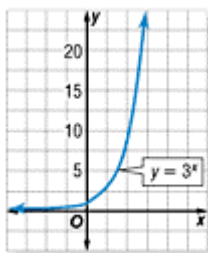


Lesson 10-5

Example 1 Graph an Exponential Function with $a > 1$

a. Graph $y = 3^x$. State the y-intercept.

| x | 3^x | y |
|-----|----------|---------------|
| -2 | 3^{-2} | $\frac{1}{9}$ |
| -1 | 3^{-1} | $\frac{1}{3}$ |
| 0 | 3^0 | 1 |
| 1 | 3^1 | 3 |
| 2 | 3^2 | 9 |
| 3 | 3^3 | 27 |



Graph the ordered pairs and connect the points with a smooth curve. The y-intercept is 1. Notice that the y-values change little for small values of x , but they increase quickly as the values of x become greater.

b. Use the graph to determine the approximate value of $3^{-1.5}$.

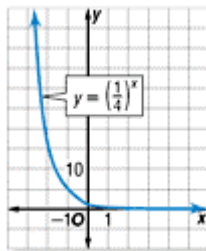
The graph represents all real values of x and their corresponding values of y for $y = 3^x$. So, the value of y is about 0.2 when $x = -1.5$. Use a calculator to confirm this value.

$$3^{-1.5} \approx 0.19245009.$$

Example 2 Graph Exponential Functions with $0 < a < 1$

a. Graph $y = \left(\frac{1}{4}\right)^x$. State the y-intercept.

| x | $\left(\frac{1}{4}\right)^x$ | y |
|-----|---------------------------------|----------------|
| -3 | $\left(\frac{1}{4}\right)^{-3}$ | 64 |
| -2 | $\left(\frac{1}{4}\right)^{-2}$ | 16 |
| -1 | $\left(\frac{1}{4}\right)^{-1}$ | 4 |
| 0 | $\left(\frac{1}{4}\right)^0$ | 1 |
| 1 | $\left(\frac{1}{4}\right)^1$ | $\frac{1}{4}$ |
| 2 | $\left(\frac{1}{4}\right)^2$ | $\frac{1}{16}$ |



Graph the ordered pairs and connect the points with a smooth curve. The y-intercept is 1.

- b. Use the graph to determine the approximate value of $\left(\frac{1}{4}\right)^{1.5}$.

The value of y is about 0.1 when $x = 1.5$. Use a calculator to confirm this value.

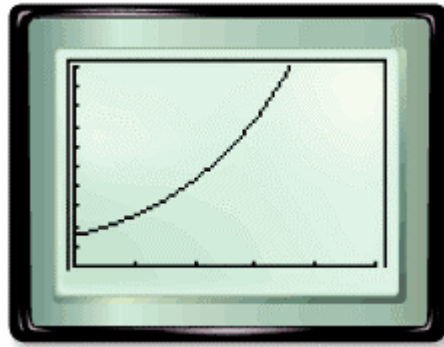
$$\left(\frac{1}{4}\right)^{1.5} = \frac{1}{8}.$$

Example 3 Use Exponential Functions to Solve Problems

Connor has 4 weeks before his math final exam. He plans to study for 3 hours the first week and increase the time he will study $S(x)$ in hours according to the function $S(x) = 3(1.7)^x$, where x represents the number of weeks of studying.

- a. Graph the function. What values of $S(x)$ and x are meaningful in the context of the problem?

Use a graphing calculator to graph the function. Only values where $S(x) > 0$ and $x > 0$ are meaningful in the context of the problem



- b. How many hours did he study the second week?

$$S(x) = 3(1.7)^x \quad \text{Original equation}$$

$$S(2) = 3(1.7)^2 \quad x = 2$$

$$S(2) = 8.67 \quad \text{Use a calculator.}$$

He studied 8.67 hours during the second week.

- c. Connor has scheduled 20 hours to study during the fourth week. According to the function, has he scheduled enough time?

$$S(x) = 3(1.7)^x \quad \text{Original equation}$$

$$S(4) = 3(1.7)^4 \quad x = 4$$

$$S(4) = 25.0563 \quad \text{Use a calculator.}$$

According to the function, he should schedule 25.0563 hours. He has not scheduled enough time.

Example 4 Identify Exponential Behavior

Determine whether each set of data displays exponential behavior.

a.

| | | | | | | |
|-----|----|----|----|----|----|----|
| x | 0 | 1 | 2 | 3 | 4 | 5 |
| y | 50 | 46 | 42 | 38 | 34 | 30 |

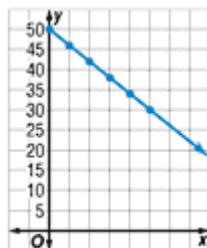
Method 1 Look for a Pattern

The domain values are at regular intervals of 1. The range values have a common difference of -4 .

| | | | | | |
|----|----|----|----|----|----|
| 50 | 46 | 42 | 38 | 34 | 30 |
| -4 | -4 | -4 | -4 | -4 | |

The data do not display exponential behavior. They display linear behavior.

Method 2 Graph the Data



This is a graph of a line, not an exponential function.

b.

| | | | | | | |
|-----|---|----|----|-----|-----|------|
| x | 0 | 10 | 20 | 30 | 40 | 50 |
| y | 1 | 5 | 25 | 125 | 625 | 3125 |

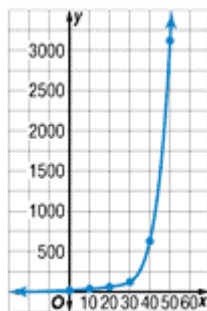
Method 1 Look for a Pattern

The domain values are at regular intervals of 10. The range values have a common factor of 5.

| | | | | | |
|------------|------------|------------|------------|------------|------|
| 1 | 5 | 25 | 125 | 625 | 3125 |
| $\times 5$ | $\times 5$ | $\times 5$ | $\times 5$ | $\times 5$ | |

Since the domain values are at regular intervals and the range values have a common factor, the data are probably exponential. The equation for the data may involve 5^x .

Method 2 Graph the Data



The graph shows a rapidly increasing value of y as x increases. This is a characteristic of exponential behavior.