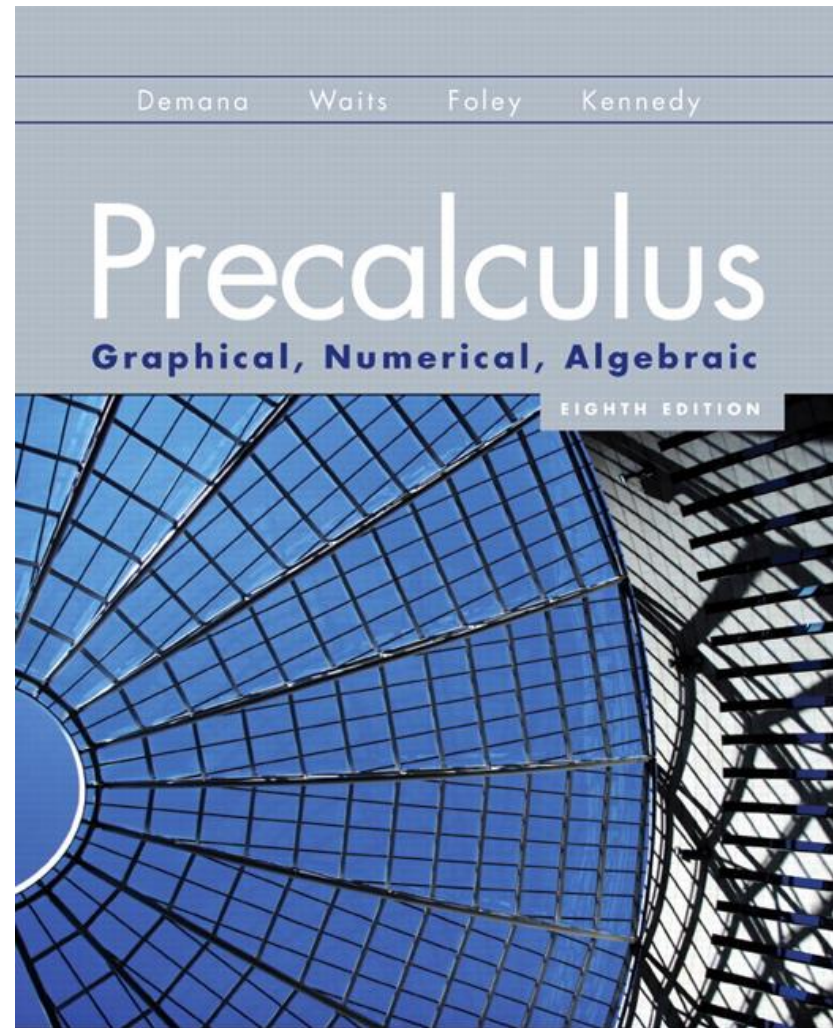# 2.2

Power Functions with Modeling

What you'll learn about

- Power Functions and Variation
- Monomial Functions and Their Graphs
- Graphs of Power Functions
- Modeling with Power Functions

… and why

Power functions specify the proportional relationships of geometry, chemistry, and physics.

Power Function

Any function that can be written in the form $f(x) = k \cdot x^a$, where k and a are nonzero constants, is a **power function**. The constant a is the **power**, and k is the **constant of variation**, or **constant of proportion**. We say $f(x)$ **varies as** the ath power of x, or $f(x)$ **is proportional to** the ath power of x.
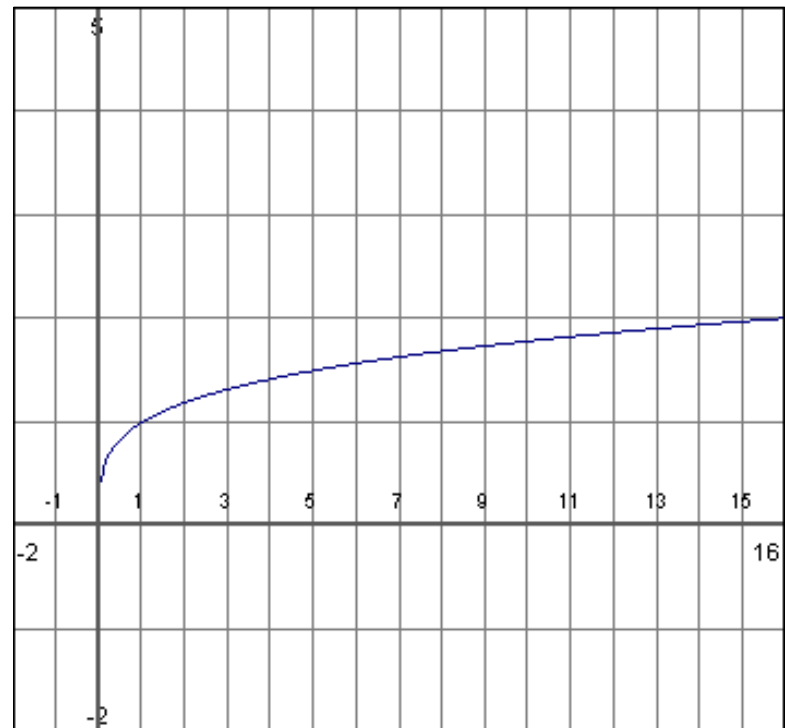
Example **Analyzing Power Functions**

State the power and constant of variation for the function $f(x) = \sqrt[4]{x}$, and graph it.

Example **Analyzing Power Functions**

State the power and constant of variation for the function $f(x) = \sqrt[4]{x}$, and graph it.

$$f(x) = \sqrt[4]{x} = x^{1/4} = 1 \cdot x^{1/4}$$

so the power is 1/4 and

the constant of variation is 1.

Monomial Function

Any function that can be written as

$$f(x) = k \text{ or } f(x) = k \cdot x^n,$$

where k is a constant and n is a positive integer, is a **monomial function**.

Example **Graphing Monomial Functions**

Describe how to obtain the graph of the function $f(x) = 3x^3$ from the graph of $g(x) = x^n$ with the same power n.

Example **Graphing Monomial Functions**

Describe how to obtain the graph of the function $f(x) = 3x^3$ from the graph of $g(x) = x^n$ with the same power n.

We obtain the graph of $f(x) = 3x^3$ by vertically stretching the graph of $g(x) = x^3$ by a factor of 3. Both are odd functions.
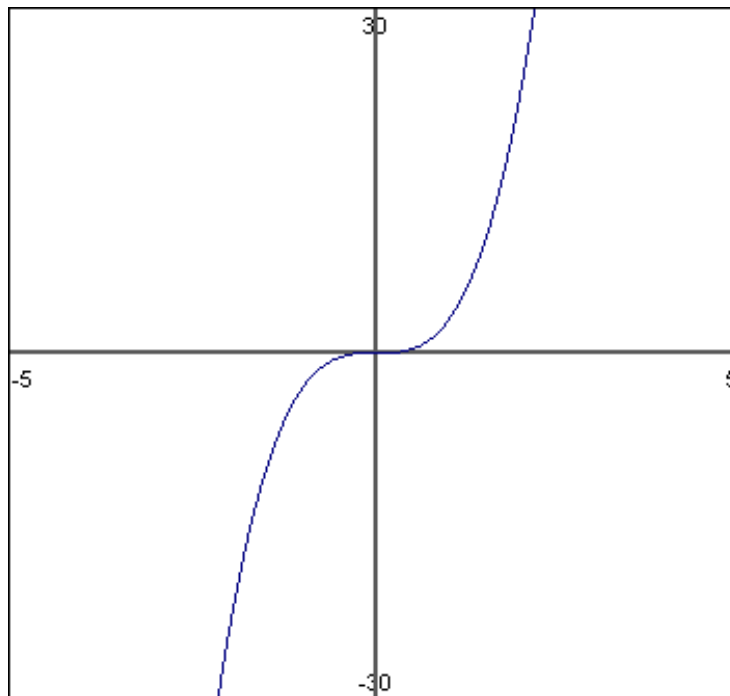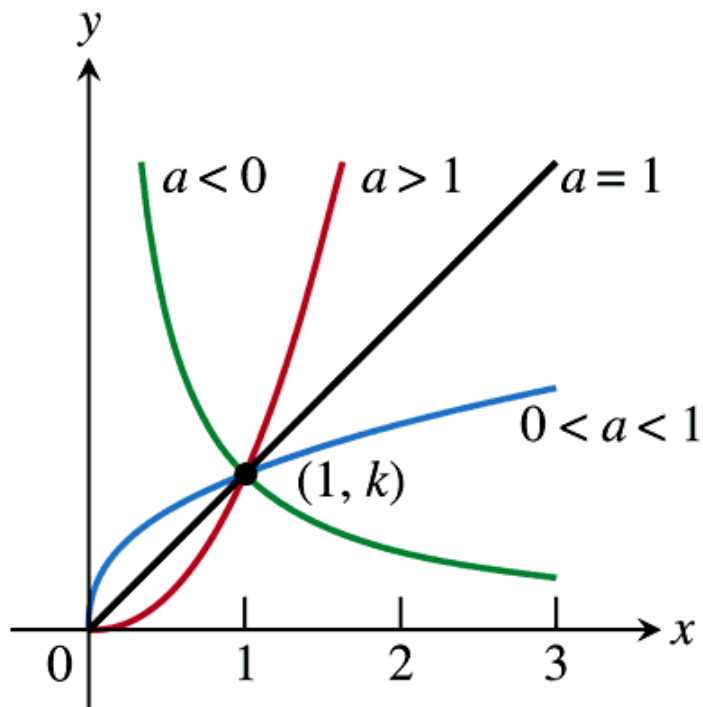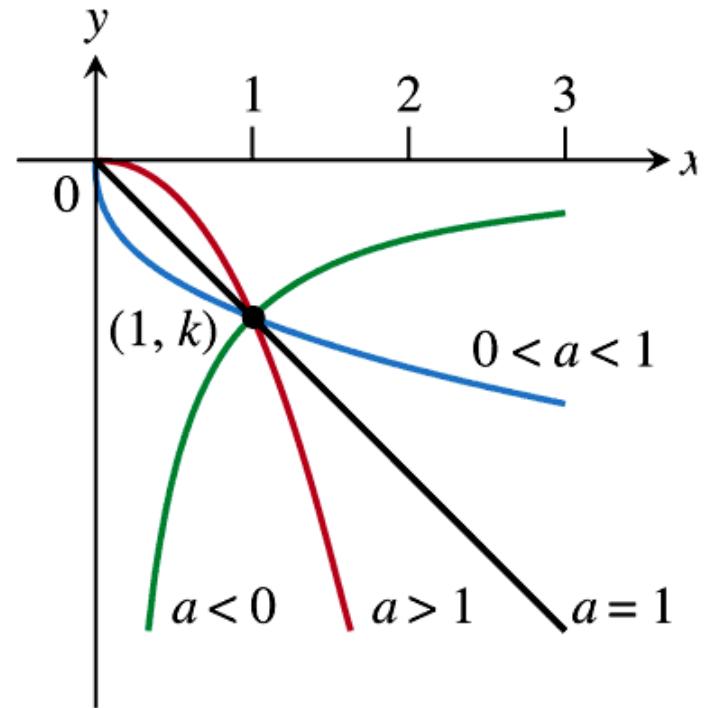
Graphs of Power Functions

For any power function $f(x) = k \cdot x^a$, one of the following three things happens when $x < 0$.

- f is undefined for $x < 0$.

- f is an even function.

- f is an odd function.

Graphs of Power Functions

Quick Review

Write the following expressions using only positive integer powers.

1. $x^{5/3}$

2. r^{-3}

3. $m^{1.5}$

Write the following expressions in the form $k \cdot x^a$ using a single rational number for the power of a.

4. $\sqrt{16x^3}$

5. $\sqrt[3]{\dfrac{x}{27}}$

Quick Review Solutions

Write the following expressions using only positive integer powers.

1. $x^{5/3}$ $\sqrt[3]{x^5}$

2. r^{-3} $\dfrac{1}{r^3}$

3. $m^{1.5}$ $\sqrt{m^3}$

Write the following expressions in the form $k \cdot x^a$ using a single rational number for the power of a.

4. $\sqrt{16x^3}$ $4x^{\frac{3}{2}}$

5. $\sqrt[3]{\dfrac{x}{27}}$ $\dfrac{1}{3}x^{\frac{1}{3}}$