1. Given \( f(x) = x^2 - 3 \), and \( g(x) = 2x + 1 \), find
   a) \((f + g)(x)\)  
   b) \((f - g)(x)\)  
   c) \((f \cdot g)(x)\)  
   d) \(\left(\frac{g}{f}\right)(x)\)  
   e) \((f \circ g)(x)\)  
   f) \((g \circ f)(-1)\)

2. Determine if the given function is one-to-one. If it is one-to-one, list the elements of its inverse.  
   \( f = \{(-5, 5), (0, 4), (13, 7), (11, -6)\} \)

3. Given that \( f(x) = \frac{1}{x+2} \) is a one-to-one function, find the following.
   a) \( f(0) \)  
   b) \( f^{-1}\left(\frac{1}{2}\right) \)  
   c) \( f^{-1}\left(\frac{1}{4}\right) \)

4. The following function is one-to-one. Find its inverse and graph both on the same set of axes.
   \( f(x) = 2x + 5 \)

5. Find the inverse of the following functions.
   a) \( f(x) = \sqrt{x+2} \)  
   b) \( g(x) = \frac{2x}{x+1}, \quad x \neq -1 \)

6. Solve the given exponential equations.
   a) \( 4^x = 64 \)  
   b) \( 3^x = \frac{1}{9} \)  
   c) \( 2^{3x} = \frac{1}{16} \)  
   d) \( 8^{3x-2} = 4 \)

7. Graph the exponential functions.
   a) \( y = 3^x \)  
   b) \( y = \left(\frac{1}{3}\right)^x \)  
   c) \( y = 3^{x+2} \)  
   d) \( y = \left(\frac{1}{3}\right)^x + 2 \)

8. Use the formula \( A = P\left(1 + \frac{r}{n}\right)^n \) to solve the following problem.
   Find the amount accrued if $1600 is invested at 9% interest compounded monthly for 3 years.

9. Find the exact value of the following logarithms.
   a) \( \log_8 8 \)  
   b) \( \log_{\frac{1}{16}} \frac{1}{16} \)  
   c) \( \log 100 \)  
   d) \( \log_{12} 1 \)  
   e) \( \ln e \)  
   f) \( \log 10 \)  
   g) \( \ln e^3 \)  
   h) \( \log \frac{1}{100} \)
10. Solve the following equations. Give only exact answers.
   a) \( \log_2 x = 2 \)  
   b) \( \log_4 64 = 2 \)  
   c) \( \log_3 (2x + 5) = 2 \)
   d) \( \ln(3x) = 2 \)  
   e) \( \ln(5x - 2) = 7 \)

11. Graph the given equations on the same set of axes.
   \( y = 3^x \) and \( y = \log_3 x \)  
   (What type of symmetry do these graphs have?)

12. Use properties of logarithms to write the following as a sum or a difference of simpler logarithms.
   a) \( \log_7 \frac{y x^3}{z} \)  
   b) \( \log_4 \frac{x + 5}{x^3} \)

13. Write as a single logarithm.
   \( 4 \log_3 x - \log_3 z + \frac{1}{2} \log_3 y \)

14. Approximate the logarithm to four decimal places.
   \( \log_3 4 \)

15. Use the formula \( A = Pe^{rt} \) to solve the following problem.
   Find the amount to which a $940 investment grows if it is invested at 11% compounded continuously for 3 years.

16. Solve the following equations. Give only exact answers.
   a) \( e^{x+3} = 2 \)  
   b) \( 7^{2x-1} = 35 \)  
   c) \( 2 \cdot 5^{x-1} = 1 \)
   d) \( \log(5x) - \log(x + 1) = 4 \)  
   e) \( \ln x - \ln 2 = 1 \)  
   f) \( \log_3 x + \log_3 (x + 6) = 3 \)

17. Use the exponential decay formula \( y = C(1 - r)^t \) to answer the following question.
   A rare isotope of a nuclear material is very unstable, decaying at a rate of 15% each second. Find how much isotope remains 10 seconds after 5 grams of the isotope is created. Round to the nearest whole number.

18. Use the formula \( A = P \left(1 + \frac{r}{n}\right)^{nt} \) to solve the following problem.
   How long does it take $5,000 to grow to $10,000 if it is invested at 8% interest compounded quarterly? (Round to the nearest tenth.)

19. Use the formula \( A = Pe^{rt} \) to solve the following problem.
   How long does it take $5,000 to grow to $50,000 at 7% compounded continuously? Round to the nearest tenth.)

20. Determine the center and radius of the circle: \( x^2 + y^2 + 4x - 6y - 3 = 0 \), and graph it.

21. Find the vertex and sketch the graph of the parabola: \( x = -y^2 - 4y + 6 \).
22. Sketch the graph of the ellipse: \( 9y^2 + 16x^2 = 144 \)

23. Sketch the graph of the hyperbola: \( \frac{x^2}{9} - \frac{y^2}{25} = 1 \)

24. Identify the conic and sketch its graph.
   a) \( (x-7)^2 + (y-2)^2 = 4 \)
   b) \( x = (y+3)^2 - 1 \)
   c) \( 4y^2 - 25x^2 = 100 \)
   d) \( \frac{x^2}{16} + \frac{y^2}{4} = 1 \)
   e) \( x^2 - 10y + y^2 + 9 = 0 \)

25. Find an equation of the circle with center \((-4,3)\) and a radius of \(5\sqrt{3}\)

26. Solve the nonlinear systems of equations
   a) \( \begin{cases} x^2 + y^2 = 4 \\ x + y = -2 \end{cases} \)
   b) \( \begin{cases} y = x^2 \\ 3x + y = 10 \end{cases} \)
   c) \( \begin{cases} x^2 + 2y^2 = 4 \\ x^2 - y^2 = 4 \end{cases} \)

27. Graph the inequality
   a) \( x^2 + y^2 < 36 \)
   b) \( \frac{y^2}{4} - x^2 \leq 1 \)
   c) \( y > x^2 + x - 2 \)

28. Graph the systems of nonlinear inequalities
   a) \( \begin{cases} x^2 + y^2 \geq 25 \\ \frac{x^2}{25} + \frac{y^2}{4} \geq 1 \end{cases} \)
   b) \( \begin{cases} x > y^2 \\ x + y \leq 4 \end{cases} \)
   c) \( \begin{cases} x^2 + y^2 \leq 4 \\ y > x^2 - 1 \\ x > 0 \end{cases} \)

Answer key is on the next page.
Answer key:

1a.) \((f + g)(x) = x^2 + 2x - 2\)  
1b.) \((f - g)(x) = x^2 - 2x - 4\)  
1c.) \((f \cdot g)(x) = 2x^3 + x^2 - 6x - 3\)  
1d.) \(\left(\frac{g}{f}\right)(x) = \frac{2x + 1}{x^2 - 3}\)  
1e.) \((f \circ g)(x) = 4x^2 + 4x - 2\)  
1f.) \((g \circ f)(-1) = -3\)

2.) The function is 1-1 since each input has one output, and each output comes from only one input (no repeated y-coordinates). \(f^{-1} = \{(5,-5),(4,0),(7,13),(-6,11)\}\)

3a.) \(f(0) = \frac{1}{2}\)  
3b.) \(f^{-1}\left(\frac{1}{2}\right) = 0\)  
3c.) \(f^{-1}\left(\frac{1}{4}\right) = 2\)

4.)

5a.) \(f^{-1}(x) = x^3 - 2\)  
5b.) \(g^{-1}(x) = \frac{x}{2 - x}, \ x \neq 2\)

6a.) \(x = 3\)  
6b.) \(x = -2\)  
6c.) \(x = -\frac{4}{3}\)  
6d.) \(x = \frac{8}{9}\)

7a.)
7b.)

\[ y = x \]

7c.)

\[ y = 3^{x^2} \]

7d.)

\[ y = e^{-x} \]

8.) \( A \approx \$2,039.83 \)

9a.) \( \log_8 8 = 1 \)  
9b.) \( \log_4 \frac{1}{16} = -2 \)  
9c.) \( \log 100 = 2 \)  
9d.) \( \log_{32} 1 = 0 \)  
9e.) \( \ln e = 1 \)  
9f.) \( \log 10 = 1 \)  
9g.) \( \ln e^3 = 3 \)  
9h.) \( \log \frac{1}{100} = -2 \)
10a.) \( x = 9 \)  
10b.) \( x = 8 \)  
10c.) \( x = 2 \)  
10d.) \( x = \frac{e^3}{3} \)  
10e.) \( x = \frac{e^7 + 2}{5} \)

11.)

![Graph](image)

The graphs are symmetric about the line \( y = x \).

12a.) \( \log_7 y + 3 \log_7 x - \log_7 z \)  
12b.) \( \log_4 (x + 5) - 2 \log_4 x \)

13.) \( \log_5 \frac{x^4 \sqrt{y}}{z} \)

14.) \( \log_3 4 \approx 1.2619 \)

15.) \( A \approx $1,307.51 \)

16a.) \( x = -3 + \ln 2 \)  
16b.) \( x = \frac{\log 35}{2 \log 7} + \frac{1}{2} \)  
16c.) \( x = 1 - \frac{\log 2}{\log 5} \)  
16d.) \( x = -\frac{10,000}{9,995} \), No solution  
16e.) \( x = 2e \)  
16f.) \( x = 3 \)

17.) \( y \approx 0.984 \approx 1 \) gram

18.) \( t \approx 8.8 \) years

19.) \( t \approx 32.9 \) years
20.) Center \((-2, 3),\) radius \(= 4\)

![Circle graph](image1)

21.) Vertex \((10, -2),\) x-intercepts \((6, 0)\)

![Parabola graph](image2)

22.) Divide both sides by 144 to put it in the form we need. You will get: \[\frac{y^2}{16} + \frac{x^2}{9} = 1\]

Now, we recognize that this is a: Ellipse, Center \((0, 0),\) y-intercepts \((0, \pm 4),\) x-intercepts \((\pm 3, 0)\)

![Ellipse graph](image3)
23.) Hyperbola, Center \((0, 0)\), x-intercepts \((\pm 3, 0)\), no y-intercept

24a.) Circle, Center \((7, 2)\), radius \(r = 2\)

24b.) Horizontal Parabola, Vertex \((-1, -3)\), y-intercepts are \((0, -2)\) and \((0, -4)\)
24c.) Divide both sides by 100 to get: \( \frac{y^2}{25} - \frac{x^2}{4} = 1 \). Now, we recognize that this is a:

Hyperbola, Center \((0, 0)\), y-intercepts \((0, \pm 5)\), no x-intercept

24d.) Ellipse, Center \((0, 0)\), x-intercepts \((\pm 4, 0)\), y-intercepts \((0, \pm 2)\)

24e.) Rewrite it: \( x^2 + y^2 - 10y + 9 = 0 \rightarrow x^2 + (y^2 - 10y + 25) = -9 + 25 \rightarrow x^2 + (y - 5)^2 = 16 \)

Now, we recognize this as a: Circle, Center \((0, 5)\), \(r = 4\)
25.) \((x + 4)^2 + (y - 3)^2 = 75\)

26a.) \((0, -2)\) and \((-2, 0)\)

26b.) \((-5, 25)\) and \((2, 4)\)

26c.) \((-2, 0)\) and \((2, 0)\)

27a.)

27b.)

27c.)
28a.)

28b.)

28c.)