

Section 5.5

Dividing Polynomials

Have you seen the latest blockbuster?



As individuals and as a nation, we've grown up with movies. Our images of love, war, family, country, and even the things that terrify us, have been greatly influenced by what we've seen on the big screen.



In this section's Exercise Set, we'll model our love for movies with polynomials and polynomial division.

First Steps:

- Take comprehensive notes** from your instructor's lecture and insert your notes into this section of the *Learning Guide*. Be sure to write down all examples, definitions, and other key concepts. Additional learning resources include the *Lecture Series on DVD*, the *PowerPoints*, and Section 5.5 of your textbook which begins on page 377.
- Complete the *Concept and Vocabulary Check* on page 383 of the textbook.

Guided Practice:

- Review each of the following *Solved Problems* and complete each *Pencil Problem*.

Objective #1: Use the quotient rule for exponents.

✓ *Solved Problem #1*

1a. Divide the expression using the quotient rule: $\frac{5^{12}}{5^4}$

$$\begin{aligned}\frac{5^{12}}{5^4} &= 5^{12-4} \\ &= 5^8\end{aligned}$$

Pencil Problem #1

1a. Divide the expression using the quotient rule: $\frac{3^{20}}{3^5}$

1b. Divide the expression using the quotient rule: $\frac{x^9}{x^2}$

$$\begin{aligned}\frac{x^9}{x^2} &= x^{9-2} \\ &= x^7\end{aligned}$$

1b. Divide the expression using the quotient rule: $\frac{x^6}{x^2}$

Objective #2: Use the zero-exponent rule. **Solved Problem #2**

2a. Use the zero-exponent rule to simplify the expression: 14^0

The zero-exponent rule states that if b is any real number other than 0, then $b^0 = 1$.

Thus, $14^0 = 1$.

 **Pencil Problem #2**

2a. Use the zero-exponent rule to simplify the expression: $(-2)^0$

2b. Use the zero-exponent rule to simplify the expression: -10^0

Note that only the 10 is raised to the 0 power.

$$\begin{aligned} -10^0 &= -1 \cdot 10^0 \\ &= -1 \cdot 1 \\ &= -1 \end{aligned}$$

2b. Use the zero-exponent rule to simplify the expression: -2^0

2c. Use the zero-exponent rule to simplify the expression: $20x^0$

Note that only the x is raised to the 0 power.

$$\begin{aligned} 20x^0 &= 20 \cdot 1 \\ &= 20 \end{aligned}$$

2c. Use the zero-exponent rule to simplify the expression: $(100y)^0$

Objective #3: Use the quotients-to-powers rule. **Solved Problem #3**

3a. Simplify the expression using the quotients-to-powers rule: $\left(\frac{x}{5}\right)^2$

$$\begin{aligned} \left(\frac{x}{5}\right)^2 &= \frac{x^2}{5^2} \\ &= \frac{x^2}{25} \end{aligned}$$

 **Pencil Problem #3**

3a. Simplify the expression using the quotients-to-powers rule: $\left(\frac{x^2}{4}\right)^3$

3b. Simplify the expression using the quotients-to-powers rule: $\left(\frac{2a^{10}}{b^3}\right)^4$

$$\begin{aligned}\left(\frac{2a^{10}}{b^3}\right)^4 &= \frac{2^4(a^{10})^4}{(b^3)^4} \\ &= \frac{16a^{40}}{b^{12}}\end{aligned}$$

3b. Simplify the expression using the quotients-to-powers rule: $\left(\frac{-2a^7}{b^4}\right)^5$

Objective #4: Divide monomials.

 **Solved Problem #4**

4a. Divide: $\frac{3x^4}{15x^4}$

$$\begin{aligned}\frac{3x^4}{15x^4} &= \frac{3}{15}x^{4-4} \\ &= \frac{1}{5}x^0 \\ &= \frac{1}{5}\end{aligned}$$

 **Pencil Problem #4** 

4a. Divide: $\frac{30x^{10}}{10x^5}$

4b. Divide: $\frac{9x^6y^5}{3xy^2}$

$$\begin{aligned}\frac{9x^6y^5}{3xy^2} &= \frac{9}{3} \cdot x^{6-1} \cdot y^{5-2} \\ &= 3x^5y^3\end{aligned}$$

4b. Divide: $\frac{-18x^{14}y^2}{36x^2y^2}$

Objective #5: Check polynomial division.

 **Solved Problem #5**

5. Check your answer to 4b by showing that the product of the divisor and the quotient is the dividend.

$$\begin{aligned}(3xy^2)(3x^5y^3) &= 3 \cdot 3 \cdot x^{1+5} \cdot y^{2+3} \\ &= 9x^6y^5\end{aligned}$$

 **Pencil Problem #5** 

5. Check your answer to 4b by showing that the product of the divisor and the quotient is the dividend.

Objective #6: Divide a polynomial by a monomial. **Solved Problem #6**

6a. Divide: $\frac{-15x^9 + 6x^5 - 9x^3}{3x^2}$

$$\frac{-15x^9 + 6x^5 - 9x^3}{3x^2} = \frac{-15x^9}{3x^2} + \frac{6x^5}{3x^2} - \frac{9x^3}{3x^2}$$

$$= -5x^7 + 2x^3 - 3x$$

 **Pencil Problem #6** 

6a. Divide: $\frac{18x^5 + 6x^4 + 9x^3}{3x^2}$

6b. Divide: $\frac{18x^7y^6 - 6x^2y^3 + 60xy^2}{6xy^2}$

$$\frac{18x^7y^6 - 6x^2y^3 + 60xy^2}{6xy^2} = \frac{18x^7y^6}{6xy^2} - \frac{6x^2y^3}{6xy^2} + \frac{60xy^2}{6xy^2}$$

$$= 3x^6y^4 - xy + 10$$

6b. Divide: $\frac{12x^2y^2 + 6x^2y - 15xy^2}{3xy}$

Answers for Pencil Problems (Textbook Exercise references in parentheses):

1a. 3^{15} (5.5 #1) 1b. x^4 (5.5 #3) 2a. 1 (5.5 #13) 2b. -1 (5.5 #15) 2c. 1 (5.5 #19)

3a. $\frac{x^6}{64}$ (5.5 #27) 3b. $-\frac{32a^{35}}{b^{20}}$ (5.5 #33) 4a. $3x^5$ (5.5 #37) 4b. $-\frac{1}{2}x^{12}$ (5.5 #47)

5. $\left(-\frac{1}{2}x^{12}\right)(36x^2y^2) = -18x^{14}y^2$ (5.5 #47) 6a. $6x^3 + 2x^2 + 3x$ (5.5 #61) 6b. $4xy + 2x - 5y$ (5.5 #75)

Homework:

- Review the Section 5.5 summary which begins on page 411 of the textbook.
- Insert your homework into this section of the *Learning Guide*. Show all work neatly and check your answers. Strive to work through difficulties when possible, making note of any exercises where you need additional help. Remember, even if your instructor assigns homework through *MyMathLab*, you should still write out your work.