

## EXPLORE &amp; REASON

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

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

Enter your answer.

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.

To add/subtract  
can only combine  
like terms

Same variable  
and exponent  
combinations

± coefficients

## Workbooks Pg. 66

## EXAMPLE 1 Add and Subtract Polynomials

## Try It!

1. Add or subtract the polynomials.

a.  $(\underline{4a^4} - \underline{6a^3} - \underline{3a^2} + \underline{a} + \underline{1}) + (\underline{5a^3} + \underline{7a^2} + \underline{2a} - \underline{2})$

$$4a^4 - a^3 + 4a^2 + 3a - 1$$

## CHECK ANSWER

Must distribute  
Subtraction  
to each term.

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

$$\underline{2a^2b^2} + \underline{3ab^2} - \underline{5a^2b} - \underline{3a^2b^2} + \underline{9a^2b} - \underline{7ab^2}$$

$$-a^2b^2 - 4ab^2 + 4a^2b$$

## EXAMPLE 2 Multiply Polynomials

## Try It!

2. Multiply the polynomials.

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

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

$$6n^4 + 6n^3 + 11n^2 - 7n - 21$$

$$\begin{array}{r} 2 \cdot 3 \cdot 4 \\ \quad \cdot 4 \\ \hline 24 \end{array}$$

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

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

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

What cool thing will happen?....

$(x+3)(x^2 - 3x + 9)$

$(5x - 4)(25x^2 + 20x + 16)$

$$125x^3 + 100x^2 + 80x - 100x^2 - 80x - 64$$

$x^3 + 27$

$125x^3 - 64$

## EXAMPLE 3 Understand Closure

## Try It!

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

closed

$$3x \cdot -2x^3$$

$$= -6x^4$$

mono  $\cdot$  mono = mono

Not closed

$$3x + -2x^3$$

$$= -2x^3 + 3x$$

mono + mono = binomial

## EXAMPLE 3 Understand Closure

## Try It!

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

is a mono  $\cdot$  mono = mono

ex.  $8x \cdot 3x^3 = 24x^4$  ✓ Yes closed

mono + mono ~~is~~ mono not closed

$$8x + 3x = 11x \text{ yes}$$

$$8x + 3x^3 = 3x^3 + 8x \text{ is a binomial}$$

no

EXAMPLE 4 Write a Polynomial Function

ESSENT

Carolina makes wind chimes to sell at the local street market. As Carolina produces a greater number of wind chimes, she can lower the price per unit. The function  $v(x) = 48 - 2x$  relates the price  $v$  to the number produced  $x$ . The cost  $c$  of making  $x$  wind chimes can be represented with the function  $c(x) = 12x + 64$ .



How many wind chimes should Carolina sell each week to maximize her profit  $P$ ?

Profit = Revenue - Cost  
 Profit = Price  $\cdot$   $x$  - cost  
 $P(x) = (48 - 2x)x - (12x + 64)$   
 $P(x) = 48x - 2x^2 - 12x + 64$   
 $= -2x^2 + 36x + 64$  maximize? Find Vertex  
 $x = -\frac{b}{2a} = -\frac{(36)}{2(-2)} = \frac{-36}{-4} = 9$   
 She needs to sell 9 windchimes per week

EXAMPLE 4 Write a Polynomial Function

ESSENT

Try It!

4. The function  $v(x) = 48 - 2x$  relates the price,  $v$ , of Carolina's wind chimes to the number produced,  $x$ . 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.

Profit = Revenue - Cost  
 $P(x) = (48 - 2x)x - (4x + 42)$   
 $P(x) = -2x^2 + 44x - 42$  Maximize Profit  
 $x = -\frac{b}{2a} = -\frac{(44)}{2(-2)} = \frac{-44}{-4} = 11$   
now sell 11 per week

