

Student Workbook

Dividing Polynomials

Learning Target: I can divide polynomials using long division and synthetic division, and apply the Remainder and Factor Theorems.

Vocabulary

Term	Meaning
Synthetic Division	A shortcut method for dividing a polynomial by a linear factor $(x-c)$.
Remainder Theorem	Dividing $f(x)$ by $(x-c)$ gives a remainder equal to $f(c)$.
Factor Theorem	$(x-c)$ is a factor of $f(x)$ if and only if $f(c) = 0$.

Key Concept: Polynomial Long Division

EXAMPLE 1

Divide $x^3 - 2x^2 - 5x + 6$ by $(x - 3)$.

$$x^2(x-3) = x^3 - 3x^2 \rightarrow \text{subtract: } x^2 - 5x + 6$$

$$x(x-3) = x^2 - 3x \rightarrow \text{subtract: } -2x + 6$$

$$-2(x-3) = -2x + 6 \rightarrow \text{subtract: } 0$$

Quotient: _____ Remainder: _____

Key Concept: Synthetic Division

SHORTCUT for dividing by $(x - c)$

Write just the coefficients. Bring down the first one, multiply by c and add to the next coefficient, repeating across.

EXAMPLE 2

Same division as Example 1, using synthetic division with $c = 3$: coefficients 1, -2, -5, 6.

Bring down 1. $1 \times 3 = 3$, $-2 + 3 =$ _____. $1 \times 3 = 3$, $-5 + 3 =$ _____. $-2 \times 3 = -6$, $6 + (-6) =$ _____.

COMMON MISTAKE

If a term is missing (like no x^2 term), you MUST include a 0 as a placeholder coefficient — skipping it will shift every value and ruin the division.

Key Concept: The Remainder & Factor Theorems

EXAMPLE 3 — Remainder Theorem

Find $f(3)$ for $f(x) = x^3 - 2x^2 - 5x + 6$, without dividing.

$$f(3) = 27 - 18 - 15 + 6 = \underline{\hspace{2cm}} \quad (\text{matches the remainder from Example 1!})$$

EXAMPLE 4 — Factor Theorem

Is $(x+2)$ a factor of $f(x) = x^3 - 2x^2 - 5x + 6$?

$$f(-2) = -8 - 8 + 10 + 6 = \underline{\hspace{2cm}} \rightarrow \underline{\hspace{2cm}}$$

Guided Practice — Part A: Long Division

A1 $(x^3 + 4x^2 - 3x - 12) \div (x + 4)$

A2 $(2x^3 - 3x^2 + 4x - 1) \div (x - 1)$

Guided Practice — Part B: Synthetic Division

B1 $(x^3 - 6x^2 + 11x - 6) \div (x - 2)$

B2 $(3x^3+5x^2-2x+8) \div (x+2)$

Guided Practice — Part C: The Remainder Theorem

C1 Find the remainder when $f(x)=x^3-4x^2+x+6$ is divided by $(x-2)$, without full division.

C2 Find $f(-3)$ for $f(x)=2x^3+5x^2-x+4$. What does this tell you about dividing by $(x+3)$?

Guided Practice — Part D: The Factor Theorem

D1 Is $(x-1)$ a factor of $f(x)=x^3-2x^2-x+2$?

D2 Is $(x+3)$ a factor of $f(x)=x^3+3x^2-4x-12$?

BEFORE YOU MOVE ON

Check with a partner: for synthetic division, did you use the VALUE of c (not $-c$) as your multiplier?