

**Objectives**

- Use long division and synthetic division to divide polynomials

**Vocabulary**

- Synthetic Division

**Example 1 Using Long Division to Divide Polynomials**

Divide by using long division.

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

**Step 1** Write the dividend in standard form, including terms with coefficient of 0.

**Step 2** Write division in the same way as you would when dividing numbers.

**Step 3** Divide

**Step 4** Write the final answer

*Try it*

**Divide by using long division.**

a)  $(15x^2 + 8x - 12) \div (3x + 1)$

**Step 1** Write the dividend in standard form, including terms with coefficient of 0.

**Step 2** Write division in the same way as you would when dividing numbers.

**Step 3** Divide

**Step 4** Write the final answer

**Divide by using long division.**

a)  $(x^2 + 5x - 28) \div (x - 3)$

**Step 1** Write the dividend in standard form, including terms with coefficient of 0.

**Step 2** Write division in the same way as you would when dividing numbers.

**Step 3** Divide

**Step 4** Write the final answer

<b>Synthetic Division Method</b>	
Divide $(2x^2 + 7x + 9) \div (x + 2)$ by using synthetic division	
Words	Numbers
<b>Step 1:</b> Write the coefficients of the dividend, 2, 7, and 9. In the upper left corner, write the value of $a$ for the divisor $(x-a)$ . So $a = -2$ . Copy the first coefficient in the dividend Below the horizontal bar.	$\begin{array}{r} -2 \quad 2 \quad 7 \quad 9 \\ \hline 2 \end{array}$
<b>Step 2:</b> Multiply the first coefficient by the divisor, and write the product under the next coefficient. Add the numbers in the new column.	$\begin{array}{r} -2 \quad 2 \quad 7 \quad 9 \\ \quad -4 \quad \quad \quad \\ \hline 2 \quad 3 \end{array}$
Repeat step 2 until the additions have been completed in all columns. Draw a box around the last sum.	$\begin{array}{r} -2 \quad 2 \quad 7 \quad 9 \\ \quad -4 \quad \quad \quad -6 \\ \hline 2 \quad 3 \quad 3 \end{array}$
<b>Step 3:</b> The quotient is represented by the numbers below The horizontal bar. The boxed number is the <i>remainder</i> . The others are the coefficients of the polynomial quotient, In order of decreasing degree.	$= 2x + 3 + \frac{3}{x + 2}$

**Example 2**     **Using Synthetic Division to Divide by a Linear Binomial**  
Divide by using synthetic division.

a)      $(4x^2 - 12x + 9) \div \left(x + \frac{1}{2}\right)$

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

**Try it!** Divide by using synthetic division.

a)  $(6x^2 - 5x - 6) \div (x + 3)$

b)  $(x^2 - 3x - 18) \div (x - 6)$

**Example 3**     **Remainder Theorem**

Use synthetic substitution to evaluate the polynomial for the given value.

a)  $P(x) = x^3 - 4x^2 + 3x - 5$  for  $x = 4$

Use synthetic substitution to evaluate the polynomial for the given value.

b)  $P(x) = 4x^4 + 2x^3 + 3x + 5$  for  $x = -\frac{1}{2}$

***Try it!***

Use synthetic substitution to evaluate the polynomial for the given value.

a)  $P(x) = x^3 + 3x^2 + 4$  for  $x = -3$

b)  $P(x) = 5x^2 + 9x + 3$  for  $x = \frac{1}{5}$