5-2 Study Guide and Intervention

Dividing Polynomials

Long Division To divide a polynomial by a monomial, use the skills learned in Lesson 5-1.

To divide a polynomial by a polynomial, use a long division pattern. Remember that only like terms can be added or subtracted.

Example 1 **Simplify $\dfrac{12p^3t^2r - 21p^2qtr^2 - 9p^3tr}{3p^2tr}$.**

$$\frac{12p^3t^2r - 21p^2qtr^2 - 9p^3tr}{3p^2tr} = \frac{12p^3t^2r}{3p^2tr} - \frac{21p^2qtr^2}{3p^2tr} - \frac{9p^3tr}{3p^2tr}$$

$$= \frac{12}{3}p^{(3-2)}t^{(2-1)}r^{(1-1)} - \frac{21}{3}p^{(2-2)}qt^{(1-1)}r^{(2-1)} - \frac{9}{3}p^{(3-2)}t^{(1-1)}r^{(1-1)}$$

$$= 4pt - 7qr - 3p$$

Example 2 **Use long division to find $(x^3 - 8x^2 + 4x - 9) \div (x - 4)$.**

$$\begin{array}{r}
x^2 - 4x - 12 \\
x - 4 \overline{\smash{)}\, x^3 - 8x^2 + 4x - 9} \\
\underline{(-)x^3 - 4x^2 } \\
-4x^2 + 4x \\
\underline{(-)-4x^2 + 16x } \\
-12x - 9 \\
\underline{(-)-12x + 48} \\
-57
\end{array}$$

The quotient is $x^2 - 4x - 12$, and the remainder is -57.

Therefore $\dfrac{x^3 - 8x^2 + 4x - 9}{x - 4} = x^2 - 4x - 12 - \dfrac{57}{x - 4}$.

Exercises

Simplify.

1. $\dfrac{18a^3 + 30a^2}{3a}$

   $6a^2 + 10a$

2. $\dfrac{24mn^6 - 40m^2n^3}{4m^2n^3}$

   $\dfrac{6n^3}{m} - 10$

3. $\dfrac{60a^2b^3 - 48b^4 + 84a^5b^2}{12ab^2}$

   $5ab - \dfrac{4b^2}{a} + 7a^4$

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

   $2x + 1$

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

   $m - 5 + \dfrac{3}{m + 2}$

6. $(p^3 - 6) \div (p - 1)$

   $p^2 + p + 1 - \dfrac{5}{p - 1}$

7. $(t^3 - 6t^2 + 1) \div (t + 2)$

   $t^2 - 8t + 16 - \dfrac{31}{t + 2}$

8. $(x^5 - 1) \div (x - 1)$

   $x^4 + x^3 + x^2 + x + 1$

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

   $2x^2 - x + 2$

Lesson 5-2

5-2 Study Guide and Intervention *(continued)*

Dividing Polynomials

Synthetic Division

Synthetic division	a procedure to divide a polynomial by a binomial using coefficients of the dividend and the value of r in the divisor $x - r$

Use synthetic division to find $(2x^3 - 5x^2 + 5x - 2) \div (x - 1)$.

Step 1	Write the terms of the dividend so that the degrees of the terms are in descending order. Then write just the coefficients.	$2x^3 - 5x^2 + 5x - 2$ 2 −5 5 −2
Step 2	Write the constant r of the divisor $x - r$ to the left, In this case, $r = 1$. Bring down the first coefficient, 2, as shown.	$\begin{array}{r\|rrrr} 1 & 2 & -5 & 5 & -2 \\ & & & & \\ \hline & 2 & & & \end{array}$
Step 3	Multiply the first coefficient by r, $1 \cdot 2 = 2$. Write their product under the second coefficient. Then add the product and the second coefficient: $-5 + 2 = -3$.	$\begin{array}{r\|rrrr} 1 & 2 & -5 & 5 & -2 \\ & & 2 & & \\ \hline & 2 & -3 & & \end{array}$
Step 4	Multiply the sum, −3, by r: $-3 \cdot 1 = -3$. Write the product under the next coefficient and add: $5 + (-3) = 2$.	$\begin{array}{r\|rrrr} 1 & 2 & -5 & 5 & -2 \\ & & 2 & -3 & \\ \hline & 2 & -3 & 2 & \end{array}$
Step 5	Multiply the sum, 2, by r: $2 \cdot 1 = 2$. Write the product under the next coefficient and add: $-2 + 2 = 0$. The remainder is 0.	$\begin{array}{r\|rrrr} 1 & 2 & -5 & 5 & -2 \\ & & 2 & -3 & 2 \\ \hline & 2 & -3 & 2 & 0 \end{array}$

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

Exercises

Simplify.

1. $(3x^3 - 7x^2 + 9x - 14) \div (x - 2)$

$3x^2 - x + 7$

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

$5x^2 + 2x - 3$

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

$2x^2 - 3x - 1$

4. $(x^3 - 8x^2 + 19x - 9) \div (x - 4)$

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

5. $(2x^3 + 10x^2 + 9x + 38) \div (x + 5)$

$2x^2 + 9 - \frac{7}{x + 5}$

6. $(3x^3 - 8x^2 + 16x - 1) \div (x - 1)$

$3x^2 - 5x + 11 + \frac{10}{x - 1}$

7. $(x^3 - 9x^2 + 17x - 1) \div (x - 2)$

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

8. $(4x^3 - 25x^2 + 4x + 20) \div (x - 6)$

$4x^2 - x - 2 + \frac{8}{x - 6}$

9. $(6x^3 + 28x^2 - 7x + 9) \div (x + 5)$

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

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

$x^3 - 2x^2 - 3x + 1$

11. $(12x^4 + 20x^3 - 24x^2 + 20x + 35) \div (3x + 5)$ $4x^3 - 8x + 20 + \frac{-65}{3x + 5}$