I used the long-division strategy that I can use to divide two real numbers. The difference is that polynomials contain variables. When I divide real numbers, I bring down the next digit each time and when I divide polynomials, I divide by the first term in the binomial and bring down the next term each time. Then, when I subtract two binomials, I have to be careful because I may have to subtract a negative term.

Long division can be used to divide a polynomial by a binomial. Since division by zero is not possible, assume that the divisor is never 0.

To divide $x^2 + 2x + 5$ by $x - 1$:

Divide x^2 by x.

$x + 3$ ← Divide $3x$ by x.

$x - 1 \overline{)\, x^2 + 2x + 5}$

$-(x^2 - x)$ — Multiply the divisor, $x - 1$, by x, then subtract.

$3x + 5$

$-(3x - 3)$ — Multiply the divisor, $x - 1$, by 3, then subtract.

8 — The remainder is 8.

So, the quotient is $x + 3$ and the remainder is 8.

Before dividing, write the polynomial and the binomial divisor in descending order.

Example 1 Dividing a Polynomial by a Binomial

Divide: $-x + 3x^3 - 6 + 2x^2$ by $x + 2$

SOLUTION

Write the polynomial in descending order: $3x^3 + 2x^2 - x - 6$

Use long division to divide.

$3x^2 - 4x + 7$

$x + 2 \overline{)\, 3x^3 + 2x^2 - x - 6}$ — $3x^3 \div x = 3x^2$

$-(3x^3 + 6x^2)$ — Subtract: $3x^2(x + 2)$

$-4x^2 - x$ — $-4x^2 \div x = -4x$

$-(-4x^2 - 8x)$ — Subtract: $-4x(x + 2)$

$7x - 6$ — $7x \div x = 7$

$-(7x + 14)$ — Subtract: $7(x + 2)$

-20

So, the quotient is $3x^2 - 4x + 7$ and the remainder is -20.

TEACHER NOTE

DI: Extending Thinking

Have students consider the meaning of the remainder 8 when $x^2 + 2x + 5$ is divided by $x - 1$. The remainder can be written as $\frac{8}{x - 1}$. Illustrate this concept using a numerical example from *Get Started*: $2748 \div 13 = 211\frac{5}{13}$

Animation

TEACHER NOTE

In this example of long division, and in the guided *Examples* that follow, the subtraction is indicated with a subtraction sign and brackets. As students become more familiar with the process, they should be able to subtract without using signs and brackets.

Check Your Understanding

1. Divide: $2x^3 + 5 - 2x + 3x^2$ by $x - 1$

Write: $(2x^3 + 3x^2 - 2x + 5) \div (x - 1)$

Divide.

$2x^2 + 5x + 3$

$x - 1 \overline{)\, 2x^3 + 3x^2 - 2x + 5}$

$2x^3 - 2x^2$

$5x^2 - 2x$

$5x^2 - 5x$

$3x + 5$

$3x - 3$

8

So, the quotient is $2x^2 + 5x + 3$ and the remainder is 8.

TEACHER NOTE

In *Check Your Understanding*, the subtraction signs and brackets have been omitted because of space restrictions.