

When the divisor of a rational expression is a linear factor in the form  $\underline{X - C}$ , you can use a process called synthetic division.

Compare the methods of the rational expression below to find the quotient.

$$\frac{x^2 + 5x + 6}{x + 2}$$

Long Division	Synthetic Division
$  \begin{array}{r}  x + 3 \\  \hline  x + 2 \overline{) x^2 + 5x + 6} \\  \underline{(-) \quad (-)} \phantom{+ 6} \\  x^2 + 2x \phantom{+ 6} \\  \hline  3x + 6 \\  \underline{(-) \quad (-)} \\  3x + 6 \\  \hline  0  \end{array}  $	$  \begin{array}{r}  -2 \overline{) 1 \quad 5 \quad 6} \\  \underline{\phantom{1} \quad -2} \\  1 \phantom{0} \\  -2 \overline{) 1 \quad 5 \quad 6} \\  \underline{\phantom{1} \quad -2 \quad -6} \\  1 \quad 3 \\  -2 \overline{) 1 \quad 5 \quad 6} \\  \underline{\phantom{1} \quad -2 \quad -6} \\  1 \quad 3 \quad \boxed{0} \\  x + 3  \end{array}  $

To perform synthetic division, the divisor **must be** a linear term in the form  $x - c$ .

**Let's Practice!**

1. Find the quotient of the rational expression below.

$$\frac{-24a + 4a^3 + 12 + 8a^2}{-4 + 4a} \div 4$$

$$\begin{array}{r|rrrr} 1 & 1 & 2 & -6 & 3 \\ (+) & \downarrow & 1 & 3 & -3 \\ \hline & 1 & 3 & -3 & 0 \\ & a^2 & +3a & -3 & \end{array}$$

$$\frac{-6a + a^3 + 3 + 2a^2}{-1 + a}$$

$$\frac{a^3 + 2a^2 - 6a + 3}{a - 1}$$

2. Find the quotient of the rational expression below.

$$\frac{9y^3 + 9y^2 - y + 2}{y + \frac{2}{3}}$$

$$\begin{array}{r|rrrr} -\frac{2}{3} & 9 & 9 & -1 & 2 \\ & \downarrow & -6 & -2 & 2 \\ \hline & 9 & 3 & -3 & 4 \end{array}$$

$$9y^2 + 3y - 3 + \frac{4}{y + \frac{2}{3}}$$

**Try It!**

3. Find the quotient of the rational expression below.

$$\frac{3u^3 + 11u^2 - 6u - 18}{u + 4}$$

$$\begin{array}{r|rrrr} -4 & 3 & 11 & -6 & -18 \\ & & -12 & 4 & 8 \\ \hline & 3 & -1 & -2 & -10 \end{array}$$

$$3u^2 - u - 2 - \frac{10}{u+4}$$

**Try It!**

4. Find the quotient of the rational expression below.

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

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

$3x^2 + 3x - 3$

**BEAT THE TEST!**

1. Select all the expressions for  $d(x)$  that satisfy the parameters for synthetic division.

$$\frac{2x^4 - 9x^3 - 4x^2 + 5x - 13}{d(x)}$$

$d(x) =$

- $-9 + x$   $x-9$
- $3x^{-1} + 4$
- $x - 13$
- $x - \frac{1}{2}$
- $7x^2 - x$
- $5x - 7 - 4x = x - 7$
- 6

Assignment: Practice workbook

Sections 1 - 4

"Check your Understanding for Topic 1:  
Section 4" (Online)

- Check your understanding is under  
classlink, algebra nation.