

Algebra 2 5.2

Divide polynomials using long division

Divide polynomials using synthetic division

simplify (a fraction)

long division algorithm (old school--works for all problems)

synthetic division (shortcut--works for many problems--but not ALL)

depressed polynomial



whiteboards?

whiteboards

$$(x^2 - 13x + 12) \div (x - 1)$$

$$\begin{array}{r} x - 12 \\ x - 1 \overline{) x^2 - 13x + 12} \\ \underline{-x^2 + x} \phantom{+ 12} \\ \phantom{x^2 - 13} x + 12 \end{array}$$

$$\begin{array}{r} x \cdot ? = x^2 \quad -12x + 12 \\ x \cdot ? = -12x \quad +12x + 12 \\ \hline 0 \end{array}$$

$$\begin{array}{r} \textcircled{1} \quad 1 \quad -13 \quad 12 \\ \quad \downarrow \quad 1 \quad -12 \\ \hline \textcircled{1} \quad -12 \quad 0 \\ \quad \quad \quad |x - 12 \end{array}$$

Is 54 the same as 504?

What if there is a missing term in the expression?

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

$$x^3 + 1$$

$$1 \ 0 \ 0 \ 1$$

$$\begin{array}{r} 1 \ 0 \ 2 \ 1 \\ \downarrow \quad 1 \quad 1 \quad 3 \\ \hline 1 \quad 1 \quad 3 \quad 4 \end{array}$$

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

What if there is a coefficient?

Look for similarities

Long division

vs

Synthetic division (shortcut)

$$(x^2 - 13x + 12) \div (x - 1)$$

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$$(x^2 + 3x - 40) \div (x - 5).$$

$$\begin{array}{r|rrr} 5 & 1 & 3 & -40 \\ & \downarrow & 5 & 40 \\ \hline & 1 & 8 & 0 \end{array}$$

$x + 8$

### Key Concept Synthetic Division

- Step 1** Write the coefficients of the dividend so that the degrees of the terms are in descending order. Write the constant  $r$  of the divisor  $x - r$  in the box. Bring the first coefficient down.
- Step 2** Multiply the first coefficient by  $r$ , and write the product under the second coefficient.
- Step 3** Add the product and the second coefficient.
- Step 4** Repeat Steps 2 and 3 until you reach a sum in the last column. The numbers along the bottom row are the coefficients of the quotient. The power of the first term is one less than the degree of the dividend. The final number is the remainder.

depressed polynomial

**Guided Practice**

2A.  $(x^2 + 7x - 30) \div (x - 3)$

$$\begin{array}{r} \underline{3} \overline{) \quad 1 \quad 7 \quad -30} \\ \quad \downarrow \quad 3 \quad 30 \\ \hline \quad 1 \quad 10 \quad 0 \end{array}$$

$x + 10$



#### Example 4 Synthetic Division

Use synthetic division to find  $(2x^3 - 13x^2 + 26x - 24) \div (x - 4)$ .

$$\begin{array}{r|rrrr} 4 & 2 & -13 & 26 & -24 \\ & \downarrow & 8 & -20 & 24 \\ \hline & 2 & -5 & 6 & 0 \end{array}$$

$$2x^2 - 5x + 6$$

multiply...add(?)...bring down...  
What does that remind you of?

Use synthetic division to find each quotient.

4A.  $(2x^3 + 3x^2 - 4x + 15) \div (x + 3)$

$$\begin{array}{r|rrrr} -3 & 2 & 3 & -4 & 15 \\ & \downarrow & -6 & 9 & -15 \\ \hline & 2 & -3 & 5 & 0 \end{array}$$

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

4B.  $(3x^3 - 8x^2 + 11x - 14) \div \underline{(x - 2)}$

$$\begin{array}{r} \underline{2} \mid 3 \quad -8 \quad 11 \quad -14 \\ \quad \downarrow \quad 6 \quad -4 \quad 14 \\ \hline 3 \quad -2 \quad 7 \quad 0 \end{array}$$

$$3x^2 - 2x + 7$$

4C.  $(4a^4 + 2a^2 - 4a + 12) \div (a + 2)$

$$\begin{array}{r} \underline{-2} \overline{) 4 \quad 0 \quad 2 \quad -4 \quad 12} \\ \quad \downarrow -8 \quad 16 \quad -36 \quad 80 \\ \hline \quad 4 \quad -8 \quad 18 \quad -40 \quad 92 \\ \quad 4a^3 - 8a^2 + 18a - 40 + \frac{92}{a+2} \end{array}$$

**Example 5** Divisor with First Coefficient Other than 1

~~Use synthetic division~~ to find  $(3x^4 - 5x^3 + x^2 + 7x) \div (3x + 1)$ .



There is a way... not sure if it is worth the trouble  
Just use (old school) long division...

WB 5.2 (p. 26)  
odds + 26

