 =$ | $a + b$ | 1 1 |
| $(a + b)^2 =$ | $a^2 + 2ab + b^2$ | 1 2 1 |
| $(a + b)^3 =$ | $a^3 + 3a^2b + 3ab^2 + b^3$ | 1 3 3 1 |
| $(a + b)^4 =$ | $a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$ | 1 4 6 4 1 |
| $(a + b)^5 = a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5$ | | 1 5 10 10 5 1 |

Each row of Pascal's triangle gives the coefficients of the corresponding binomial expansion. The pattern in the table can be extended to apply to the expansion of any binomial of the form $(a + b)^n$, where $n$ is a whole number.




6-2 Multiplying Polynomials

**Binomial Expansion**

For a binomial expansion of the form $(a + b)^n$, the following statements are true.

1. There are $n + 1$ terms.
2. The coefficients are the numbers from the $n$th row of Pascal's triangle.
3. The exponent of $a$ is $n$ in the first term, and the exponent decreases by 1 in each successive term.
4. The exponent of $b$ is 0 in the first term, and the exponent increases by 1 in each successive term.
5. The sum of the exponents in any term is $n$.

A few steps for binomial expansion:
1) Identify the coefficients from Pascal's Triangle
2) Multiply both terms by each other giving the first term the highest power and the second term a power of 0
3) For each progressive coefficient subtract one from the power from the first term and add one to the power of the second term.

**Expand each expression.**

**A.** $(k - 5)^3$ 1331

$(1)(k)^3(-5)^0 + (3)(k)^2(-5)^1 + (3)(k)^1(-5)^2 + (1)(k)^0(-5)^3$

$1 \cdot k^3 \cdot 1 \quad 3 \cdot k^2 \cdot -5 \quad 3 \cdot k \cdot 25 \quad 1 \cdot 1 \cdot -125$

$k^3 - 15k^2 + 75k - 125$

**B.** $(6m - 8)^3$

**Expand each expression.**

**a.** $(x + 2)^3$ 1331

$(1)(x)^3(2)^0 + (3)(x)^2(2)^1 + (3)(x)^1(2)^2 + (1)(x)^0(2)^3$

$1 \cdot x^3 \cdot 1 \quad 3x^2 \cdot 2 \quad 3 \cdot x \cdot 4 \quad 1 \cdot 1 \cdot 8$

$x^3 + 6x^2 + 12x + 8$

**b.** $(x - 4)^5$

**Expand the expression.**

**c.** $(3x + 1)^4$

Homework:

p. 418 #18-25, 27-34, 54, 58-62