Solve the given inequality.

1) \( f(x) \geq 0 \)

\[ x \geq 0 \text{ or above } x \text{-axis} \]

Solution: \((-\infty, -4] \cup [2, \infty)\)

Solve the polynomial inequality. Express the solution set in interval notation.

2) \( x^2 - 2x - 3 < 0 \)

Find zeros

\[ x^2 - 2x - 3 = 0 \]

\( (x - 3)(x + 1) = 0 \)

\( x = 3 \quad x = -1 \)

Test values

\[ \begin{array}{c|c}
\text{Test values} & \text{Sign} \\
\hline
-1 & + \quad - \quad + \\
3 & - \\
\end{array} \]

\( f(-1) = 5 \quad f(0) = -3 \quad f(4) = 5 \)

Solution: \((-1, 3)\)

Solve the rational inequality. Express the solution set in interval notation.

3) \( \frac{5x + 3}{4 - 2x} \geq 0 \)

Find zeros

\( 4 - 2x \neq 0 \)

\( x \neq 2 \)

Test values

\[ \begin{array}{c|c}
\text{Test values} & \text{Sign} \\
\hline
-3 & + \\
2 & - \\
\end{array} \]

\( f(-3) = 1.875 \quad f(2) = -9 \)

Solution: \( -\frac{3}{5}, 2 \)

Show all work!

Solve the problem.

4) The amount of water used to take a shower is directly proportional to the amount of time that the shower is in use. A shower lasting 24 minutes requires 12 gallons of water. Find the amount of water used in a shower lasting 5 minutes.

\[ y = \frac{kx}{W} \]

\[ \frac{24}{12} = \frac{k}{W} \]

\[ k = \frac{1}{2} \]

\[ W = \frac{1}{2}(5) \]

\[ W = 2.5 \text{ minutes} \]

Solution:

5) While traveling at a constant speed in a car, the centrifugal acceleration passengers feel while the car is turning is inversely proportional to the radius of the turn. If the passengers feel an acceleration of 16 feet per second per second when the radius of the turn is 100 feet, find the acceleration the passengers feel when the radius of the turn is 400 feet.

\[ a = \frac{k}{r} \]

\( (100) 16 = k (100) \)

\[ k = 1600 \]

\[ \frac{a}{1600} = \frac{4}{r} \]

Solution:

6) \( y \) varies jointly as \( a \) and \( b \) and inversely as the square root of \( c \). \( y = 21 \) when \( a = 9 \), \( b = 7 \), and \( c = 36 \). Find \( y \) when \( a = 2 \), \( b = 5 \), and \( c = 16 \).

\[ y = \frac{ab}{\sqrt{c}} \]

\[ 21 = \frac{k(9)(7)}{\sqrt{36}} \]

\[ k = 1600 \]

\[ \frac{y}{2} = \frac{20.4}{16} \]

\[ y = 5 \]
Graph the function by making a table of at least 5 coordinates. Be sure to include both positive and negative values for x.

7) \( f(x) = 4^x \)

Describe the transformations needed to graph \( g(x) \).

8) How can the graph of \( f(x) = e^x \) be used to obtain the graph of \( g(x) = e^{(x+3)} + 2 \)?

- Start with \( f(x) = e^x \)
- Shift left 3 units
- Reflect over y-axis
- Shift up 1 unit

Use the functions below to answer the following questions.

9) \( y = \log_{12} x \)

Given the equation of the asymptote and tell what kind of asymptote it is.

Vertical Asymptote: \( x = 0 \)

What kind of intercept, if any, does this function have? If there is an intercept, give its coordinate.

- x-intercept: \( (1, 0) \)

Find the domain and range of this function.

- Domain: \( (0, \infty) \)
- Range: \( (-\infty, 0) \)

10) \( y = b^x \)

What kind of intercept, if any, does this function have? If there is an intercept, give its coordinate.

- y-intercept: \( (0, 1) \)

Find the domain and range of this function.

- Domain: \( (-\infty, \infty) \)
- Range: \( (0, \infty) \)

Give the equation of the asymptote and tell what kind of asymptote it is.

Horizontal Asymptote: \( y = 0 \)

What is the restriction on \( b \) if the function decreases along its entire domain?

\( 0 < b < 1 \)

Use the compound interest formulas \( A = P\left(1 + \frac{r}{n}\right)^{nt} \) OR \( A = Pe^{rt} \) to solve.

11) Find the accumulated value of an investment of $1300 at 12% compounded quarterly for 2 years.

\[
A = P\left(1 + \frac{r}{n}\right)^{nt}
\]

\[
A = 1300\left(1 + \frac{0.12}{4}\right)^{2}\times 2 = 1300(1.03)^8
\]

\[
A = 1300(1.03)^8 \approx 1646.80
\]

Write the equation in its equivalent exponential form.

12) \( \log_7 49 = x \)

\[
7^x = 49
\]

Write the equation in its equivalent logarithmic form.

13) \( 3\sqrt{216} = 6 \)

\[
\log_{216} 6 = \frac{1}{3}
\]

Evaluate the expression without using a calculator.

14) \( \log_{\sqrt[4]{4}} \frac{1}{2} \)

\[
\log_{\sqrt[4]{4}} \frac{1}{2} \Rightarrow \log_{(4^{1/2})} \frac{1}{2} \Rightarrow \log_{4^{1/2}} \frac{1}{2} = \frac{-1}{2}
\]

Describe the transformations.

15) How can the graph of \( \log_5 x \) be used to obtain the graph of \( f(x) = \log_5 (x - 2) \)?

- Shift \( f(x) \) \( 2 \) units to the right

Graph the function by changing the function to exponential form and creating a table of at least five values. Be sure to include both positive and negative values of x.

16) \( g(x) = \log_4 x \)

\[
g(x) = \log_4 x
\]

\[
y = \log_4 x
\]

\[
y = x
\]

<table>
<thead>
<tr>
<th>x</th>
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<tr>
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<td>-2</td>
</tr>
</tbody>
</table>

Find the domain and the equation of the asymptote of the logarithmic function.
17) \( f(x) = \log_4(x + 9) \)
\[ x + 9 > 0 \]
\[ x > -9 \]

\[ \text{V.A. } x = -9 \]

D: \((-9, \infty)\)

Use common logarithms or natural logarithms and a calculator to evaluate to four decimal places.
18) \( \log_{0.5} 18 \)
\[ \frac{\log 18}{\log 0.5} = \frac{\ln 18}{\ln 0.5} \approx -4.1699 \]

Solve the equation.
19) \( 2^{3x + 5} = \frac{1}{16} \)
\[ (3x + 5) = \frac{1}{2^4} \]
\[ 3x + 5 = -4 \]
\[ 3x = -9 \]
\[ x = -3 \]

Use properties of logarithms to expand the logarithmic expression as much as possible. Where possible, evaluate logarithmic expressions without using a calculator.
20) \( \log_3(3x) \)
\[ \log_3 3 + \log_3 x \]
\[ 1 + \log_3 x \]

21) \( \ln \left( \frac{e^6}{5} \right) \)
\[ \ln e^6 - \ln 5 \]
\[ 6 - \ln 5 \]

22) \( \log_a \left( \frac{xy^3}{w^3z^9} \right) \)
\[ \log_a (xy^3) - \log_a (w^3z^9) \]
\[ \log_a x + \log_a y^3 - (\log_a w^3 + \log_a z^9) \]
\[ \log_a x + 3 \log_a y - 3 \log_a w - 9 \log_a z \]

Use properties of logarithms to condense the logarithmic expression. Write the expression as a single logarithm whose coefficient is 1. Where possible, evaluate logarithmic expressions.
23) \( \frac{2}{3} (\log_7 x + \log_7 y) - 4 \log_7 (x + 4) \)
\[ \log_7 x + \log_7 y \]
\[ (\log_7 x + \log_7 y)^\frac{2}{3} - \log_7 (x + 4)^4 \]
\[ \log_7 x^\frac{2}{3} - \log_7 (x + 4)^4 \]

Solve the logarithmic equation. Be sure to reject any value that is not in the domain of the original logarithmic expressions. Give the exact answer AND the approximate answer.
24) \( \log_3 (x + 2) = 1 \)
\[ 3^1 = x + 2 \]
\[ 3 = x + 2 \]
\[ -2 = -2 \]
\[ x = 1 \]

25) \( \log_3 (x + 2) - \log_3 x = 2 \)
\[ \log_3 \left( \frac{x + 2}{x} \right) = 2 \]
\[ 3^2 = \frac{x + 2}{x} \]
\[ 9 = \frac{x^2 + 2x}{x} \]
\[ 9x = x^2 + 2x \]
\[ x^2 - 7x + 2 = 0 \]
\[ x = \frac{7 \pm \sqrt{49 - 8}}{2} \]
\[ x = \frac{7 \pm 1}{2} \]
\[ x = 1, 4 \]

26) \( \log x + \log (x + 1) = \log 12 \)
\[ \log x(x + 1) = \log 12 \]
\[ x(x + 1) = 12 \]
\[ x^2 + x = 12 \]
\[ x^2 + x - 12 = 0 \]
\[ (x + 4)(x - 3) = 0 \]
\[ x = -4, x = 3 \]

Solve the exponential equation. Give the exact answer AND the approximate answer.
27) \( e^{(x + 4)} = 8 \)
\[ \ln e^{(x + 4)} = \ln 8 \]
\[ x + 4 = \ln 8 \]
\[ x = \ln 8 - 4 \]
exact
\[ x \approx -1.9206 \] approx.