

"Closed" under
add & multiplication

EXPLORE & REASON

Let S be the set of expressions that can be written as $ax + b$, where a and b are real numbers. $a(b+c) = (a+b)c$ $a+b = b+a$

- A. Describe the Associative Property, the Commutative Property, and the Distributive Property. Then, explain the role of each in simplifying the sum $(3x + 2) + (7x - 4)$ and identify the leading coefficient and the constant term in the result.

$$a(b+c) = ab+ac$$

- B. Is the sum you found in part A a member of S ? Explain.

- C. **Construct Arguments** Is the product of two expressions in S also a member of S ? Explain why or produce a counterexample. © MP3

HABITS OF MIND

Construct Arguments Is the quotient of two expressions in S also a member of S ? Explain why or produce a counterexample. © MP3

3-2

Adding,
Subtracting,
and Multiplying
Polynomials

PearsonRealize.com

add/subt: combine like terms

mult/div: properties of exponents



EXAMPLE 1 Try It! Add and Subtract Polynomials

1. Add or subtract the polynomials.

a. $(4a^4 - 6a^3 - 3a^2 + a + 1) + (5a^3 + 7a^2 + 2a - 2)$
 $4a^4 - a^3 + 4a^2 + 3a - 1$

b. $(2a^2b^2 + 3ab^2 - 5a^2b) - (3a^2b^2 - 9a^2b + 7ab^2)$
 $2a^2b^2 + 3ab^2 - 5a^2b - 3a^2b^2 + 9a^2b - 7ab^2$
 $-a^2b^2 - 4ab^2 + 4a^2b$

HABITS OF MIND

Generalize When can you combine two terms using addition or subtraction? © MP.8

→ Same # of variables

EXAMPLE 2 Try It! Multiply Polynomials

2. Multiply the polynomials.

a. $(6n^2 - 7)(n^2 + n + 3)$

→ $6n^4 + 6n^3 + 11n^2 - 7n - 21$

	n^2	n	3
$6n^2$	$6n^4$	$6n^3$	$18n^2$
-7	$-7n^2$	$-7n$	-21

b. $(mn + 1)(m^2n - 1)(mn^2 + 2)$

$(m^3n^2 - mn + m^2n - 1)(mn^2 + 2)$

→ $m^4n^4 + m^3n^3 + 2m^3n^2 + 2m^2n - m^2n^3 - 2mn - mn^2 - 2$

	m^3n^2	$-mn$	$+m^2n$	-1
mn^2	m^4n^4	$-m^2n^3$	$+m^3n^2$	$-mn^2$
$+2$	$2m^3n^2$	$-2mn$	$+2m^2n$	-2

EXAMPLE 3 Try It! Understand Closure

3. Is the set of monomials closed under multiplication? Explain.

yes... $3x \cdot 4x = 4x \cdot 3x$

HABITS OF MIND

Construct Arguments Is the set of polynomials closed under multiplication? Explain. © MP.3

See above

Price × Units Sold

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

Notes

Assess

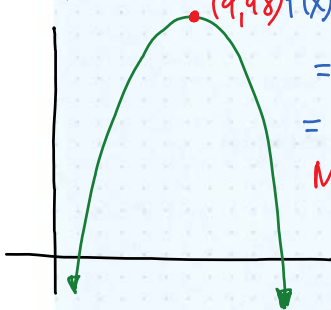
EXAMPLE 4 Try It! Write a Polynomial Function

4. The cost of Carolina's materials changes so that her new cost function is $c(x) = 4x + 42$. Find the new profit function. Then find the quantity that maximizes profit and calculate the profit.

$V(x) = 48 - 2x$

↑ price ↗ #

$C(x) = 12x + 64$



$$P(x) = (48 - 2x)x - (12x + 64)$$

$$= 48x - 2x^2 - 12x - 64$$

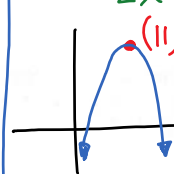
$$= -2x^2 + 36x - 64$$

Max Profit:
9 windchimes = \$98
0 windchimes = \$-64

$$P(x) = (48 - 2x)x - (4x + 42)$$

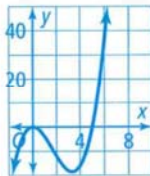
$$= 48x - 2x^2 - 4x - 42$$

$$= -2x^2 + 44x - 42$$



EXAMPLE 5 Try It! Compare Two Polynomial Functions

5. Compare the profit functions of two additional market sellers modeled by the graph of f and the equation $g(x) = (x + 1)(5 - x)$. Compare and interpret the y -intercepts of these functions and their end behavior.



HABITS OF MIND

Make Sense and Persevere Find the quantity that maximizes profit for $g(x) = (x + 1)(5 - x)$. Calculate the profit. © MP.1

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How do you add, subtract, and multiply polynomials?

2. **Error Analysis** Chen subtracted two polynomials as shown. Explain Chen's error. © MP.3

$$p^2 + 7mp + 4 - (-2p^2 - mp + 1)$$

$$p^2 + 2p^2 + 7mp - mp + 4 + 1$$

$$3p^2 + 6m + 5 \quad \mathbf{X}$$

3. **Construct Arguments** Why do we often write the results of polynomial calculations in standard form? © MP.3

4. **Reason** Is the set of whole numbers closed under subtraction? Explain why you think so, or provide a counterexample. © MP.2

Do You KNOW HOW?

Add or subtract the polynomials.

5. $(-3a^3 + 2a^2 - 4) + (a^3 - 3a^2 - 5a + 7)$

$$\rightarrow -2a^3 - a^2 - 5a + 3$$

6. $(7x^2y^2 - 6x^3 + xy) - (5x^2y^2 - x^3 + xy + x)$

$$\rightarrow 2x^2y^2 - 5x^3 - x$$

Multiply the polynomials.

7. $(7a + 2)(2a^2 - 5a + 3)$

$$\begin{array}{r} 14a^3 - 35a^2 + 21a \\ + \quad 4a^2 - 10a + 6 \\ \hline \rightarrow 14a^3 - 31a^2 + 11a + 6 \end{array}$$

8. $(xy - 1)(xy + 6)(xy - 8)$

$$\begin{array}{r} x^2y^2 + 6xy - xy - 6 \\ (x^2y^2 + 5xy - 6)(xy - 8) \\ \hline x^3y^3 - 8x^2y^2 \\ + 5x^2y^2 - 40xy \\ - 6xy + 48 \\ \hline \rightarrow x^3y^3 - 3x^2y^2 - 46xy + 48 \end{array}$$

9. The length of a rectangular speaker is three times its width, and the height is four more than the width. Write an expression for the volume V of the rectangular prism in terms of its width, w .