

## 5.3 Add, Subtract, and Multiply Polynomials

Simplify: watch what operation you are performing!

1.  $(2x^3 - 5x^2 + 3x - 9) + (x^3 + 6x^2 + 11)$

2.  $(8x^3 - 5x + 1) - (3x^3 + 2x^2 - x + 7)$

Multiplying Polynomials: Distribute, combine like terms, and write in descending order.

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

4.  $(x - 5)(x + 1)(x + 3)$

5.  $(x - 2)^3$

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

## 5.3 Practice Worksheet

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

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

3.  $(b^4 + 10b) - (4b^3 + 6b^2 - b + 5)$

4.  $(2p + 1)(6p^2 + 7)$

5.  $(x + 5)^3$

6.  $(d^2 - 6d + 1) - (2d^2 + d - 8)$

7.  $(n - 1)(n^2 + 6n - 2)$

8.  $(3x + 2)(x + 1)(x - 4)$

4.  $(4x^3 - 9x^2 - 10x - 2) \div (x - 3)$

5.  $(-x^4 + 5x^3 - 10x - 4) \cdot (x+1)^{-1}$

6. 
$$\frac{(4x^3 - 7x^2 - 11x + 5)}{(4x + 5)}$$

7.  $(5x^4 + 2x^3 - 9x + 12) \div (x^2 - 3x + 4)$

**5.5 Day 1 Homework**  
**Page 366 #5-10 all**

**USING LONG DIVISION** Divide using polynomial long division.

3.  $(x^2 + x - 17) \div (x - 4)$

5.  $(x^3 + 3x^2 + 3x + 2) \div (x - 1)$

7.  $(3x^3 + 11x^2 + 4x + 1) \div (x^2 + x)$

9.  $(5x^4 - 2x^3 - 7x^2 - 39) \div (x^2 + 2x - 4)$

4.  $(3x^2 - 11x - 26) \div (x - 5)$

6.  $(8x^2 + 34x - 1) \div (4x - 1)$

8.  $(7x^3 + 11x^2 + 7x + 5) \div (x^2 + 1)$

10.  $(4x^4 + 5x - 4) \div (x^2 - 3x - 2)$

## 5.5 Apply the Remainder and Factor Theorems-Day 2

**Synthetic Division:** used to divide a polynomial by a binomial divisor in the form  $(x - c)$  in which  $c$  is a constant value and the coefficient of  $x$  is 1.

1.  $(x^3 - 6x^2 + 2x - 4) \div (x - 2)$

2.  $(2x^3 + x^2 - 8x + 16) \div (x + 4)$

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

4.  $(x^3 - 64) \div (x - 4)$

### Remainder Theorem:

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

➤ If  $k$  is the input, then the remainder is the output value.

5. Divide  $f(x) = x^3 + 4x^2 - 5x + 3$  by  $x + 2$ .

6. Divide  $g(x) = 4x^3 - 2x^2 + 6x - 1$  by  $2x + 3$ .

7. Divide  $y = 6x^2 - 5x + 9$  by  $(2x - 1)$ .

8. Divide  $f(x) = 4x^4 + 26x^3 - 8x^2 + 39x - 21$  by  $x + 7$ .

**5.5-Day 2 Homework**  
**Page 366: 12-20 (evens)**

**USING SYNTHETIC DIVISION** Divide using synthetic division.

11.  $(2x^2 - 7x + 10) \div (x - 5)$

12.  $(4x^2 - 13x - 5) \div (x - 2)$

13.  $(x^2 + 8x + 1) \div (x + 4)$

14.  $(x^2 + 9) \div (x - 3)$

15.  $(x^3 - 5x^2 - 2) \div (x - 4)$

16.  $(x^3 - 4x + 6) \div (x + 3)$

17.  $(x^4 - 5x^3 - 8x^2 + 13x - 12) \div (x - 6)$

18.  $(x^4 + 4x^3 + 16x - 35) \div (x + 5)$

**ERROR ANALYSIS** Describe and correct the error in using synthetic division to divide  $x^3 - 5x + 3$  by  $x - 2$ .

19.

$$\begin{array}{r|rrrr} 2 & 1 & 0 & -5 & 3 \\ & & 2 & 4 & -2 \\ \hline & 1 & 2 & -1 & 1 \end{array}$$

$\frac{x^3 - 5x + 3}{x - 2} = x^3 + 2x^2 - x + 1$

20.

$$\begin{array}{r|rrrr} 2 & 1 & -5 & 3 \\ & & 2 & -6 \\ \hline & 1 & -3 & -3 \end{array}$$

$\frac{x^3 - 5x + 3}{x - 2} = x^2 - 3x - \frac{3}{x - 2}$



## 5.5 Apply the Remainder and Factor Theorems-Day 3

Warm-Ups: Is  $(x-2)$  a factor of the following polynomials?

1. $x^3 - 4x^2 + 2x - 6$	2. $x^4 - 16$
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To find the remaining factors/zeros given one factor or zero:

1. Use synthetic or long division using the given factor to find the *depressed polynomial*.
2. Factor the depressed polynomial completely, if possible.
3. Set the factors equal to zero and solve if you are asked to find the zeros of the function.

A polynomial  $f$  and a factor of  $f$  are given. Factor  $f$  completely.

3. $f(x) = x^3 - x^2 - 5x - 3; (x+1)$	4. $f(x) = 2x^3 - 11x^2 + 3x + 36; (x-3)$
5. $f(x) = 16x^5 + 32x^4 - x - 2; (x+2)$	6. $f(x) = 2x^3 - 15x^2 + 34x - 21; (2x-7)$

A polynomial  $f$  and one zero of  $f$  are given. Find ALL the zeros of  $f$ .

7.  $f(x) = x^3 - 2x^2 - 21x - 18$ ;  $f(-3) = 0$

8.  $f(x) = 10x^3 - 81x^2 + 71x + 42$ ;  $x = 7$

9.  $f(x) = 2x^3 - 10x^2 - 71x - 9$ ;  $x = 9$

**5.5-Day 3 Homework**  
**Page 366: 22-34 (evens)**

**USING SYNTHETIC DIVISION** Divide using synthetic division.

11.  $(2x^2 - 7x + 10) \div (x - 5)$

12.  $(4x^2 - 13x - 5) \div (x - 2)$

13.  $(x^2 + 8x + 1) \div (x + 4)$

14.  $(x^2 + 9) \div (x - 3)$

15.  $(x^3 - 5x^2 - 2) \div (x - 4)$

16.  $(x^3 - 4x + 6) \div (x + 3)$

17.  $(x^4 - 5x^3 - 8x^2 + 13x - 12) \div (x - 6)$

18.  $(x^4 + 4x^3 + 16x - 35) \div (x + 5)$

**ERROR ANALYSIS** Describe and correct the error in using synthetic division to divide  $x^3 - 5x + 3$  by  $x - 2$ .

19.

$$\begin{array}{r|rrrr} 2 & 1 & 0 & -5 & 3 \\ & & 2 & 4 & -2 \\ \hline & 1 & 2 & -1 & 1 \end{array}$$

$\frac{x^3 - 5x + 3}{x - 2} = x^3 + 2x^2 - x + 1$

20.

$$\begin{array}{r|rrrr} 2 & 1 & -5 & 3 \\ & & 2 & -6 \\ \hline & 1 & -3 & -3 \end{array}$$

$\frac{x^3 - 5x + 3}{x - 2} = x^2 - 3x - \frac{3}{x - 2}$

## 5.5 Practice Worksheet

Divide the following and then decide if the divisor is a *factor* of the dividend.

1.  $(4x^3 + x^2 - 3x + 7) \div (x - 1)$

2.  $(4x^3 - 7x^2 - 11x + 5) \div (4x + 5)^{-1}$

3.  $(x^3 + 3x^2 - 7) \div (x^2 - x - 2)$

4. 
$$\frac{(5x^3 - x^2 - 18x + 8)}{(x + 2)}$$

5.  $(x^3 + 125) \div (x + 5)$

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

A polynomial  $f$  and a factor of  $f$  are given. Factor  $f$  completely.

7.  $f(x) = x^3 - 18x^2 + 95x - 126; (x - 9)$

8.  $f(x) = 3x^3 - 16x^2 - 103x + 36; (x + 4)$

A polynomial  $f$  and one zero of  $f$  are given. Find ALL the zeros of  $f$ .

9.  $f(x) = x^3 - x^2 - 21x + 45; f(-5) = 0$

10.  $f(x) = x^3 + x^2 + 2x + 24; x = -3$

11.  $f(x) = 2x^3 + 11x^2 + 9x + 2; f\left(-\frac{1}{2}\right) = 0$

