



### 3.5 Dividing Polynomials

#### Math Learning Target:

"I can determine the quotient when one polynomial is divided by another polynomial."

### Polynomial Division

#### Word wall:

divisor  
quotient  
dividend  
remainder

Ex. 1: Divide 352 by 15 using long division.

$$\begin{array}{r}
 23 \\
 15 \overline{) 352} \\
 \underline{-30} \phantom{x} \\
 52 \\
 \underline{45} \\
 7 \text{ Remainder}
 \end{array}
 \quad
 \left.
 \begin{array}{l}
 \frac{352}{15} \\
 = 23 \text{ R } 7 \\
 = 23 + \frac{7}{15} \\
 = 23 \frac{7}{15}
 \end{array}
 \right\}$$

#### Division Statement:

$$\text{dividend} = \text{divisor} \times \text{quotient} + \text{remainder}$$

$$352 = 15(23) + 7$$

Ex. 2: Divide:  $3x - 2x^4 + 5$  by  $x + 3$  using long division.

$$\begin{array}{r}
 \hookrightarrow -2x^4 + 3x + 5 \\
 -2x^3 + 6x^2 - 18x + 57 \\
 \hline
 x+3 \overline{) -2x^4 + 0x^3 + 0x^2 + 3x + 5} \\
 \downarrow \begin{array}{l} + \\ - \end{array} \begin{array}{l} -2x^4 + \\ -6x^3 \end{array} \\
 \hline
 6x^3 + 0x^2 \\
 -6x^3 + 18x^2 \\
 \hline
 -18x^2 + 3x \\
 +16x^2 - 54x \\
 \hline
 57x + 15 \\
 -57x + 171 \\
 \hline
 -166
 \end{array}$$

Add the opposite

$$\text{dividend} = \text{divisor} \times \text{quotient} + \text{remainder}$$

$$\therefore -2x^4 + 3x + 5 = (x+3)(-2x^3 + 6x^2 - 18x + 57) + (-166)$$

$$\frac{\text{dividend}}{\text{divisor}} = \text{quotient} + \frac{\text{remainder}}{\text{divisor}}$$

$$\frac{-2x^4 + 3x + 5}{x+3} = -2x^3 + 6x^2 - 18x + 57 + \frac{-166}{x+3}$$

Ex. 3: When dividing by  $x - k$  we can use **synthetic division**.  
Divide  $4x^3 - 10x^2 - 18x + 10$  by  $x - 4$ .  $* \rightarrow x - 4 = 0$

$$\begin{array}{r|rrrr}
 4 & 4 & -10 & -18 & 10 \\
 & \downarrow & 16 & 24 & 24 \\
 \hline
 & -4 & 6 & 6 & 34
 \end{array}$$

$x = 4$

← Remainder

Coefficients of the Quotient

$$\therefore \text{Quotient} = 4x^2 + 6x + 6, \text{ Remainder} = 34$$

**Division Statement:**

**dividend = divisor x quotient + remainder**

$$4x^3 - 10x^2 - 18x + 10 = (x - 4)(4x^2 + 6x + 6) + 34$$

Ex. 4: Using synthetic division, find the remainder  
when  $13x - 2x^3 + x^4 - 6$  is divided by  $x + 2$ .

$$\hookrightarrow x^4 - 2x^3 + 13x - 6 \quad k = -2$$

$$\begin{array}{r|rrrrr}
 -2 & 1 & -2 & 0 & 13 & -6 \\
 & \downarrow & -2 & 8 & -16 & 6 \\
 \hline
 & 1 & -4 & 8 & -3 & 0
 \end{array}$$

**Division Statement:**

$$x^4 - 2x^3 + 13x - 6 = (x + 2)(x^3 - 4x^2 + 8x - 3) + 0 \text{ Remainder}$$

**If the remainder is zero, then**

👉 we have **factors** of the dividend: divisor and quotient.

**Alternate using Long Division and Synthetic Division...**

Complete pp.168-170 #5cd, 7ad, 8bc, 9ab, 10ae, 11, 12, 15  
Challenge yourself! #17, 18, 19