

The numbers below the line are the coefficients of the quotient polynomial and the remainder. Since the dividend is a polynomial of degree 2, the quotient is a polynomial of degree 1. So, the quotient is  $5x + 17$  and the remainder is 30.

All the steps in a synthetic division can be recorded in one diagram.

### Check Your Understanding

3. Divide:  $-3x^4 + 2x^3 + 3x^2 - 4x + 5$  by  $x + 2$   
Write the division statement.

 Compare  $x + 2$  to  $x - a$ :  $a = -2$

$$\begin{array}{r|rrrrr} -2 & -3 & 2 & 3 & -4 & 5 \\ & \downarrow & 6 & -16 & 26 & -44 \\ \hline & -3 & 8 & -13 & 22 & -39 \end{array}$$

The dividend is a polynomial of degree 4, so the quotient is a polynomial of degree 3.

$$\begin{aligned} \text{So, } & -3x^4 + 2x^3 + 3x^2 - 4x + 5 \\ & = (x + 2)(-3x^3 + 8x^2 - 13x + 22) - 39 \end{aligned}$$

### Example 3 Using Synthetic Division to Divide

Divide:  $2x^3 + 4x^2 - 5x - 6$  by  $x + 1$   
Write the division statement.

#### SOLUTION

Compare  $x + 1$  to  $x - a$ :  $a = -1$

$$\begin{array}{r|rrrr} -1 & 2 & 4 & -5 & -6 \\ & \downarrow & -2 & -2 & 7 \\ \hline & 2 & 2 & -7 & 1 \end{array}$$

Write the value of  $a$  on the left.

Write the coefficients of the polynomial on the right.

Bring down the first coefficient, 2.

Multiply 2 by  $-1$ . Record the product,  $-2$ , beneath the second coefficient, 4, then add.

Multiply the sum, 2, by  $-1$ . Record the product,  $-2$ , beneath the third coefficient,  $-5$ , then add.


Multiply the sum,  $-7$ , by  $-1$ . Record the product, 7, beneath the fourth coefficient,  $-6$ , then add.

Since the dividend is a polynomial of degree 3, the quotient is a polynomial of degree 2.

$$\text{So, } 2x^3 + 4x^2 - 5x - 6 = (x + 1)(2x^2 + 2x - 7) + 1$$

### THINK FURTHER

How could you use synthetic division to divide  $6x^3 + 4x^2 + 8$  by  $2x + 4$ ?

 I could divide both the binomial and the polynomial by 2 so that the divisor has the form  $x - a$ ; that is, the divisor would become  $x + 2$  and the dividend would become  $3x^3 + 2x^2 + 4$ . I would include  $0x$  in the dividend before I divide.