

12.3 Divide Polynomials Goal • Divide polynomials.**EXAMPLE 1:** Divide a polynomial by a monomialDivide $10x^3 - 25x^2 + 15x$ by $5x$.Steps:

$$= \frac{10x^3 - 25x^2 + 15x}{5x}$$

Step 1: Write the division as a fraction.

$$= \frac{10x^3}{5x} + \frac{-25x^2}{5x} + \frac{15x}{5x}$$

Step 2: Divide each term by $5x$. *THIS IS A MENTAL STEP*

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

Step 3: Simplify

Step 4: Check

To check your answer, multiply the quotient by the divisor.

$$5x \cdot (2x^2 - 5x + 3) = 10x^3 - 25x^2 + 15x$$

mentally check by multiplying
must equal

Checkpoint Complete the following exercise.

1. Divide
- $(12x^3 + 9x^2 - 3x)$
- by
- $-3x$

$$\frac{12x^3 + 9x^2 - 3x}{-3x} =$$

$$-4x^2 - 3x + 1$$

mentally check multiply!

Algebra 1 Notes...

EXAMPLE 2: *Divide a polynomial by a binomial*

versus

Review arithmetic long division

2a) Divide 81,536 by 32

$$\begin{array}{r}
 \text{2548} \\
 32 \overline{) 81,536} \\
 \underline{-64} \downarrow \\
 175 \downarrow \\
 \underline{-160} \downarrow \\
 153 \downarrow \\
 \underline{-128} \downarrow \\
 256 \\
 \underline{-256} \\
 0
 \end{array}$$

NO REMAINDER

How can you check?

$$32 \times 2,548 = 81,536 \checkmark$$

Long division with variables

2b) Divide $4x^2 - 4x - 3$ by $2x + 1$

FRACTION →

$$\begin{array}{r} 2x+1 \overline{) 4x^2 - 4x - 3} \\ \underline{+ (4x^2 + 2x)} \\ -6x - 3 \\ \underline{+ (-6x + 3)} \\ 0 \end{array}$$

Tip: When you subtract change the subtract sign to addition and take the opposite of what's in the ()'s

No remainder → 0

How can you check?

MULT $(2x-3)(2x+1) =$
 $4x^2 - 4x - 3 \checkmark$

$$\frac{4x^2 - 4x - 3}{2x + 1}$$

STEPS

- ① mult
- ② subtract
- ③ bring down

EXAMPLE 3: *Divide a polynomial by a binomial with a remainder*

Divide $2x^2 + 9x + 12$ by $x + 3$.

$$\begin{array}{r} x+3 \overline{) 2x^2+9x+12} \\ \underline{-(2x^2+6x)} \\ 3x+12 \\ \underline{-(3x+9)} \\ 3 \end{array}$$

Remainder

$$2x + 3 + \frac{3}{x+3}$$

Check

$$(x+3)(2x+3) = 2x^2 + 9x + 9$$

remainder $\rightarrow +3$

$$2x^2 + 9x + 12 \checkmark$$

Algebra 1 Notes...

EXAMPLE 4: Rewrite polynomials

Divide $2x - 1 + 3x^2$ by $1 + x$. rewrite in descending order

$$\frac{3x^2 + 2x - 1}{x + 1}$$

$$\begin{array}{r} \textcircled{3x - 1} \\ x + 1 \overline{) 3x^2 + 2x - 1} \\ \underline{+ (3x^2 + 3x)} \\ -1x - 1 \\ \underline{+ (-x + 1)} \\ 0 \end{array}$$

Mentally check

$$(x + 1)(3x - 1) = 3x^2 + 2x - 1 \checkmark$$

EXAMPLE 5: Insert missing terms for "place holders"

Divide $-24 + 6x^2$ by $-6 + 3x$.

$$\frac{6x^2 - 24}{3x - 6}$$

NOTICE MISSING x TERM
(must add place holder "0x")

$$\begin{array}{r} \textcircled{2x + 4} \\ 3x - 6 \overline{) 6x^2 + 0x - 24} \\ \underline{+ (6x^2 - 12x)} \\ 12x - 24 \\ \underline{+ (12x - 24)} \\ 0 \end{array}$$

$\rightarrow 0$
No remainder

$$\boxed{2x + 4}$$

remember:
mentally check
 $(2x + 4)(3x - 6) =$
 $6x^2 - 24 \checkmark$

✓ Checkpoint Divide.

2. $(-8 - 2x + x^2) \div (2 + x)$

$$\begin{array}{r}
 x^2 - 2x - 8 \\
 \hline
 x + 2 \\
 \hline
 x + 2 \overline{) x^2 - 2x - 8} \\
 \underline{-(x^2 + 2x)} \\
 -4x - 8 \\
 \underline{-(-4x - 8)} \\
 0
 \end{array}$$

Handwritten notes: A blue circle around $x - 4$ with an arrow pointing to the divisor $x + 2$. The quotient $x - 4$ is written above the division bar.

3. $(x^3 + 125) \div (x + 5)$

$$\begin{array}{r}
 x^3 + 125 \\
 \hline
 x + 5 \\
 \hline
 x + 5 \overline{) x^3 + 0x^2 + 0x + 125} \\
 \underline{-(x^3 + 5x^2)} \\
 -5x^2 + 0x + 125 \\
 \underline{-(-5x^2 - 25x)} \\
 25x + 125 \\
 \underline{-(25x + 125)} \\
 0
 \end{array}$$

Handwritten notes: A pink circle around $x^2 - 5x + 25$ with an arrow pointing to the divisor $x + 5$. The quotient $x^2 - 5x + 25$ is written above the division bar.