EXAMPLE 2 Use polynomial long division with a linear divisor

Divide $f(x) = x^3 + 5x^2 - 7x + 2$ by $x - 2$.

$x^2 + 7x + 7$	← quotient
$x - 2\,\overline{)\,x^3 + 5x^2 - 7x + 2}$	
$\underline{x^3 - 2x^2}$	Multiply divisor by $x^3/x = x^2$.
$7x^2 - 7x$	Subtract.
$\underline{7x^2 - 14x}$	Multiply divisor by $7x^2/x = 7x$.
$7x + 2$	Subtract.
$\underline{7x - 14}$	Multiply divisor by $7x/x = 7$.
16	← remainder

▶ $\frac{x^3 + 5x^2 - 7x + 2}{x - 2} = x^2 + 7x + 7 + \frac{16}{x - 2}$

✓ GUIDED PRACTICE for Examples 1 and 2

Divide using polynomial long division.

1. $(2x^4 + x^3 + x - 1) \div (x^2 + 2x - 1)$
2. $(x^3 - x^2 + 4x - 10) \div (x + 2)$

SYNTHETIC DIVISION If you use synthetic substitution to evaluate $f(x)$ in Example 2 when $x = 2$, as shown below, you can see that $f(2)$ equals the remainder when $f(x)$ is divided by $x - 2$. Also, the other values below the line match the coefficients of the quotient. For this reason, synthetic substitution is sometimes called **synthetic division**. Synthetic division can be used to divide any polynomial by a divisor of the form $x - k$.

	2	1	5	−7	2
			2	14	14
coefficients of quotient →		1	7	7	16 ← remainder

KEY CONCEPT *For Your Notebook*

Remainder Theorem

If a polynomial $f(x)$ is divided by $x - k$, then the remainder is $r = f(k)$.

EXAMPLE 3 Use synthetic division

DIVIDE POLYNOMIALS
Because the divisor is $x + 3 = x - (-3)$, evaluate the dividend when $x = -3$.

Divide $f(x) = 2x^3 + x^2 - 8x + 5$ by $x + 3$ using synthetic division.

−3	2	1	−8	5
		−6	15	−21
	2	−5	7	−16

▶ $\frac{2x^3 + x^2 - 8x + 5}{x + 3} = 2x^2 - 5x + 7 - \frac{16}{x + 3}$