

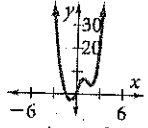
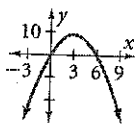
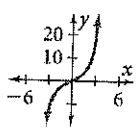
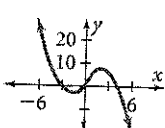
# End Behavior

## Extension

## End Behavior

FOR USE WITH LESSON 6-1

The end behavior of a graph describes the far left and the far right portions of the graph. The graphs of polynomial functions show four types of end behavior—*up and up*, *down and down*, *down and up*, and *up and down*.

Up and Up ( $\nearrow$ , $\nearrow$ )	Down and Down ( $\searrow$ , $\searrow$ )	Down and Up ( $\searrow$ , $\nearrow$ )	Up and Down ( $\nearrow$ , $\searrow$ )
Example  $y = x^4 - 3x^3 + 5x$	Example  $y = -x^2 + 6x$	Example  $y = x^3$	Example  $y = -0.3x^3 + 4x + 2$

You can determine by *inspection* the end behavior of the graph of a polynomial function in standard form. Look at the coefficient and degree of the leading term.

**Right** If the leading coefficient is positive, then the graph rises to the right. If the leading coefficient is negative, then the graph falls to the right.

**Left** If the degree of the polynomial is even, then the left behavior is the same as the right behavior. If the degree of the polynomial is odd, then the left behavior is the opposite of the right behavior.

### EXAMPLE Describing End Behavior

Determine by inspection the end behavior of the graph of each polynomial.

a.  $y = 4x^3 - 3x$

The leading coefficient 4 is positive, so the graph rises to the right. The degree of the polynomial is 3, which is odd. The left behavior is opposite the right behavior, so the graph falls to the left. The end behavior is ( $\searrow$ ,  $\nearrow$ ).

b.  $f(x) = -2x^4 + 8x^3 - 8x^2$

The leading coefficient  $-2$  is negative, so the graph falls to the right. The degree of the polynomial is 4, which is even. The left behavior is the same as the right behavior, so the graph falls to the left. The end behavior is ( $\searrow$ ,  $\searrow$ ).

### EXERCISES

Determine by inspection the end behavior of the graph of each function.

1.  $y = 3x + 2$  ( $\nearrow$ ,  $\nearrow$ ) ( $\searrow$ ,  $\uparrow$ )

3.  $g(t) = -t^2 + 1$  ( $\searrow$ ,  $\searrow$ ) ( $\searrow$ ,  $\downarrow$ )

5.  $g(x) = x^6$  ( $\nearrow$ ,  $\nearrow$ ) ( $\nearrow$ ,  $\downarrow$ )

7.  $y = -7x^8$  ( $\searrow$ ,  $\searrow$ ) ( $\searrow$ ,  $\downarrow$ )

9.  $y = -\frac{1}{2}x^3 + 4x^2 + x - 1$  ( $\searrow$ ,  $\downarrow$ ) ( $\uparrow$ ,  $\downarrow$ )

2.  $y = 4x^3$  ( $\searrow$ ,  $\nearrow$ ) ( $\searrow$ ,  $\uparrow$ )

4.  $f(x) = 2x + x^5$  ( $\searrow$ ,  $\nearrow$ ) ( $\searrow$ ,  $\uparrow$ )

6.  $y = 3x^5 - 4x^4$  ( $\searrow$ ,  $\nearrow$ ) ( $\searrow$ ,  $\uparrow$ )

8.  $f(x) = \frac{1}{2}x^4 - 2$  ( $\nearrow$ ,  $\uparrow$ ) ( $\uparrow$ ,  $\uparrow$ )

10.  $g(x) = x - x^3 + 5$  ( $\searrow$ ,  $\downarrow$ ) ( $\uparrow$ ,  $\downarrow$ )