

**Unit 2: Polynomials**  
**Student Edition**

## Unit 2.1 Interpret the Structure of Expressions

### Student Learning Targets (SWBAT):

- Interpret parts of expressions such as terms, factors, coefficients
- Use the structure of an expression to identify ways to rewrite it
- Add polynomials
- Subtract polynomials
- Multiply polynomials

### Notes:

### Assignment 2.1:

Determine which are polynomial functions. State the degree, leading coefficient. For those that are not functions explain why.

1.  $f(x) = 3x^{-2} + 17$

2.  $f(x) = 2x^5 - \frac{1}{2}x + 9$

3.  $f(x) = -9 + 2x$

4.  $h(x) = 13$

5.  $k(x) = \sqrt[3]{27x + 8x^3}$

**Add or subtract the following polynomials**

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

7.  $(4a^2 - 2 - 8a^3) + (5a^2 - 4a + 8a^3)$

8.  $(6x^2 + 7x + 3x^3) - (5x^2 + 3x + 7x^3)$

9.  $(8x^3 - 4x^2 + 5x^4) - (5x^3 - 5x^4 + 6x^2)$

10.  $(2 - 3i) + (6 + 5i)$

11.  $(\sqrt{5} - 3i) + (-2 + \sqrt{-9})$

12.  $(2 - 3i) + (3 - 4i)$

13.  $(2 - i) + (3 - \sqrt{-3})$

Find each product

10.  $(5m - 6)(2m + 7)$

11.  $(7r + 8)(3r - 5)$

12.  $(2x - 4)^2$

13.  $(\sqrt{-4} + i)(6 - 5i)$

14.  $(3n^3 + 2n)(4n^2 - 1)$

15.  $(6x^3 + 2x)(x + 5)$

16.  $(2x + 3)^3$

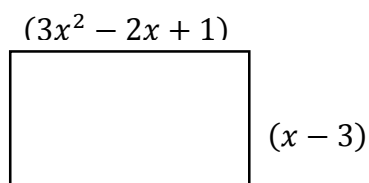
17.  $(2 + 3i)(2 - i)$

18.  $(2 - i)(1 + 3i)$

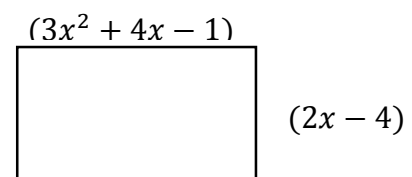
19.  $(7i - 3)(2 + 6i)$

Find the area and perimeter of the rectangles.

21.



22.



## 2.2: Factoring Polynomials

### Objectives:

- Factor expressions with a common factor
- Factor expressions when  $a = 1$
- Factor expressions when  $a > 1$

### Notes:

## Assignment 2.2

Factor each expression completely.

1.  $3x^2 + 10x + 3$

2.  $3x^2 - 13x + 12$

3.  $9x^3 + 3x^2 - 12x$

4.  $2x^3 - x^2 - 3x$

5.  $14u^2 - 33u - 5$

6.  $3x^4 + 7x^3 + 2x^2$

7.  $x^2 + 9x + 14$

8.  $y^2 - 11y + 30$

9.  $6t^2 + 5t + 1$

10.  $12x^2 + 11x - 15$

Solve each equation using factoring.

11.  $x^2 + 9x - 22 = 0$

12.  $3x^2 + 8x + 4 = 0$

13.  $x^4 - 29x^2 + 100 = 0$

14.  $4x^4 - 14x^2 + 12 = 0$

15.  $x^6 - 9x^4 - x^2 + 9 = 0$

16.  $4x^4 - 4x^2 - x^2 + 1 = 0$

## Unit 2.3 – Factoring Special Polynomials

### Objectives:

- Factor expressions using grouping
- Factor over complex numbers
- Factor perfect cubes
- Factor perfect squares

### Notes:

## 2.3 Assignment

### Factor by grouping.

1.  $4x^3 - 20x^2 + 4x - 20$

2.  $x^3 + 3x^2 + 5x + 15$

3.  $x^3 - 4x^2 + 5x - 20$

4.  $x^6 - 3x^4 + x^2 - 3$

### Factor the sum or difference of two cubes.

5.  $y^3 - 8$

6.  $z^3 + 64$

7.  $8x^3y^3 - 64x^6$

8.  $64z^3 + 27$

### Factor the sum or difference of two squares.

9.  $z^2 - 49$

10.  $64 - 25y^2$

11.  $x^2 + 9$

12.  $16z^2 + 25$

13.  $9y^2 - 16$

14.  $36x^2 + 64$

### Find the zeros of the function.

15.  $x^3 + x^2 + 4x + 4$

16.  $9x^2 - 3x - 2$

17.  $5x^3 - 5x^2 - 10x$

18.  $x^3 - 25x$

19.  $x^6 - 9x^4 - x^2 + 9$

20.  $4x^4 - 4x^2 - x^2 + 1$



## 2.4 Assignment! Mixed factoring...

## Unit 2.5 Graphing Polynomial Functions

### Objectives:

- Graph polynomial function using the roots of the function
- Analyze properties of polynomial functions

### Notes:

## Assignment 2.5

Identify the zeros for each of the following functions. State the multiplicity of each zero.

1.  $y = (x - 4)(x + 5)^8(x - 6)^3$

2.  $y = 2x^7(x + 8)^2(x - 9)^3$

3.  $y = -4x^5(x - 1)(2x + 5)^4$

4.  $y = (7x + 21)^9(x - 4)^3(2x + 10)$

Graph each polynomial function using a graphing calculator. Identify the x-intercepts, local max and min, intervals of increasing and decreasing, end behavior, and domain and range.

5.  $y = (x - 3)(x + 6)$

6.  $y = -2(x - 2)(x - 5)$

7.  $y = (x + 3)^2(x - 1)$

8.  $y = -4(x - 2)(x + 4)^3(x + 6)$

9.  $y = (x + 1)^{24}(x - 3)^2$

10.  $y = -x(x + 3)(x - 4)$

Graph each polynomial function by hand. Identify the x-intercepts and end behavior.

11.  $y = -6x(4x - 3)^2(2x + 8)^7$

12.  $y = (6x + 12)(x - 3)(3x + 15)^3$

13.  $y = 2x^4 + 8x^3 - 42x^2$

14.  $y = -3x^2 - 12x^2 - 3x$

15.  $y = x^3 + 3x^2 - 9x - 27$

16.  $y = -x^5 - x^4 + 2x^3$

## Unit 2.6 Dividing Polynomials Using Long Division and Synthetic Division

Student Learning Targets:

- I can divide polynomials using long division.
- I can find the remainder using the Remainder Theorem
- I can apply the ideas of the Factor Theorem
- I can divide polynomials using synthetic division.

Remainder Theorem:

If a polynomial  $f(x)$  is divided by  $x - k$ , then the remainder is  $r = f(k)$ .

Factor Theorem:

A polynomial function  $f(x)$  has a factor  $x - k$ , if and only if  $f(k) = 0$ .

**Notes:**

**Assignment 2.6:**

**Simplify.**

1.  $\frac{4xy^2 - 2xy + 2x^2y}{xy}$

2.  $(3a^2b - 6ab + 5ab^2) \div (ab)$

**Simplify using long division.**

3.  $(10x^2 + 15x + 20) \div (5x + 5)$

4.  $\frac{x^4 - 3x^3 + 6x^2 - 3x + 5}{x^2 + 1}$

5.  $(18a^2 + 6a + 9) \div (3a - 2)$

6.  $\frac{27y^2 + 27y - 30}{9y - 6}$

**Use the Remainder Theorem to find the remainder when  $f(x)$  is divided by  $x - k$ .**

7.  $f(x) = 2x^2 - 3x + 1; k = 2$

8.  $f(x) = x^4 - 5; k = 1$

**Use the Factor Theorem to determine whether the first polynomial is a factor of the second polynomial.**

9.  $(x - 3); x^3 - x^2 - x - 15$

10.  $(x - 2); x^3 + 3x - 4$

**Simplify using synthetic division.**

11.  $(z^4 - 3z^3 + 2z^2 - 4z + 4) \div (z - 1)$

12.  $\frac{y^3 + 11y^2 - 10y + 6}{y + 2}$

13.  $\frac{2x^4 - 5x^3 + 7x^2 - 3x + 1}{x - 3}$

14.  $(5x^4 - 3x + 1) \div (x - 4)$

15.  $\frac{x^4 - 3x^2 - 18}{x - 2}$

## **Unit 2.7: Extend Polynomial Identities to Complex Numbers**

Student Learning Targets:

- Know what the Linear Factorization Theorem is and how to use it.
- Find complex zeros of a polynomial function.
- Write a linear factorization of a polynomial function.

**Notes:**



**Assignment 2.7:**

**Write each polynomial in standard form.**

1.  $f(x) = (x + 1)(x - 3)(x + 5)$

2.  $f(x) = (2x - 1)(x + 4i)(x - 4i)$

**State the number of zeros each function has without graphing the function.**

3.  $f(x) = x^5 + 4x^3 - 6x^2 + 2x + 1$

4.  $f(x) = -3x^7 + 8x^6 - 2x^3 + 4x^2$

**Use the rational zeros theorem to identify all the possible rational zeros of each function.**

5.  $f(x) = x^4 + 8x + 32$

6.  $f(x) = x^3 + x^2 + x - 28$

7.  $f(x) = x^7 - 9x^5 + 5x^4 - 3x^2 + 7$

8.  $f(x) = x^{12} + 12x^7 + 4x^3 + x - 30$

**Given a polynomial and one of its factors, find the remaining factors of the polynomial.**

9.  $f(x) = x^3 - x^2 - 10x - 8; x + 2$

10.  $f(x) = 2x^3 + 7x^2 - 53x - 28; x - 4$

11.  $f(x) = 2x^3 + 17x^2 + 23x - 42; x - 1$

12.  $f(x) = 6x^3 - 25x^2 + 2x + 8; 2x + 1$

**Find all of the zeros of each function. Then write each polynomial in factored form.**

13.  $f(x) = x^3 + 10x^2 + 31x + 30$

14.  $f(x) = x^4 - x^3 - x^2 - x - 2$

15.  $f(x) = x^3 + 6x^2 - x - 30$

16.  $f(x) = x^3 + x^2 + 4x + 4$

**True or False. Justify your answer.**

17. The polynomial  $f(x) = 4x^3 + 7x + 5$  has three zeros.

18. The polynomial  $f(x) = x^4 + 5x - 4$  has a zero at  $x = 2$ .

19. A polynomial with degree of 4 will cross the x-axis 4 times.