LESSON MAKER PRO

# Remainder Detectives

*Evaluate polynomials to find remainders and factors.*

**HIGH SCHOOL · HSA-APR.B.2**

**CCSS.Math.Content.HSA-APR.B.2** "Know and apply the Remainder Theorem: For a polynomial p ( x ) and a number a, the remainder on division by x - a is p ( a ), so p ( a ) = 0 if and only if ( x - a ) is a factor of p ( x )."

NAME _____ DATE _____

## THE REMAINDER SHORTCUT

When dividing p(x) by x - a, plug a into p(x). The value p(a) is the remainder. If p(a) = 0, then x - a is a factor of p(x).

## WORKED EXAMPLE

Find the remainder when $p(x) = x^4 + 13x - 11$ is divided by $x + 2$.

1. Write x + 2 as x - (-2), so a = -2.
2. Evaluate $p(-2) = (-2)^4 + 13(-2) - 11$.
3. Simplify: 16 - 26 - 11 = -21.

**Answer: The remainder is -21.**

## PRACTICE 6 problems

**1** Find the remainder when $p(x) = x^2 - 6x + 10$ is divided by x - 4.

**ANSWER** _____

**2** Find the remainder when $p(x) = 3x^3 + x^2 - 12$ is divided by x + 1.

**ANSWER** _____

**3** Is x - 6 a factor of $p(x) = x^3 - 2x^2 - 24x$? Give the remainder and conclusion.

**ANSWER** _____

**4** Find k so that x + 4 is a factor of $p(x) = x^2 + kx - 20$.

**ANSWER** _____

**5** Is x + 6 a factor of $p(x) = x^3 - 36x + 8$? Give the remainder and conclusion.

**ANSWER** _____

**6** Find the remainder when $p(x) = 4x^3 + 5x^2 - 8x + 9$ is divided by x - 3.

**ANSWER** _____

## APPLY IT Show your work

**1** A coding club models a rhythm game's bonus-score formula with $B(x) = x^3 - 9x^2 + 14x + 24$. The club wants to know whether $x - 4$ is a factor before simplifying the formula. Find the remainder and state the conclusion.

WORK SPACE

**ANSWER** _____

**2** The student council's concert-planning spreadsheet uses $R(x) = 2x^3 - 7x^2 - 3x + 18$ as a test revenue expression. The team checks whether $x - 4$ is a factor. Find the remainder and state the conclusion.

WORK SPACE

**ANSWER** _____

## CHALLENGE One step up

The polynomial $p(x) = x^3 + bx^2 - 15x + 45$ has $x - 3$ as a factor. Find b. Then decide whether $x + 5$ is a factor of the resulting polynomial. Show the values you evaluate.

WORK SPACE AND ANSWER

# Remainder Detectives



## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | Find the remainder when $p(x) = x^2 - 6x + 10$ is divided by $x - 4$. | **2** |
| 2 | Find the remainder when $p(x) = 3x^3 + x^2 - 12$ is divided by $x + 1$. | **-14** |
| 3 | Is $x - 6$ a factor of $p(x) = x^3 - 2x^2 - 24x$? Give the remainder and conclusion. | **The remainder is 0, so x - 6 is a factor.** |
| 4 | Find k so that $x + 4$ is a factor of $p(x) = x^2 + kx - 20$. | **k = -1** |
| 5 | Is $x + 6$ a factor of $p(x) = x^3 - 36x + 8$? Give the remainder and conclusion. | **The remainder is 8, so x + 6 is not a factor.** |
| 6 | Find the remainder when $p(x) = 4x^3 + 5x^2 - 8x + 9$ is divided by $x - 3$. | **138** |

## PART 2 · APPLY IT

1. **The remainder is 0, so x - 4 is a factor of B(x).** Evaluate $B(4) = 4^3 - 9(4^2) + 14(4) + 24 = 64 - 144 + 56 + 24 = 0$. A remainder of 0 means x - 4 is a factor.
2. **The remainder is 22, so x - 4 is not a factor of R(x).** Evaluate $R(4) = 2(4^3) - 7(4^2) - 3(4) + 18 = 128 - 112 - 12 + 18 = 22$. Since the remainder is not 0, x - 4 is not a factor.

## CHALLENGE

**b = -3. The resulting polynomial is $p(x) = x^3 - 3x^2 - 15x + 45$. Since $p(-5) = -80$, x + 5 is not a factor.**

Accept correct substitution using a = -c when the divisor is x + c. For factor questions, students should state both the remainder and the matching factor or nonfactor conclusion.