Graphing Exponential Functions

Algebra Worksheet · Grade 9–11

Name: _____ Date: _____

Learning Objectives

- Identify the y-intercept, asymptote, and behavior of exponential functions of the form y = n · a^x
- Determine whether an exponential function is increasing or decreasing based on the base and constant
- Graph exponential functions including transformations such as vertical shifts and reflections

Problems

1. Identify the y-intercept of the exponential function below:

$$y = 3^x$$

2. State whether the exponential function below is increasing or decreasing, and identify its y-intercept:

$$y = 4^{-x}$$

3. Identify the y-intercept and describe the behavior of the exponential function below:

$$y = \frac{1}{2} \cdot 5^x$$

4. Identify the y-intercept and describe the behavior of the exponential function below:

$$y = \frac{1}{3} \cdot 4^x$$

5. Identify the y-intercept, the horizontal asymptote, and describe the behavior of the function below:

$$y = 5 \cdot \left(\frac{1}{2}\right)^x$$

6. Explain why the two functions below produce the same graph:

Scan to watch

$y = a^{-x}$ and $y = \left(\frac{1}{a}\right)^x$

7. Find the y-intercept and horizontal asymptote of the exponential function below, then state whether it is increasing or decreasing:

$y = 5 \cdot 3^x - 2$

8. Find the y-intercept and horizontal asymptote of the function below, and describe the end behavior as x increases:

$y = -2 \cdot 4^x + 4$

9. Compare the two exponential functions below. Identify each function's y-intercept, asymptote, and whether it is increasing or decreasing:

$f(x) = 3 \cdot 2^x$ and $g(x) = 3 \cdot \left(\frac{1}{2}\right)^x$

10. For the exponential function below, identify the y-intercept, horizontal asymptote, and whether the graph is increasing or decreasing. Then sketch a description of the graph's shape:

$y = -3 \cdot \left(\frac{1}{4}\right)^x + 6$

Scan to watch

Graphing Exponential Functions — Answer Key

Algebra Worksheet · Grade 9–11

Answer Key

1. Answer: (0, 1)
- Substitute x = 0 into the function.
- y = 3^0 = 1, so the y-intercept is (0, 1).

2. Answer: Decreasing; y-intercept at (0, 1)
- When x = 0, y = 4^0 = 1, so the y-intercept is (0, 1).
- Because the exponent is negative, the function is decreasing as x increases.

3. Answer: y-intercept at (0, 1/2); increasing
- Substitute x = 0: y = (1/2) · 5^0 = (1/2) · 1 = 1/2.
- Since a = 5 > 1, the function is increasing.

4. Answer: y-intercept at (0, 1/3); increasing
- Substitute x = 0: y = (1/3) · 4^0 = 1/3.
- Since a = 4 > 1, the function is increasing.

5. Answer: y-intercept at (0, 5); asymptote at y = 0; decreasing
- Substitute x = 0: y = 5 · 1 = 5, so the y-intercept is (0, 5).
- Since a = 1/2 < 1, the function is decreasing and approaches y = 0 as x increases.

6. Answer: They are equivalent because (1/a)^x = a^{-x}
- Using exponent rules, (1/a)^x = a^{-1 · x} = a^{-x}.
- Since the expressions are algebraically identical, their graphs are the same.

7. Answer: y-intercept at (0, 3); asymptote at y = -2; increasing
- Substitute x = 0: y = 5 · 1 - 2 = 3, so the y-intercept is (0, 3).
- As x → -∞, 3^x → 0, so y → -2. The horizontal asymptote is y = -2.
- Since a = 3 > 1, the function is increasing.

8. Answer: y-intercept at (0, 2); asymptote at y = 4; decreasing toward negative infinity
- Substitute x = 0: y = -2 · 1 + 4 = 2, so the y-intercept is (0, 2).
- As x → -∞, 4^x → 0, so y → 4. The horizontal asymptote is y = 4.
- As x → +∞, -2 · 4^x → -∞, so the graph decreases without bound.

9. Answer: Both have y-intercept (0,3) and asymptote y=0; f is increasing, g is decreasing
- For both, substitute x = 0: y = 3 · 1 = 3, so both have y-intercept (0, 3).
- Both approach y = 0 as x moves away from zero in the opposite direction.
- f(x) has base 2 > 1, so it is increasing; g(x) has base 1/2 < 1, so it is decreasing.
- The graphs are reflections of each other across the y-axis.

Scan to watch

10. Answer: y-intercept at (0, 3); asymptote at y = 6; decreasing toward y = 6 from below

- Substitute x = 0: y = -3 · 1 + 6 = 3, so the y-intercept is (0, 3).
- As x → +∞, (1/4)^x → 0, so y → 6. The horizontal asymptote is y = 6.
- Since the base 1/4 < 1, the term (1/4)^x decreases, making -3·(1/4)^x increase toward 0.
- Therefore the graph increases from below, approaching y = 6 but never reaching it.

Scan to watch