

UNPACKING the B.E.S.T. | MA.912.AR.1.3

A **polynomial** is an algebraic expression with one or more terms added or subtracted together. Each term is a **constant**, a **variable**, or the product of a constant and a variable. For example, $3x^2 + 6y - 7$ is a polynomial. It contains two variable terms, $3x^2$ and $6y$, and a constant term, -7 . In a variable term, the numerical factor adjacent to the variable is called the **coefficient**. For example, in the term $3x^2$, the coefficient is 3.

You can add, subtract, and multiply polynomials. Each of these operations will result in another polynomial. This means that polynomials are closed under addition, subtraction, and multiplication.

► Words to Know

polynomial
constant
variable
coefficient
like terms

GUIDED PRACTICE

To add and subtract polynomials, combine **like terms**. Like terms have the same variable raised to the same power. For example, $2x$ and $-4x$ are like terms, but $2x$ and x^2 are not like terms. To combine like terms, add or subtract their coefficients and keep their variable part. For example, adding $2x$ and $-4x$ results in $-2x$. The terms $2x$ and x^2 are not like terms, so adding them results in $x^2 + 2x$.

Problem 1

Determine the sum $(5x^2 - 3x + 7) + (\frac{1}{7}x^2 + 4x + \frac{5}{6})$.

► Step 1

Rewrite the polynomial with like terms adjacent to each other.

$$5x^2 + \underline{\hspace{2cm}}x^2 - 3x + \underline{\hspace{2cm}}x + 7 + \underline{\hspace{2cm}}$$

► Step 2

Combine like terms.

$$\underline{\hspace{4cm}}$$

Solution

$$(5x^2 - 3x + 7) + (\frac{1}{7}x^2 + 4x + \frac{5}{6}) = \underline{\hspace{4cm}}$$

When you subtract polynomials, such as $(8x^3 + 4x - 1) - (6x^3 - 2x + 1.5)$, the subtraction sign before the second quantity represents -1 .

Problem 2

Determine the difference $(8x^3 + 4x - 1) - (6x^3 - 2x + 1.5)$.

► Step 1

Distribute -1 to each term in the second quantity.

$$8x^3 + 4x - 1 - \underline{\hspace{2cm}} + \underline{\hspace{2cm}} - \underline{\hspace{2cm}}$$

► Step 2

Rewrite the polynomial with like terms adjacent to each other.

$$\underline{\hspace{2cm}}x^3 - \underline{\hspace{2cm}}x^3 + \underline{\hspace{2cm}}x + \underline{\hspace{2cm}}x - \underline{\hspace{2cm}} - \underline{\hspace{2cm}}$$

▶ **Step 3** Combine like terms.

Solution $(8x^3 + 4x - 1) - (6x^3 - 2x + 1.5) =$ _____

You can use the distributive property to multiply a monomial by a polynomial.

Problem 3 Determine the product $3x^2 \left(-\frac{2}{5}x^2 + 8x + \frac{9}{10}\right)$.

▶ **Step 1** Distribute $3x^2$ to each term in the trinomial.

$$3x^2\left(-\frac{2}{5}x^2\right) + 3x^2(8x) + 3x^2\left(\frac{9}{10}\right)$$

▶ **Step 2** Simplify each term.

$$-\frac{6}{5}x^4 + \text{_____} + \text{_____}$$

Solution $3x^2 \left(-\frac{2}{5}x^2 + 8x + \frac{9}{10}\right) =$ _____

You can also use the distributive property to multiply two polynomials. Multiply each term in the first quantity by the second quantity.

Problem 4 The length of a rectangle is represented by the expression $4x - 3$ and the width is represented by the expression $\frac{1}{2}x^2 - x + 2$. Write a simplified expression for the area of the rectangle.

▶ **Step 1** Write an expression for the area of the rectangle.

The area of a rectangle is length times width.

$$A = lw = (4x - 3)\left(\frac{1}{2}x^2 - x + 2\right)$$

▶ **Step 2** Multiply the terms in the first quantity, $4x$ and -3 , by the second quantity $\left(\frac{1}{2}x^2 - x + 2\right)$.

$$4x\left(\frac{1}{2}x^2 - x + 2\right) - 3\left(\frac{1}{2}x^2 - x + 2\right)$$



▶ **Step 3** Distribute $4x$ and -3 .

▶ **Step 4** Combine like terms.

Solution $(4x - 3)\left(\frac{1}{2}x^2 - x + 2\right) =$ _____

You can also use an **area model** (also called the **box method**) to multiply two polynomials.

Problem 5 Multiply $(5x^2 - 7x)(2x^2 - \frac{3}{8}x + 10)$ using an area model.

▶ **Step 1** Multiply each term above the table by the term to the left of the table.

	$2x^2$	$-\frac{3}{8}x$	10
$5x^2$	$(5x^2)(2x^2) =$ _____	$(5x^2)\left(-\frac{3}{8}x\right) =$ _____	$(5x^2)(10) =$ _____
$-7x$	$(-7x)(2x^2) =$ _____	$(-7x)\left(-\frac{3}{8}x\right) =$ _____	$(-7x)(10) =$ _____

▶ **Step 2** Write the sum or difference of the terms from the table.

$10x^4 - 14x^3 -$ _____ $+$ _____ $+$ _____ $-$ _____

▶ **Step 3** Combine like terms.

Solution $(5x^2 - 7x)(2x^2 - \frac{3}{8}x + 10) =$ _____

SHORT RESPONSE QUESTIONS

This question has **two** parts.

1. Part A

Find the sum $(x^3 + 2x) + (3x^2 - 1)$.

Part B

Explain why the sum has the same number of terms as the original expression.

2. Write $2x^2(x - 6) + (3x - 4)(x^2 - x + 7)$ as a simplified polynomial. Show or explain your work.

PRACTICE

DIRECTIONS Read and answer each question carefully.

- 1** The distance from Point A to Point B is $5x^2 + 3$ miles. The distance from Point B to Point C is $10 - 2x^2$ miles. The distance from Point C to Point D is 4 miles.

If Mike walks from Point A to Point B , then to Point C , and finally to Point D , which expression represents the total distance he travels in miles?

- (A) $3x^2 - 3$ (C) $7x^2 + 7$
 (B) $3x^2 + 17$ (D) $-10x^4 + 120$

- 2** Which of the expressions is equivalent to $(y + 3) - (-3y - 2.2)$?

- (A) $4y + 5.2$
 (B) $2y + 5.2$
 (C) $-2y + 1.8$
 (D) $4y + 1.8$

- 3** Which is the product of $(2x^2 - 3x + 1)$ and $(-4x)$?

- (A) $-8x^3 - 12x^2 - 4x$
 (B) $-8x^3 + 12x^2 - 4x$
 (C) $4x^2 - 4x$
 (D) $-8x^3 - 12x^2 + 4x$

- 4** Multiply: $(x^2 - 3x + 2)(x - 3)$.

- (A) $x^3 - 3x^2 - 6$
 (B) $x^3 - 6x^2 + 11x - 6$
 (C) $x^2 - 2x - 1$
 (D) $x^2 - 4x - 6$

- 5** Judy bought a pair of jeans for x dollars and a T-shirt for \$10. The sales tax was 7%. Judy wrote the expression below to represent the total amount she paid.

$$x + 10 + 0.07(x + 10)$$

Which expression is equivalent to Judy's expression?

- (A) $0.07x + 0.7$ (C) $1.07x + 10.7$
 (B) $1.07x + 20$ (D) $x + 10.7$

- 6** Which is the product $-\frac{3}{7}x^2(-8x^2 + 4x + \frac{2}{3})$?

- (A) $-\frac{24}{7}x^4 + \frac{14}{7}x^2$
 (B) $-\frac{24}{7}x^4 + \frac{12}{7}x^3 - 14x^2$
 (C) $\frac{24}{7}x^4 - \frac{14}{7}x^2$
 (D) $\frac{24}{7}x^4 - \frac{12}{7}x^3 - \frac{2}{7}x^2$

- 7** Which is the sum $(\frac{5}{11}x^2 - \frac{3}{7}x + 9) + (x^2 - 2x + 1)$?

- (A) $\frac{4}{11}x^2 - \frac{17}{7}x + 10$
 (B) $\frac{4}{11}x^2 - \frac{5}{7}x + 10$
 (C) $\frac{16}{11}x^2 - \frac{17}{7}x + 10$
 (D) $\frac{16}{11}x^4 - \frac{17}{7}x^2 + 10$

- 8** Which is the product $(\frac{1}{8}x - 1)(3x^2 - x + 7)$?

- (A) $\frac{3}{8}x^3 + \frac{25}{8}x^2 - \frac{15}{8}x + 6$
 (B) $\frac{3}{8}x^3 - \frac{25}{8}x^2 + \frac{15}{8}x + 6$
 (C) $\frac{3}{8}x^3 + \frac{25}{8}x^2 - \frac{15}{8}x - 7$
 (D) $\frac{3}{8}x^3 - \frac{25}{8}x^2 + \frac{15}{8}x - 7$

ASSESSMENT

DIRECTIONS Read and answer each question carefully.

- 1 Mouse 1 ran through a maze in $3c^2 - 9$ seconds. Mouse 2 ran through the same maze in $5c^2 + 7c + 1$ seconds.

Which expression represents how much longer Mouse 2 took to complete the maze?

- (A) $2c^2 - 8$
- (B) $2c^2 + 7c + 10$
- (C) $2c^2 + 7c - 8$
- (D) $-8c^2 - 7c - 10$

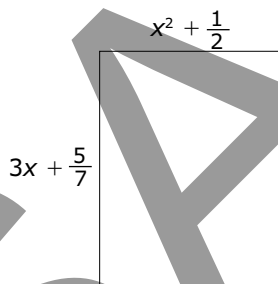
- 2 Keira simplifies the following expression.

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

In Keira's simplified expression, what is the coefficient of x^2 ?

Write your answer in the box.

- 3 A rectangle has the side lengths shown.



Circle the correct value from each drop-down menu to complete the simplified expression for the area of the rectangle.

$\frac{5}{14}$	$x^3 +$	$\frac{5}{14}$	$x^2 +$	$\frac{5}{14}$	$x +$	$\frac{5}{14}$
$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$		$\frac{5}{7}$
$\frac{3}{2}$		$\frac{3}{2}$		$\frac{3}{2}$		$\frac{3}{2}$
3		3		3		3

- 4 An expression is shown.

$$3.2x - 1.5$$

Select **all** the expressions that are equivalent.

- (A) $(7x + 3) - (-3.8x + 4)$
- (B) $(10.2x - 2.5) - (7x - 1)$
- (C) $(9x - 3) - (5.8x + 1.5)$
- (D) $(2x^2 - 5x + 4) + (2x^2 + 8.2x - 5.5)$
- (E) $(2x^2 - 5x + 4) - (2x^2 - 8.2x + 5.5)$

- 5 Find the product.

$$(6x - 7)(3x^2 - x + 9)$$

Write your answer in the box.

- 6 Choose the correct answer from the drop-down menu to complete the statement.

A binomial is multiplied by a monomial. Then, that product is subtracted from a trinomial. The result will be a polynomial. will not

- 7 Which is the product $(8x + 3)(\frac{2}{3}x^2 - 2x + 5)$?

- (A) $\frac{16}{3}x^3 - 14x^2 + 34x + 15$
- (B) $\frac{16}{3}x^3 + 14x^2 + 34x + 8$
- (C) $\frac{10}{3}x^3 - 14x^2 + 36x + 15$
- (D) $\frac{10}{3}x^3 + 14x^2 + 36x + 8$