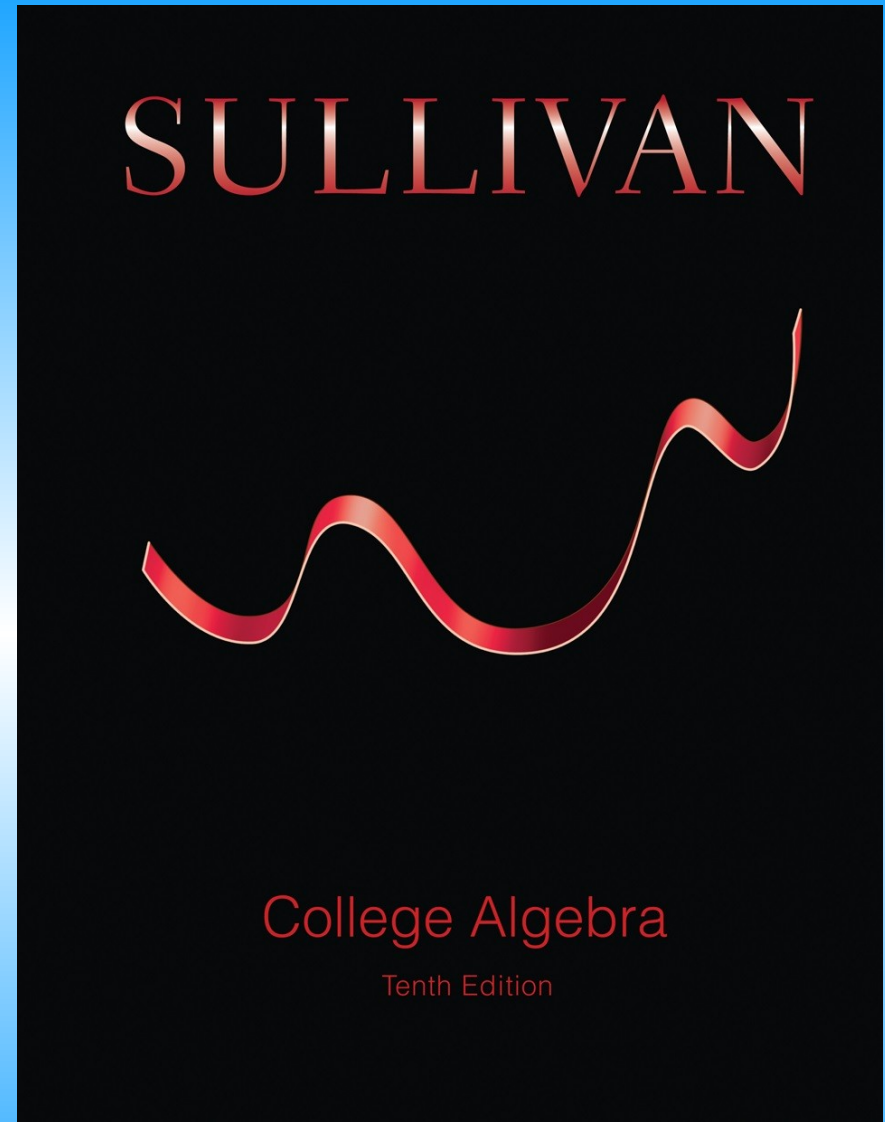


Chapter R

Section 6



R.6 Synthetic Division

OBJECTIVE 1 Divide Polynomials Using Synthetic Division (p. 58)

Divide Polynomials Using Synthetic Division

Example

Using Synthetic Division

Use synthetic division to find the quotient and remainder when

$$2x^3 + 13x^2 - 64 \quad \text{is divided by} \quad x + 3$$

Solution

Step 1: Write the dividend in descending powers of x .
Then copy the coefficients, remembering to
insert a 0 for any missing powers of x .

2 13 0 -64 Row 1

Solution continued

Step 2: Insert the usual division symbol. In synthetic division, the divisor is of the form $x - c$, and c is the number placed to the left of the division symbol.

The divisor is $x + 3 = x - (-3)$, so insert -3 to the left of the division symbol.

$$\begin{array}{r|rrrr} -3 & 2 & 13 & 0 & -64 \end{array} \quad \text{Row 1}$$

Solution continued

Step 3: Bring the 2 down two rows, and enter it in row 3.

$$\begin{array}{r|rrrr} -3 & 2 & 13 & 0 & -64 & \text{Row 1} \\ & \downarrow & & & & \text{Row 2} \\ & 2 & & & & \text{Row 3} \end{array}$$

Solution continued

Step 4: Multiply the latest entry in row 3 by -3 , and place the result in row 2, one column over to the right.

$$\begin{array}{cccc} -3 \overline{) 2} & 13 & 0 & -64 & \text{Row 1} \\ & & & & \text{Row 2} \\ & 2 & & & \text{Row 3} \end{array}$$

A blue arrow points from the '2' in Row 3, Column 1 to the '-6' in Row 2, Column 2. A blue circled '-3' is written below the arrow, with a '+' sign below the circled '-3'.

Solution continued

Step 5: Add the entry in row 2 to the entry above it in row 1, and enter the sum in row 3.

$$\begin{array}{rcccc} -3 & \overline{)2} & 13 & 0 & -64 & \text{Row 1} \\ & & -6 & & & \text{Row 2} \\ \hline & 2 & 7 & & & \text{Row 3} \end{array}$$

A blue arrow points from the -6 in Row 2 to the 2 in Row 3. A blue circle with a plus sign is drawn around the 2 in Row 3.

Solution continued

Step 7: The final entry in row 3, the -1 , is the remainder; the other entries in row 3, the 2, 7, and -21 , are the coefficients (in descending order) of a polynomial whose degree is 1 less than that of the dividend. This is the quotient. That is,

$$\text{Quotient} = 2x^2 + 7x - 21$$

$$\text{Remainder} = -1$$

Solution continued

✓ Check:

$$\begin{aligned} & (\text{Divisor}) (\text{Quotient}) + \text{Remainder} \\ &= (x + 3)(2x^2 + 7x - 21) + (-1) \\ &= (2x^3 + 7x^2 - 21x + 6x^2 + 21x - 63) + (-1) \\ &= 2x^3 + 13x^2 - 64 = \text{Dividend} \end{aligned}$$