IM 9–12 MATH v.1

Unit 2

Polynomials and Rational Functions

ALGEBRA 2

Lesson 13

Polynomial Division (Part 2)

Illustrative Mathematics®

Kendall Hunt

Learning Goal

Let’s learn a different way to divide polynomials.

Algebra 2

Different Divisions

Warm-up: Notice and Wonder

What do you notice? What do you wonder?

$$\begin{array}{r} 2 \\ 11\,\overline{)2772} \\ \underline{22} \\ 5 \end{array}$$

$$\begin{array}{r} 25 \\ 11\,\overline{)2772} \\ \underline{22} \\ 57 \\ \underline{55} \\ 2 \end{array}$$

$$\begin{array}{r} 252 \\ 11\,\overline{)2772} \\ \underline{22} \\ 57 \\ \underline{55} \\ 22 \\ \underline{22} \\ 0 \end{array}$$

$$\begin{array}{r} 2x^2 \\ x+1\,\overline{)2x^3+7x^2+7x+2} \\ \underline{-2x^3-2x^2} \\ 5x^2+7x \end{array}$$

1. Diego used the long division shown here to figure out that $6x^2 - 7x - 5 = (2x + 1)(3x - 5)$. Show what it would look like if he had used a diagram.

$$
\begin{array}{r}
3x - 5 \\
2x + 1 \overline{)\, 6x^2 - 7x - 5} \\
\underline{-6x^2 - 3x} \qquad \\
-10x - 5 \\
\underline{10x + 5} \\
0
\end{array}
$$

$2x$	$6x^2$	
1		

Pause here for a whole-class discussion.

Polynomial Long Division

2. (x - 2) is a factor of $2x^3 - 7x^2 + x + 10$, which means there is some other factor A where $2x^3 - 7x^2 + x + 10 = (x - 2)(?A)$. Finish the division started here to find the value of A.

$$\begin{array}{r} 2x^2 \\ x-2\overline{\smash{)}2x^3 - 7x^2 + x + 10} \\ \underline{-2x^3 + 4x^2} \end{array}$$

2. Jada used the diagram shown here to figure out that $2x^3 + 13x^2 + 16x + 5 = (2x + 1)(x^2 + 6x + 5)$. Show what it would look like if she had used long division.

	x^2	$6x$	5
$2x$	$2x^3$	$12x^2$	$10x$
1	x^2	$6x$	5

$$2x+1\overline{\smash{)}2x^3 + 13x^2 + 16x + 5}$$

More Long Division

Here are some polynomial functions with known factors. Rewrite each polynomial as a product of linear factors using long division.

1. $A(x) = x^3 - 7x^2 - 16x + 112$, $(x - 7)$

$$\begin{array}{r|l} & x^2 \\ x - 7 & x^3 - 7x^2 - 16x + 112 \\ & \underline{-x^3 + 7x^2} \end{array}$$

1. $C(x) = x^3 - 3x - 13x + 15$, $(x + 3)$

Missing Numbers

Here are pairs of equivalent expressions, one in standard form and the other in factored form. Find the missing numbers.

1. $x^2 + 9x + 14$ and $(x + 2)(x + \square)$
2. $x^2 + 9x + 20$ and $(x - \square)(x - \square)$
3. $2x^2 + 2x - 24$ and $(x + \square)(x - \square)$
4. $\square\, x^3 + x^2 - 13x + 6$ and $(-x + 3)(2x - 1)(x - 2)$
5. $6x^3 + 2x^2 - 16x + 8$ and $(x - 1)(2x + 4)(\square\, x - 2)$
6. $2x^3 + 7x^2 - 7x - 12$ and $(2x - 3)(x + \square)(x + \square)$
7. $x^3 + 6x^2 + \square\, x - 10$ and $(x + 2)(x - 1)(x + \square)$

Polynomial Division (Part 2)

Lesson Synthesis

Use long division to find the quotient $440 \div 24$.

Use long division to find the quotient for $(4x^2 + 4x) \div (2x + 4)$

I can use long division to divide polynomials.

Learning Targets

Algebra 2

A Small Division Error

Cool-down

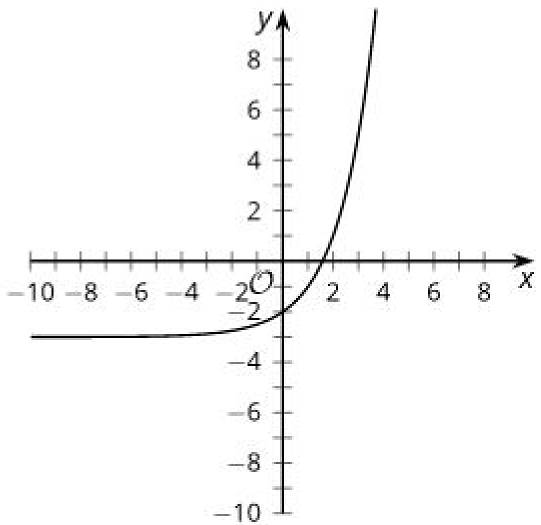
Let the function *P* be defined by $P(x) = x^3 + 10x^2 - 23x - 132$ where $(x + 11)$ is a factor. To rewrite the function as the product of two factors, long division was used, but an error was made:

$$
\begin{array}{r}
x^2 + 21x + 208 \\
x + 11 \overline{\big) x^3 + 10x^2 - 23x - 132} \\
\underline{-x^3 + 11x^2} \qquad\qquad\quad \\
21x^2 - 23x \qquad\;\; \\
\underline{-21x^2 + 231x} \qquad\; \\
208x - 132 \\
\underline{-208x + 2288} \\
2156
\end{array}
$$

1. Identify the error.
2. Redo the long division correctly.
3. Write *P(x)* as the product of two factors.

end behavior

How the outputs of a function change as we look at input values further and further from 0.



This function shows different end behavior in the positive and negative directions. In the positive direction the values get larger and larger. In the negative direction the values get closer and closer to -3.

multiplicity

The power to which a factor occurs in the factored form of a polynomial. For example, in the polynomial $(x - 1)^2(x + 3)$, the factor $x - 1$ has multiplicity 2 and the factor $x + 3$ has multiplicity 1.