

## Lesson 20: Dividing Polynomials Synthetically

### Opening Exercise

You will need: highlighters or colored pencils.

A faster way to divide polynomials was developed that uses the coefficients of the dividend and the divisor. The one drawback is that the divisor must be of the form  $(x - k)$ , where  $k$  is any real number. We'll see how synthetic division works by first using long division and then comparing the two methods.

1. Divide  $x^2 + 3x + 5$  by  $x + 1$  using long division.

$$\begin{array}{r} \text{Divisor } x + 1 \overline{) x^2 + 3x + 5} \end{array} \quad \text{Dividend}$$

$$(x^2 + 3x + 5) \div (x + 1) =$$

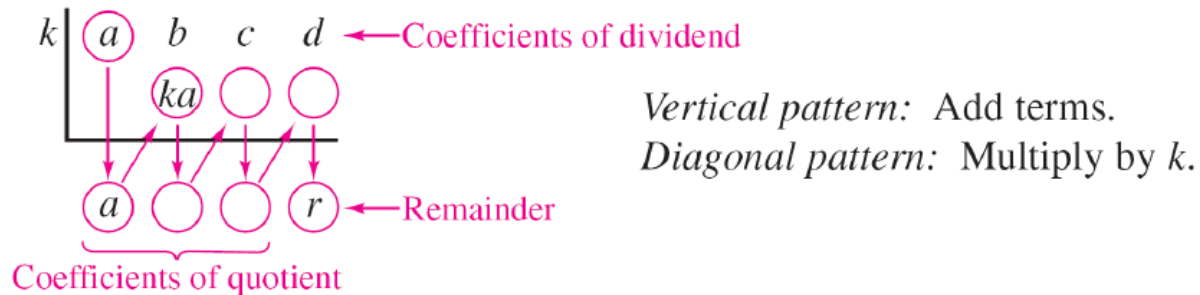
2. Below are the steps using synthetic division with the same problem. Color code both problems showing which steps are equivalent to each other.

$$\begin{array}{r|rrr} -1 & 1 & 3 & 5 \\ & & -1 & -2 \\ \hline & 1 & 2 & 3 \end{array} \quad x + 2 \text{ r. } 3$$

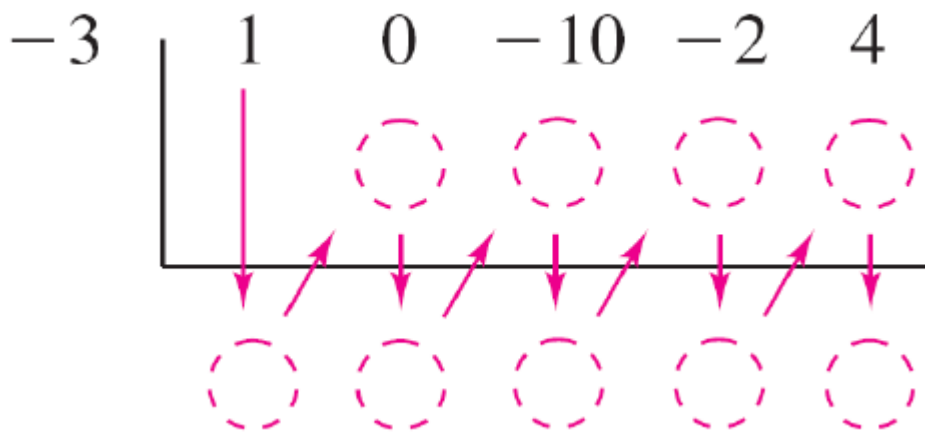
The pattern for synthetic division is shown in the diagram below.

## Synthetic Division (for a Cubic Polynomial)

To divide  $ax^3 + bx^2 + cx + d$  by  $x - k$ , use the following pattern.



3. Use synthetic division to divide  $x^4 - 10x^2 - 2x + 4$  by  $x + 3$ . The problem has been set up for you below. Note that a zero is included for the missing  $x^3$ -term in the dividend.



$$(x^4 - 10x^2 - 2x + 4) \div (x + 3) = (\underline{\hspace{10cm}})$$

**Homework Problem Set**

Use synthetic division for each problem.

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

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

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

4. 
$$\frac{2x^2 - x - 4}{x - 3}$$

5.  $P(x) = x^3 + 2x^2 - 7$  and  $Q(x) = x + 2$ , what is  $P(x) \div Q(x)$  ?

