1. Circle the factors of \( x^3 - 4x^2 \).

\[
\begin{array}{ccc}
\text{factor} & x^3 & x^2 \\
\text{factor} & x - 4 & -4x^2
\end{array}
\]

2. Cross out the expression that is NOT a factor of \( 2x^5 + 8x^3 \).

\[
\begin{array}{ccc}
\text{factor} & x^2 & 2x^3 \\
\text{factor} & 2x^2 + 8 & 8x^3
\end{array}
\]

**Vocabulary Builder**

**quotient** (noun) KWOH shunt

Related Words: dividend, divisor, remainder

Main Idea: A quotient is the simplification of a division expression.

3. Circle the dividend and underline the divisor in each quotient.

\[
\begin{array}{ccc}
\text{quotient} & \frac{x}{5} & 3.2 \div 16 \\
\text{dividend} & 15 \div 100 & \text{two divided by seven}
\end{array}
\]

**Problem 1** Polynomial Long Division

**Got It?** Use polynomial long division to divide \( 3x^2 - 29x + 56 \) by \( x - 7 \). What are the quotient and remainder?

4. Use the justifications to divide the expressions.

\[
x - 7 \mid 3x^2 - 29x + 56
\]

Divide the first term in the dividend by the first term in the divisor to get the first term in the quotient: \( 3x^2 \div x = 3x \).

Multiply the first term in the quotient by the divisor: \( 3x(x - 7) \).

Subtract to get \(-8x\). Bring down 56.

Divide \(-8x\) by \(x\).

Subtract to find the remainder.
5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.

5. Identify each part of the problem.

Dividend

Quotient

6. Check your solution.
Problem 3 Using Synthetic Division

Got It? Use synthetic division to divide \( x^3 - 57x + 56 \) by \( x - 7 \). What are the quotient and remainder?

12. Do the synthetic division. Remember that the sign of the number in the divisor is reversed.

\[
\begin{array}{c|cccc}
7 & 1 & 0 & & \\
\hline
 & & & & \\
& & & & \\
\end{array}
\]

Write the coefficients of the polynomial.

Bring down the first coefficient. Multiply the coefficient by the divisor.

Add to the next coefficient. Continue multiplying and adding through the last coefficient.

13. The quotient is \( \underline{\phantom{12345}} \), and the remainder is \( \underline{\phantom{12345}} \).

Problem 4 Using Synthetic Division to Solve a Problem

Got It? Crafts If the polynomial \( x^3 + 6x^2 + 11x + 6 \) expresses the volume, in cubic inches, of a shadow box, and the width is \( (x + 1) \) in., what are the dimensions of the box?

14. Use synthetic division.

15. Factor the quotient.

16. The height of the box is \( \underline{\phantom{12345}} \) in., the width of the box is \( \underline{\phantom{12345}} \) in., and the length of the box is \( \underline{\phantom{12345}} \) in.

Theorem The Remainder Theorem

If you divide a polynomial \( P(x) \) of degree \( n \geq 1 \) by \( x - a \), then the remainder is \( P(a) \).

17. If you divide \( 3x^2 + x - 5 \) by \( x - 1 \), the remainder is \( P(\underline{\phantom{12345}}) \).

18. If you divide \( 2x^2 + x + 6 \) by \( x + 1 \), the remainder is \( P(\underline{\phantom{12345}}) \).

Problem 5 Evaluating a Polynomial

Got It? What is \( P(-4) \), given \( P(x) = x^5 - 3x^4 - 28x^3 + 5x + 20 \)?

19. \( P(-4) \) is the remainder when you divide \( x^5 - 3x^4 - 28x^3 + 5x + 20 \) by \( x - 4 \).
Lesson Check • Do you UNDERSTAND?

Reasoning A polynomial $P(x)$ is divided by a binomial $x - a$. The remainder is zero. What conclusion can you draw? Explain.

Write T for true or F for false.

22. One factor of the polynomial is $x - a$.  
   
23. One root of the polynomial is $-a$.  
   
24. An $x$-intercept of the graph of $y = P(x)$ is $a$.  
   
25. If $P(x)$ is divided by $x - a$ then $P(a) =$ the remainder and $P(x) = (x - a)(Q(x))$.  
   This illustrates the Division Algorithm / Remainder Theorem / Factor Theorem.

26. If the remainder of $P(x)$ divided by $x - a$ is zero, what do you know about the factors and roots of $P(x)$?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Math Success

Check off the vocabulary words that you understand.

☐ polynomial  ☐ synthetic division  ☐ Remainder Theorem

Rate how well you can divide polynomials.

Need to review 0 2 4 6 8 10 Now I get it!