

Section 9: Polynomial Operations

In this section, we are going to learn skills for:

NGSS Standards

☀ **MA.912.A.4.2** Add, subtract, and multiply polynomials.

NOTE: Items requiring multiplication of polynomials are limited to a product of: two monomials, a monomial and a binomial, a monomial and a trinomial, or two binomials.

☀ **MA.912.A.4.4** Divide polynomials by monomials and polynomials with various techniques, including synthetic division.

CCS Standards

☉ **MACC.912.A-APR.1.1** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Section 9 – Video 1

Addition and Subtraction

This is the same as combining like terms!

$$(b^6 + 6b^3 - b^2) + (3b^2 + 5b)$$

Study Edge Tip

When you have a negative in front of parentheses, change every sign in the parentheses!

$$(6e^3 + 8e^2 - 8e) - (3e^3 - 6e^2 + 8)$$

Try it!

$$(-6m^4 - 4m^3 + 8m^2 + 4) - (4m^5 + 5m^3 - 4m^2 + 1)$$

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

BEAT THE TEST!

1. Simplify:

$$(-6a^4 + 6a^2 + 2a) - (-3a^3 + 2a^2 - a)$$

What is the coefficient of the a^2 term?

--	--	--	--	--	--	--

2. Simplify:

$$(6a^2 - a - 2) + (-a^2 - 7a + 8)$$

Which is the correct answer?

- A. $-6a^2 - 8a + 6$
- B. $-6a^2 - 8a + 10$
- C. $5a^2 - 8a + 6$
- D. $5a^2 - 8a + 10$

Section 9 – Video 2

Multiplication

- In general, you need to multiply coefficients and add exponents!

$$6c(4c^3 - 8c^2 + 5c)$$

$$-6h^3(6h^4 - 3h^2 + 8h)$$

Try it!

$$4d^2(7d^4 + 3d^2 + 7)$$

$$(3x^2 + 2x - 6)(-4x^2)$$

$$(2 + 3)(4 + 5)$$

- The **FOIL** method

- **F**irst

- **O**uter

- **I**nnner

- **L**ast

$$(3n - 2)(2n + 5)$$

$$(6a - 8)(2a^2 + 5)$$

Try it!

$$(2 - 8f^2)(f + 8)$$

- Multiplying a trinomial by a binomial is similar to FOIL. Multiply everything in the first set of parentheses by everything in the second set. Then, combine like terms.

$$(x + 8)(-x^2 - 5x + 4)$$

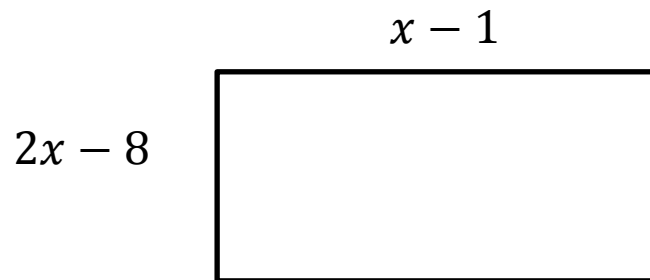
$$(x^3 - 2x + 3)(x + 7)$$

Try it!

$$(-3g^2 + g - 2)(g + 7)$$

BEAT THE TEST!

1. Emily wants to paint the bottom of her pool. In order to determine how much paint to buy, she needs to find the area of the bottom of her pool.



Which polynomial represents the area?

- A. $2x^2 - 10x + 8$
- B. $2x^2 - 6x + 8$
- C. $2x^2 + 6x + 8$
- D. $2x^2 + 10x + 8$

2. Jillian needs to determine the area of her garden so she can calculate how many roses she can plant. The width can be expressed as $2r$ and the length can be expressed as $6r^4 + r^3 - 7r^2 - 8r$.

$$6r^4 + r^3 - 7r^2 - 8r$$

$2r$



If Jillian finds the area correctly, what would be the coefficient of the r^2 term?

--	--	--	--	--	--	--

Section 9 – Video 3

Dividing Polynomials by Monomials

- In short... split up the numerator.
 - Distribute the denominator to each piece of the numerator.

$$\frac{24c^2f^4g^4 - 20f^6g^2 - 32f^4g^2}{4f^4g^2}$$

Study Edge Tip

Remember to divide the coefficients and subtract the exponents.

$$\frac{42a^2c^3d^2 + 60a^3d^2}{6a^2}$$

Try it!

$$\frac{25n^2z^2 - 50nr^2z + 35n^2z}{-5nz}$$

BEAT THE TEST!

1. Simplify:

$$\frac{12e^3n^4 - 54e^4n^3}{6e^3n^3}$$

What is the coefficient of n ?

--	--	--	--	--	--	--

2. Simplify:

$$\frac{45z^4 - 20k^3n^2z}{5z}$$

- A. $40z^3 - 15k^3n^2$
- B. $9z^3 - 4k^3n^2$
- C. $40z^3 - 15k^3n^2z$
- D. $9z^3 - 4k^3n^2z$

Section 9: Polynomial Operations

Practice Problems

1. A wooden garden tray with a base area of xy square inches is filled with soil up to a certain height. The tray contains $(x^2y + 10xy^2 + 12xy)$ cubic inches of soil. The height of the tray is represented by the expression:

$$\frac{x^2y + 10xy^2 + 12xy}{xy}$$

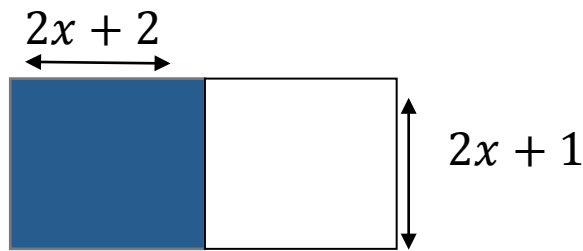
Write an expression for the simplified form of the height of the tray.

2. Charlie is dividing a polynomial by a monomial as shown below:

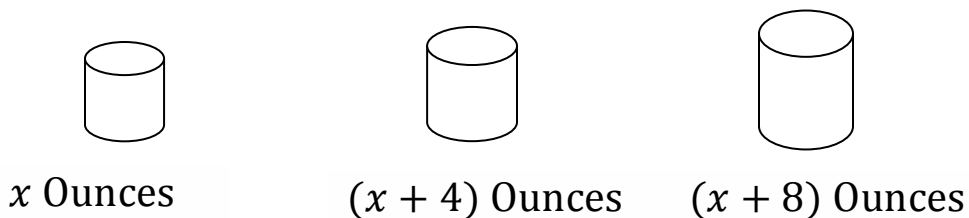
$$\frac{14a^4b^4 + 21a^3b^3 - 28a^2b^2}{7a^3b^2}$$

Write the result in simplest form.

3. Which expression is equivalent to the perimeter of the shaded portion of the rectangle below?

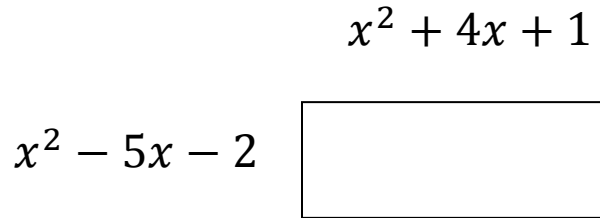


- A. $4x + 6$
B. $8x + 4$
C. $12x + 10$
D. $8x + 6$
4. Buzz Cola sells three different cans that hold different quantities of soda, as shown in the figure below.



How many ounces of soda do all three cans hold in all?

5. What is the perimeter of this rectangle?



6. A college wants to compare the number of students who rent their textbooks to the number who buy their textbooks. The polynomials below show expressions for each.

$$\text{Own: } 8x^2 + 6x + 654$$

$$\text{Rent: } 3x^2 + 9x + 95$$

In each polynomial, $x = 0$ corresponds to a student's first year in college. Find the polynomial that represents how many **MORE** students own their books rather than rent them.

If you write your answer in the form, $ax^2 + bx + c$, what is the value of, b , the coefficient of the x term?

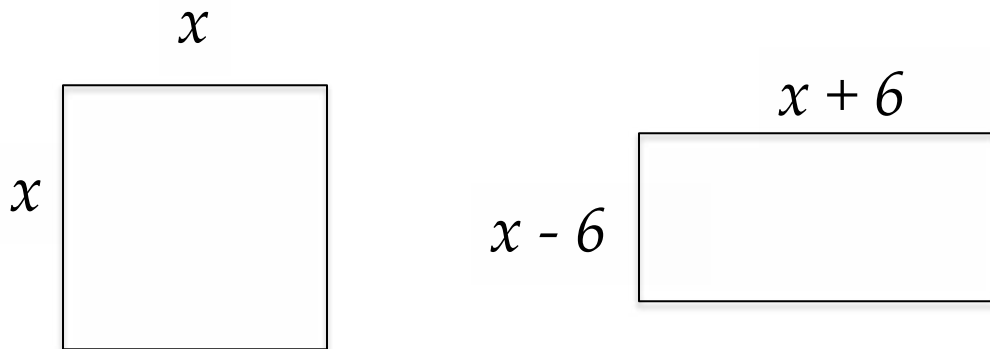
7. A patio floor is in the shape of a rectangle. The floor has a length of $(2x + 2)$ meters and a width of $(3x - 2)$ meters. The expression below represents the area of the patio floor in square meters.

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

Which of the following simplified expressions represents the area of the patio floor, in square meters?

- A. $6x^2 + 2x - 4$
- B. $6x^2 + 2x - 6$
- C. $5x^2 + 6x - 4$
- D. $x^2 + 10x - 4$

8. You are trying to decide between two different poster boards for your science presentation. The first poster has a length of x units and a width of x units. The second poster has a length of $(x - 6)$ units and a width of $(x + 6)$ units.



Which poster board has a larger surface area? How many square units larger is it?

9. A greenhouse that specializes in growing flowers is divided into sections. The number of plants in each section depends on the number of sprinklers in that section.

In a section with x sprinklers, there are $3x(x + 5)$ Daffodil plants and $(x + 6)^2$ Purple Rose plants.

Write a simplified expression representing the **total** number of Daffodil plants **and** Purple Rose plants in a section with x sprinklers.

10. Write a simplified expression for the area of the shaded portion of the rectangle.

