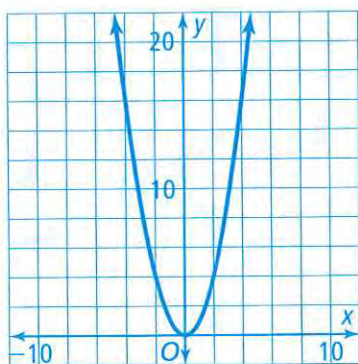


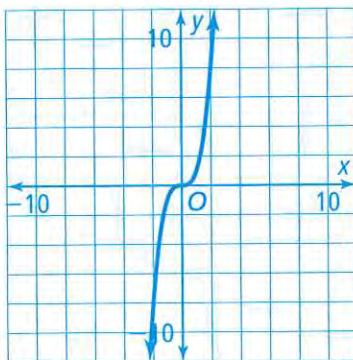
EXPLORE & REASON

Look at the polynomial graphs below.

$$f(x) = x^2$$



$$g(x) = x^3$$



- A. Is the graph of f or g symmetric about the y -axis? Is the graph of f or g symmetric about the origin? Explain.

- B. **Look for Relationships** Graph more functions of the form $y = x^n$ where n is a natural number. Which of these functions are symmetric about the origin? Which are symmetric about the y -axis? What conjectures can you make? © MP.7

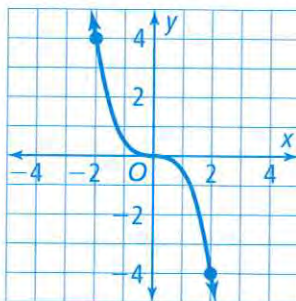
HABITS OF MIND

Look for Relationships Do you notice any other patterns among the functions with even degree or the functions with odd degree? © MP.7

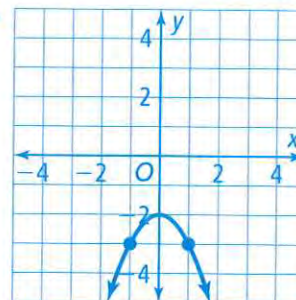
**EXAMPLE 1** **Try It!** Identify Even and Odd Functions From Their Graphs

1. Classify the polynomial functions as even or odd based on the graphs.

a.



b.

**EXAMPLE 2** **Try It!** Identify Even and Odd Functions From Their Equations

2. Is the function odd, even, or neither?

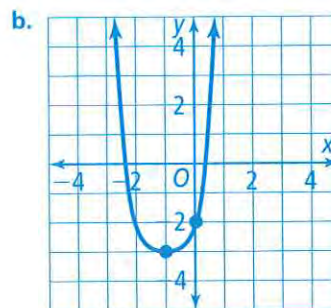
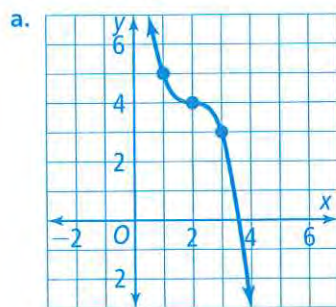
a. $f(x) = 7x^5 - 2x^2 + 4$

b. $f(x) = x^6 - 2$

HABITS OF MIND**Make Sense and Persevere** Why do you replace x with $-x$ when determining if a function is odd, even, or neither? © MP.1**EXAMPLE 3** **Try It!** Graph Transformations of Cubic and Quartic Parent Functions3. How does the graph of the function $g(x) = 2x^3 - 5$ differ from the graph of its parent function?

**EXAMPLE 4** **Try It! Identify a Transformation**

4. Determine the equation of each graph as it relates to its parent cubic function or quartic function.

**HABITS OF MIND**

Look for Relationships What type of transformation would change a function's end behavior? © MP.7

EXAMPLE 5 **Try It! Apply a Transformation of a Cubic Function**

5. a. The volume of a cube, in cubic feet, is given by the function $V(x) = x^3$. Write a function for the volume of the cube with cubic inches as the units.
- b. A storage unit is in the shape of a rectangular prism. The volume of the storage unit is given by $V(x) = (x)(x)(x - 1) = x^3 - x^2$. A potential customer wants to compare the volume of this storage unit with that of another storage unit that is 1 foot longer in every dimension. Write a function for the volume of this larger unit.

HABITS OF MIND

Critique Arguments A student thought that, for 5a, the new function should be $V(x) = 144x^3$. What are the two errors the student made? © MP.3

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How are symmetry and transformations represented in the graph and equation of a polynomial function?

2. **Vocabulary** What is the difference between the graph of an even function and the graph of an odd function?

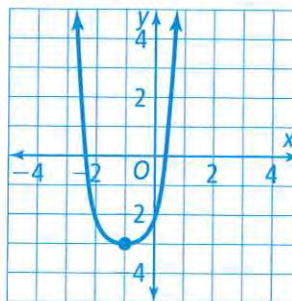
3. **Error Analysis** A student identified the transformations of the polynomial function $f(x) = 3(x - 1)^3 - 6$ as follows:

The function is shifted to the left 1 unit, stretched vertically, and is shifted downward 6 units.

Describe and correct the error the student made. © MP.6

Do You KNOW HOW?

4. Classify the function on the graph as odd, even, or neither.



5. Use the equation to classify the function as odd, even, or neither.

$$g(x) = 4x^3 - x$$

6. The volume of cardboard box is given by the function $V(x) = x(x - 2)(x) = x^3 - 2x^2$. Write a new function for the volume of a cardboard box that is 2 units longer in every dimension.