1) Simplify each expression.
   a. \((2x^3 - 1)^3 \left(\frac{4}{3}(x^3 - 4)^{1/3}(3x^2) + (x^3 - 4)^{4/3}(3)(2x^3 - 1)^2(6x^2)\right)\)
   b. \(\frac{(3x+5)^{2/3}(-3)(x+4)^{-4} - (x+4)^{-3}\left(\frac{2}{3}\right)(3x+5)^{-1/3}(3)}{(3x+5)^{4/3}}\)
   c. \(\left(\frac{1}{2}\right)(5x^2 + 3)^{-3/2}(2x)(7x + 2)^{3/2} + (5x^2 + 3)^{-1/2}\left(\frac{3}{2}\right)(7x + 2)^{1/2}(7)\)

2) Solve each inequality. Express the solution set using interval notation.
   a. \(\frac{2}{x-1} \leq 3x + 2\)
   b. \(x^2 + 2x > 15\)
   c. \(4x^2 + 8x < 5\)
   d. \(\frac{6}{x-3} < \frac{3}{x+1}\)
   e. \(-2 \leq 4 - 6x < 22\)

3) Given \(f(x) = 2x^2 + 7x + 5\), find:
   a. \(f(0)\)
   b. \(f(-2)\)
   c. \(f\left(\sqrt{x}\right)\)
   d. \(f(2t)\)
   e. \(f(a + 3)\)
   f. \(f(-x)\)

4) Find the difference quotient \(\frac{f(x+h)-f(x)}{h}\). Simplify your answer.
   a. \(f(x) = 2x^2 - 3x + 1\)
   b. \(f(x) = \frac{3}{x}\)
   c. \(f(x) = \sqrt{x - 5}\)
   d. \(f(x) = \frac{x+7}{3x}\)

5) State the domain of each function.
   a. \(f(x) = \frac{x+5}{x^2-2x-35}\)
   b. \(f(x) = \sqrt{16 - x^2}\)
   c. \(f(x) = \frac{x+5}{\sqrt{x^2-9}}\)
   d. \(f(x) = \frac{4}{\sqrt{x+2}}\left(\frac{x-9}{x+2}\right)\)
   e. \(f(x) = \frac{\sqrt{x}}{\sqrt{16-x^2}}\)

6) Solve for \(x\): \(f(x) = \frac{7x^3-21x^2-70x}{7x} = 0\)
7) Graph: \( f(x) = \begin{cases} x^2 + 2, & x < 0 \\ \sqrt{x + 4}, & x \geq 0 \end{cases} \)

8) Express \(|x + 4|\) as a piecewise-defined function.

9) Graph each function. Identify any transformations from the parent function.
   a. \( f(x) = 3|x - 2| \)
   b. \( f(x) = -(x + 5)^2 + 2 \)
   c. \( f(x) = \frac{1}{3} (x + 2)^3 - 2 \)
   d. \( f(x) = -\sqrt{5 - x} + 3 \)
   e. \( f(x) = \lfloor x \rfloor + 3 \)

10) Given \( f(x) = x^2 - 5 \) and \( g(x) = \sqrt{x + 3} \), find:
    a. \((f + g)(6)\)
    b. \((g - f)(-3)\)
    c. \((f \circ g)(5)\)
    d. \((f \circ g)(x)\)
    e. The domain of \( (f \circ g)(x) \)

11) Given \( f(x) = \sqrt{x^2 + 2} \) and \( g(x) = x - 5 \), find:
    a. \((g \circ f)(5)\)
    b. \((f \circ g)(x)\)
    c. \((f \circ f)(x)\)

12) Determine whether the function has an inverse. If so, find the inverse, and state the domain and range of \( f \) and \( f^{-1} \).
    a. \( f(x) = \frac{x + 7}{x - 3} \)
    b. \( f(x) = \sqrt{x} - 1 \)
    c. \( f(x) = \frac{x^2 - 4}{7} \)
    d. \( f(x) = |x + 3| \)
    e. \( f(x) = \frac{1}{x} \)

13) Given \( f(x) = x^3 - 7 \) and \( g(x) = \sqrt[3]{x + 7} \), show that \( f \) and \( g \) are inverse functions.

14) Write the standard form of the equation of the parabola that has the indicated vertex and whose graph passes through the given point.
    a. Vertex: \((3,2)\) Point: \((6,29)\)
    b. Vertex: \((2, -3)\) Point: \((4, -15)\)

15) Given the function: \( f(x) = \frac{1}{5}x^2 - 4x + 15 \)
    a. Identify the vertex, axis of symmetry, and intercepts.
    b. Sketch the graph of \( y = f(x) \).
16) Sketch the graph of each polynomial.
   a. \( f(x) = x^4 - 10x^2 + 9 \)
   b. \( f(x) = 3x^3 - 4x^2 \)
   c. \( f(x) = (x^2 - 9)(3x^2 - 4x - 4) \)

17) Perform the operation and write the result in standard form \((a + bi)\).
   a. \( (3 + 2i)(7 + i) \)
   b. \( \frac{2}{4-i} + \frac{4}{3+i} \)

18) Simplify the complex number and write it in standard form \((a + bi)\).
   \[5i^4 + 3i^2 + 7i^2 - i\]

19) Divide. Express your answer in the form: \(\text{quotient} + \frac{\text{remainder}}{\text{divisor}}\).
   a. \( (x^4 - 4x^3 + x^2 + 10x - 8) \div (x^2 + 4) \)
   b. \( (x^3 - 1) \div (x - 1) \)

20) Find all the real zeros of each polynomial function and determine its multiplicity.
   a. \( f(x) = x^4 - 3x^2 - 4 \)
   b. \( f(x) = x^3 - 4x^2 + 4x \)

21) Find all solutions of the polynomial equation.
   a. \( x^4 - x^3 - 6x^2 + 4x = -8 \)
   b. \( x^4 - 13x^2 = -36 \)
   c. \( x^4 - 16 = 0 \)

22) Use the given zero to find all the zeros of the function.
   \[\text{Function: } f(x) = x^3 - 2x^2 + x - 2 \quad \text{zero: } i\]

23) Find the simplest polynomial of degree three with real coefficients that has \textbf{zeros:} \(1, 3i\)

24) Find all the zeros of the polynomial and write the result as a product of linear factors.
   a. \( f(x) = x^3 + 2x^2 - 5x - 6 \)
   b. \( f(x) = x^4 - 3x^3 - 12x - 16 \)
   c. \( f(x) = x^4 - 39x^2 - 70x \)

25) State the domain of the function. Identify any asymptotes and intercepts.
   a. \( f(x) = \frac{x-3}{x^2-9} \)
   b. \( f(x) = \frac{x^2}{x-1} \)
   c. \( f(x) = \frac{x^2+5x-2}{x^2+x+2} \)
26) **Exponential Growth**: The world population \( P \) (in billions) was 6.4 in 2005. The exponential growth rate \( k \) was 1.2% per year.

   a. Find the exponential growth function for the population \( (P = P_0e^{kt}, \ k > 0) \).
   b. Find the world population in 2008.
   c. When will the world population be 8 billion? 9 billion?
   d. Find the time for the world population to double in size.

27) **Radioactive Decay**: Let \( Q \) represent a mass of carbon 14 (in grams) whose half-life is 5,730 years. The quantity of carbon 14 present after \( t \) years is given by the model \( Q = Q_0 \left( \frac{1}{2} \right)^{\frac{t}{5730}} \)

   a. Determine the initial quantity.
   b. Determine the quantity present after 5,730 years.
   c. Determine the quantity present after 40,110 years.

28) **Radioactive Decay**: The initial quantity present of carbon 14 is 800 grams. If this substance has a half-life of 5,730 years,

   a. Find the formula for the quantity present \( (Q = Q_0e^{kt}) \).
   b. Find the amount of substance present after 150 years.

29) Sketch the graph of each function. Find the domain and any asymptotes.

   a. \( f(x) = -\left(\frac{1}{2}\right)^{x-5} + 3 \)
   b. \( f(x) = 1 - \log(x + 6) \)
   c. \( f(x) = -\log_3(7 - x) + 3 \)
   d. \( f(x) = \frac{1}{2}e^{-x} \)
   e. \( f(x) = \ln(2x) \)
   f. \( f(x) = -3\ln(x - 4) \)

30) Condense each expression.

   a. \( \frac{1}{2} \ln(4x - 3) - 3\ln(x + 3) + 2\ln(2x - 3) - 5 \ln x \)
   b. \( \frac{1}{3} [\ln x + 3 \ln x - 2\ln(x + 5)] \)
   c. \( \frac{1}{3} \log 27 - \frac{1}{2} \log y - \log z \)

31) Expand each expression.

   a. \( \log \left(\frac{\sqrt{2x^3}}{y^2z^2}\right) \)
   b. \( \ln \left(\frac{3 \sqrt{(x-5)y}}{3z}\right) \)
   c. \( \ln \left(\frac{5x+z}{xy}\right)^3 \)
32) Solve for x.
   
   a. \( x = \log_5 25 \)

   b. \( x = \log_8 2 \)

   c. \( 2 = \log x \)

   d. \( 2^x = 8 \)

   e. \( 3^2(3^x) = \frac{1}{27} \)

   f. \( 3(2^{3x-7}) + 1 = 49 \)

   g. \( 2^{3x-7} = 4^{x-3} \)

   h. \( \log_5 x - 2\log_5 2 = 3 \)

   i. \( \log_4(2x + 7) + \log_4 x = 1 \)

   j. \( \ln x^2 - \ln 5 = \ln 20 \)

   k. \( 2\ln \sqrt{x} + 2 = 2 \)

   l. \( \ln x^4 + \ln x^2 - \ln x^3 - 2 = 7 \)

   m. \( \ln \frac{1}{e} + x = 5 \)

   n. \( \frac{1}{3} \ln e^{3x} - 3e^{\ln x} = 12 \)

   o. \( e^{2x} - 3e^x - 18 = 0 \)

   p. \( e^{2x+6} = \left(\frac{1}{e}\right)^{-x^2-3x} \)

33) **Compound Interest**: You own a credit card that charges an annual interest rate of 16%, compounded continuously. \((A = Pe^{rt})\)

   a. Given the initial balance of $10,000, find your balance after 7 years.

   b. How much time will it take for your debt to double?

34) **Depreciation**: A car is worth $12,000. Five years ago the car was brand new and worth $25,000.

   a. Find a linear model of depreciation \(V = mt + b\), where \(V\) is the value of the car after \(t\) years.

   b. Find an exponential model of depreciation \(V = ae^{kt}\)

35) Determine the **exact** values of the six trigonometric functions of the indicated angle.

   a. \( \theta = 2\pi \)

   b. \( \theta = \frac{3\pi}{4} \)

   c. \( \theta = \frac{2\pi}{3} \)

   d. \( \theta = -\pi \)

   e. \( \theta = -\frac{\pi}{3} \)

   f. \( \theta = \frac{7\pi}{6} \)
36) Find the values of the six trigonometric functions of the angle \( \theta \) using the right triangles:

\[ g. \quad \theta = -\frac{5\pi}{4} \quad h. \quad \theta = -\frac{13\pi}{6} \quad i. \quad \theta = -\frac{3\pi}{2} \]

37) Find the remaining five trigonometric functions of \( \theta \) satisfying the indicated condition.

\[ a. \quad \tan \theta = 1; \ \theta \text{ lies in quadrant III} \]
\[ b. \quad \cos \theta = -\frac{\sqrt{3}}{2}; \ \theta \text{ lies in quadrant II} \]
\[ c. \quad \sec \theta = -\frac{5}{2}; \ \sin \theta > 0 \]
\[ d. \quad \cot \theta = \sqrt{3}; \ \cos \theta > 0 \]

38) Find the amplitude, period, and phase shift.

\[ a. \quad y = 5 \sin 2x \quad c. \quad y = -3 \cos(2x - \pi) + 1 \]
\[ b. \quad y = -\pi \sin \left(\frac{\pi x}{4}\right) \quad d. \quad y = -\tan \left(x + \frac{\pi}{4}\right) \]

39) Sketch the graph of each function. Include two full periods. Label any asymptotes and find the domain of the trigonometric function.

\[ a. \quad y = 5 - \sin 2x \]
\[ b. \quad y = 3 \sin \pi x \]
\[ c. \quad y = -3 \sin(2x - \pi) + 1 \]
\[ d. \quad y = 2 \cos 2x - 2 \]
\[ e. \quad y = 3 + \cos \left(\frac{\pi x}{4}\right) \]
\[ f. \quad y = \tan \left(\frac{\pi x}{2}\right) \]
\[ g. \quad y = -\tan \left(x - \frac{\pi}{3}\right) \]
\[ h. \quad y = 4 \cot \left(\frac{\pi x}{4}\right) \]
\[ i. \quad y = 2 \csc \left(x + \frac{\pi}{4}\right) \]
\[ j. \quad y = 3 \sec(\pi - x) \]
40) Verify each identity.
   a. \( \tan^2 \theta \sec^2 \theta = \frac{\sin^2 \theta}{\cos^4 \theta} \)
   b. \( \sin^2 \theta \cot \theta + \frac{\cos^3 \theta}{\sin \theta} = \cot \theta \)
   c. \( \frac{\sec^2 \theta}{\csc^2 \theta} = \sec^2 \theta - 1 \)
   d. \( \cos \theta \sin \theta + \cos^3 \theta \csc \theta = \cos \theta \csc \theta \)

41) Solve for \( x \) on the interval \([0, 2\pi]\).
   a. \( \sin 2x + \cos x = 0 \)
   b. \( 5\sin^2 x + 12 \sin x + 7 = 0 \)
   c. \( 4\cos^2 x - 3 = 0 \)
   d. \( \cos \left( x - \frac{\pi}{2} \right) \left[ 3 \tan \left( x - \frac{\pi}{2} \right) \right] = 3 \)
   e. \( \tan^2 x - 3 = 0 \)
   f. \( \frac{\sec x}{\csc x} = 1 \)

42) Solve for \( x \) on the interval \([0, \pi]\).
   a. \( 5 \cos x + 3 = 8 \)
   b. \( \sin x \tan x - \sqrt{3} \sin x = 0 \)
   c. \( 2 \sin 3x - 1 = 0 \)
   d. \( \frac{\sec^2 x - 1}{\sin^2 x} = 2 \)

43) Solve for \( x \). Give all solutions.
   a. \( \sin x = \frac{1}{2} \)
   b. \( \cos x = -\frac{\sqrt{2}}{2} \)
   c. \( \tan x = \sqrt{3} \)
   d. \( \sec x = -1 \)

44) Evaluate each expression.
   a. \( \sin^{-1} \left( \frac{\sqrt{3}}{2} \right) \)
b. \( \arccos\left(\frac{1}{2}\right) \)

c. \( \tan^{-1}(1) \)

d. \( \arcsin(-1) \)

e. \( \arctan(0) \)

f. \( \cos^{-1}\left(-\frac{\sqrt{3}}{2}\right) \)

g. \( \sin\left[\arccos\left(-\frac{3}{5}\right)\right] \)

h. \( \tan\left[\sin^{-1}\left(\frac{5}{13}\right)\right] \)

i. \( \csc\left[\tan^{-1}x\right] \)

j. \( \arccos\left[\cos\left(-\frac{\pi}{4}\right)\right] \)

k. \( \sin\left(\arcsin\frac{2}{3}\right) \)

45) Simplify each expression.

a. \( \sin(\pi + \theta) \)

b. \( \cos\left(\frac{\pi}{2} - \theta\right) \)

46) Find the exact values of \( \sin 2u, \cos 2u, \sin\frac{u}{2}, \cos\frac{u}{2} \), given:

a. \( \cos u = \frac{4}{5} \) where \( \frac{3\pi}{2} < u < 2\pi \)

b. \( \sin u = \frac{12}{13} \) where \( 0 < u < \frac{\pi}{2} \)

c. \( \tan u = -1 \) where \( \frac{\pi}{2} < u < \pi \)

d. \( \sin u = -\frac{12}{13} \) where \( \pi < u < \frac{3\pi}{2} \)

47) Use the power reducing formulas to express \( \cos^2\theta \) in terms of the first power of cosine.
48) Solve for the missing angles and sides using a calculator. The diagram below is not drawn to scale.

\[ \triangle ABC \]
\[ a \quad b \quad c \]
\[ A \quad C \quad B \]

\[ B = 4^\circ, A = 25^\circ, c = 5 \]  \[ C = 42^\circ, a = 21, c = 15 \]
\[ A = 13^\circ, a = 21, b = 13 \]  \[ a = 10, b = 20, c = 14 \]

49) A person casts a shadow that is 8 ft long. The angle of elevation from the tip of the shadow to the person’s head is 35°. How tall is the person.

50) A 10 foot ladder is resting against a house. The top of the ladder is 7 feet from the ground. Find the angle the ladder makes with the ground.

51) A tree is growing in a field that is slanted 7° from the vertical axis. At this moment in time, the tree is leaning towards the sun casting a shadow 50 meters long. The angle between the tip of the shadow and the top of the tree is 27°.

   a. Draw a diagram representing the problem.
   b. Find the height of the tree.

52) A person is standing 250 feet from the base of a tall building. The angle of elevation to the top of the building is 63°. The angle of elevation to the top of the antenna located on the roof of the building is 68°. How tall is the antenna?
1. 
   a. \(2x^2(2x^3 - 1)^2(x^3 - 4)^{1/3}(13x^3 - 38)\)  
   b. \(-\frac{(11x+23)}{(x+4)^4(3x+5)^{5/3}}\)  
   c. \(\frac{(7x+2)^{1/2}(91x^2-4x+63)}{2(5x^2+3)^{3/2}}\)

2. 
   a. \([-1,1) \cup \left[\frac{4}{3}, \infty\right)\)  
   b. \((-\infty, -5) \cup (3, \infty)\)  
   c. \(\left(-\frac{3}{2}, \frac{1}{2}\right)\)  
   d. \((-\infty, -5) \cup (-1,3)\)  
   e. \((-3,1]\)

3. 
   a. \(f(0) = 5\)  
   b. \(f(-2) = -1\)  
   c. \(f(\sqrt{y}) = 2y + 7\sqrt{y} + 5\)  
   d. \(f(2t) = 8t^2 + 14t + 5\)  
   e. \(f(a + 3) = 2a^2 + 19a + 44\)  
   f. \(f(-x) = 2x^2 - 7x + 5\)

4. 
   a. \(4x + 2h - 3\)  
   b. \(-\frac{3}{x(x+h)}\)  
   c. \(\frac{1}{\sqrt{x+h-5} + \sqrt{x-5}}\)  
   d. \(-\frac{7}{3x(x+h)}\)

5. 
   a. Domain: \((-\infty, -5) \cup (-5,7) \cup (7, \infty)\) or \(\{x|x \neq -5\ and \ x \neq 7\}\)  
   b. Domain: \([-4,4]\) or \(\{x|-4 \leq x \leq 4\}\)  
   c. Domain: \((-\infty, -3) \cup (3, \infty)\) or \(\{x|x < -3 \ or \ x > 3\}\)  
   d. Domain: \((-\infty, -2) \cup [9, \infty)\) or \(\{x|x < -2 \ or \ x \geq 9\}\)  
   e. Domain: \([0,4]\) or \(\{x|0 \leq x < 4\}\)

6. \(x = -2, 5\)
7. 

8. \(|x + 4| = \begin{cases} 
  x + 4, & x \geq -4 \\
  -x - 4, & x < -4 
\end{cases}\)

9. 

a. *vertical stretch; shift right 2*

Parent function is \(y = |x|\)
b. *reflection in x axis; shift left 5; shift up 2*
Parent function is $y = x^2$

c. *vertical shrink; shift left 2; shift down 2*
Parent function is $y = x^3$
d. *reflection in x axis; shift right 5; reflection in y axis; shift up 3*
Parent function is \( y = \sqrt{x} \)

10.

a. 34
b. -4
c. 40\(\sqrt{2}\)
d. \( \frac{x^2-5}{\sqrt{x^2+3}} \) or \( \frac{(x^2-5)(\sqrt{x^2+3})}{x+3} \)
e. *Domain: \((-3, \infty)\) or \(\{x \mid x > -3\}\)*
11. 
   a. $3\sqrt{3} - 5$
   b. $\sqrt{x^2 - 10x + 27}$
   c. $\sqrt{x^2 + 4}$

12. 
   a. **Inverse exists**
      
      \[
      f^{-1}(x) = \frac{3x + 7}{x - 1}
      \]
      
      Domain $f(x): (-\infty, 3) \cup (3, \infty)$ or $\{x \mid x \neq 3\}$
      
      Range $f(x): (-\infty, 1) \cup (1, \infty)$ or $\{y \mid y \neq 1\}$
      
      Domain $f^{-1}(x): (-\infty, 1) \cup (1, \infty)$ or $\{x \mid x \neq 1\}$
      
      Range $f^{-1}(x): (-\infty, 3) \cup (3, \infty)$ or $\{y \mid y \neq 3\}$
   
   b. **Inverse exists**
      
      \[
      f^{-1}(x) = x^2 + 2x + 1
      \]
      
      Domain $f(x): [0, \infty)$ or $\{x \mid x \geq 0\}$
      
      Range $f(x): [-1, \infty)$ or $\{y \mid y \geq -1\}$
      
      Domain $f^{-1}(x): [-1, \infty)$ or $\{x \mid x \geq -1\}$
      
      Range $f^{-1}(x): [0, \infty)$ or $\{y \mid y \geq 0\}$
   
   c. **no inverse**
   
   d. **no inverse**
   
   e. **Inverse exists**
      
      \[
      f^{-1}(x) = \frac{1}{x}
      \]
      
      Domain $f(x): (-\infty, 0) \cup (0, \infty)$ or $\{x \mid x \neq 0\}$
      
      Range $f(x): (-\infty, 0) \cup (0, \infty)$ or $\{y \mid y \neq 0\}$
      
      Domain $f^{-1}(x): (-\infty, 0) \cup (0, \infty)$ or $\{x \mid x \neq 0\}$
      
      Range $f^{-1}(x): (-\infty, 0) \cup (0, \infty)$ or $\{y \mid y \neq 0\}$

13. \((f \circ g)(x) = f(g(x)) = f(\sqrt[3]{x + 7}) = (\sqrt[3]{x + 7})^3 - 7 = (x + 7) - 7 = x\)

   \((g \circ f)(x) = g(f(x)) = g(x^3 - 7) = \sqrt[3]{(x^3 - 7) + 7} = \sqrt[3]{x^3} = x\)

14. 
   a. $y = 3(x - 3)^2 + 2$
   b. $y = -3(x - 2)^2 - 3$

15. 
   a. **vertex:** (10, -5)
      
      **axis of symmetry:** $x = 10$
      
      **y intercept:** (0,15)
      
      **x intercepts:** (5,0) and (15,0)
b. 16. 

a.
17.  
   a. $19 + 17i$  
   b. $\frac{142}{85} = \frac{24}{85}$

18. $-2 - 4i$

19.  
   a. $x^2 - 4x - 3 + \frac{26x + 4}{x^2 + 4}$  
   b. $x^2 + x + 1$

20.  
   a. $x = 2; \text{multiplicity} = 1$  
   $x = -2; \text{multiplicity} = 1$  
   b. $x = 2; \text{multiplicity} = 2$
21. 
   a. \( x = -2, -1, 2 \) 
   b. \( x = -3, -2, 2, 3 \) 
   c. \( x = -2, 2, -2i, 2i \) 

22. \( x = 2, i, -i \) 

23. \( x^3 - x^2 + 9x - 9 \) 

24. 
   a. zeros: \( x = -3, -1, 2 \) 
      \[ f(x) = (x + 1)(x - 2)(x + 3) \] 
   b. zeros: \( x = -1, 4, -2i, 2i \) 
      \[ f(x) = (x + 1)(x - 4)(x - 2i)(x + 2i) \] 
   c. zeros: \( x = -5, -2, 0, 7 \) 
      \[ f(x) = x(x + 2)(x + 5)(x - 7) \] 

25. 
   a. \( \text{Domain: } (-\infty, -3) \cup (-3, 3) \cup (3, \infty) \) or \( \{x | x \neq -3 \text{ and } x \neq 3\} \) 
      vertical asymptote: \( x = -3 \) 
      horizontal asymptote: \( y = 0 \) 
      \[ y \text{ intercept: } \left(0, \frac{1}{3}\right) \] 
      \( x \text{ intercept: none} \) 
   b. \( \text{Domain: } (-\infty, 1) \cup (1, \infty) \) or \( \{x | x \neq 1\} \) 
      vertical asymptote: \( x = 1 \) 
      slant asymptote: \( y = x + 1 \) 
      \[ y \text{ intercept: } (0, 0) \] 
      \( x \text{ intercept: } (0, 0) \) 
   c. \( \text{Domain: All Real Numbers} \) 
      horizontal asymptote: \( y = 1 \) 
      \[ y \text{ intercept: } (0, -1) \] 
      \[ x \text{ intercepts: } \left(-\frac{5 + \sqrt{33}}{2}, 0\right) \text{ and } \left(-\frac{5 - \sqrt{33}}{2}, 0\right) \] 

26. 
   a. \( P = 6.4e^{.012t} \) 
   b. \( P = 6.4e^{.036} \approx 6.63 \text{ billion} \) 
   c. \( 2024 \text{ and } 2033 \) 
   d. \( t = \frac{\ln 2}{.012} \approx 58 \text{ years} \) 

27. 
   a. \( Q = Q_0 \) 
   b. \( Q = \frac{1}{2}Q_0 \) 
   c. \( Q = \frac{1}{128}Q_0 \)
28.

a. \( Q = 800e^{-0.000121t} \)

b. \( Q \approx 785.6 \text{ grams} \)

29. Graphs

a. Domain: All Real Numbers

b. Domain: \((-6, \infty)\) or \(\{x | x > -6\}\)
c. \( Domain: (-\infty, 7) \) or \( \{x | x < 7\} \)

d. \( Domain: All \ Real \ Numbers \)
30.

a. \( \ln \left[ \frac{(4x-3)^{1/2}(2x-3)^2}{x^5(x+3)^3} \right] \)

b. \( \ln \left[ \frac{x^4}{(x+5)^2} \right]^{1/3} \) or \( \ln \left[ \frac{x^{4/3}}{(x+5)^{2/3}} \right] \)

c. \( \log \left[ \frac{3}{y^{1/2}z} \right] \)

31.

a. \( \frac{1}{2} \log 2 + \frac{3}{2} \log x - \log y - 2 \log z \)

b. \( \frac{1}{3} \left[ \ln(x - 5) + \ln y - \ln 3 - \ln z \right] \)
c. \(3[\ln(5x + z) - \ln x - \ln y]\)

32.

a. \(x = 2\)
b. \(x = \frac{1}{3}\)
c. \(x = 100\)
d. \(x = 3\)
e. \(x = -5\)
f. \(x = \frac{11}{3}\)
g. \(x = 1\)
h. \(x = 500\)
i. \(x = \frac{1}{2}\)
j. \(x = -10, 10\)
k. \(x = 1\)
l. \(x = e^3\)
m. \(x = 6\)
n. no solution
o. \(x = \ln 6\)
p. \(x = -3, 2\)

33.

a. \(A \approx 30,648.54\)
b. \(t \approx 4.33\) years

34.

a. \(V = -2600t + 25000\)
b. \(V = 25000e^{-0.147t}\)

35.

a. \(\sin \theta = 0; \cos \theta = 1; \tan \theta = 0; \csc \theta = \text{undefined}; \sec \theta = 1; \cot \theta = \text{undefined}\)
b. \(\sin \theta = \frac{\sqrt{2}}{2}; \cos \theta = -\frac{\sqrt{2}}{2}; \tan \theta = -1; \csc \theta = \sqrt{2}; \sec \theta = -\sqrt{2}; \cot \theta = -1\)
c. \(\sin \theta = \frac{-\sqrt{3}}{2}; \cos \theta = -\frac{1}{2}; \tan \theta = -\sqrt{3}; \csc \theta = \frac{2\sqrt{3}}{3}; \sec \theta = -2; \cot \theta = -\frac{\sqrt{3}}{3}\)
d. \(\sin \theta = 0; \cos \theta = -1; \tan \theta = 0; \csc \theta = \text{undefined}; \sec \theta = -1; \cot \theta = \text{undefined}\)
e. \(\sin \theta = -\frac{\sqrt{3}}{2}; \cos \theta = \frac{1}{2}; \tan \theta = -\sqrt{3}; \csc \theta = -\frac{2\sqrt{3}}{3}; \sec \theta = 2; \cot \theta = -\frac{\sqrt{3}}{3}\)
f. \(\sin \theta = -\frac{1}{2}; \cos \theta = -\frac{\sqrt{3}}{2}; \tan \theta = \frac{\sqrt{3}}{3}; \csc \theta = -2; \sec \theta = -\frac{2\sqrt{3}}{3}; \cot \theta = \sqrt{3}\)
g. \(\sin \theta = \frac{-\sqrt{2}}{2}; \cos \theta = -\frac{\sqrt{2}}{2}; \tan \theta = -1; \csc \theta = \sqrt{2}; \sec \theta = -\sqrt{2}; \cot \theta = -1\)
h. \(\sin \theta = -\frac{1}{2}; \cos \theta = \frac{\sqrt{3}}{2}; \tan \theta = -\frac{\sqrt{3}}{3}; \csc \theta = -2; \sec \theta = \frac{2\sqrt{3}}{3}; \cot \theta = -\sqrt{3}\)
i. \(\sin \theta = 1; \cos \theta = 0; \tan \theta = \text{undefined}; \csc \theta = 1; \sec \theta = \text{undefined}; \cot \theta = 0\)

36.

a. \(\sin \theta = \frac{4}{5}; \cos \theta = \frac{3}{5}; \tan \theta = \frac{4}{3}; \csc \theta = \frac{5}{4}; \sec \theta = \frac{5}{3}; \cot \theta = \frac{3}{4}\)
b. \(\sin \theta = \frac{9\sqrt{111}}{181}; \cos \theta = \frac{10\sqrt{111}}{181}; \tan \theta = \frac{9}{10}; \csc \theta = \frac{\sqrt{111}}{9}; \sec \theta = \frac{\sqrt{111}}{10}; \cot \theta = \frac{10}{9}\)
37.  
   a. \( \sin \theta = -\frac{\sqrt{2}}{2}; \cos \theta = -\frac{\sqrt{2}}{2}; \tan \theta = 1; \csc \theta = -\sqrt{2}; \sec \theta = -\sqrt{2}; \cot \theta = 1 \)
   b. \( \sin \theta = \frac{1}{2}; \cos \theta = -\frac{\sqrt{3}}{2}; \tan \theta = -\frac{\sqrt{3}}{3}; \csc \theta = 2; \sec \theta = -\frac{2\sqrt{3}}{3}; \cot \theta = -\sqrt{3} \)
   c. \( \sin \theta = \frac{\sqrt{21}}{5}; \cos \theta = -\frac{2}{5}; \tan \theta = -\frac{\sqrt{21}}{2}; \csc \theta = \frac{5\sqrt{21}}{21}; \sec \theta = -\frac{5}{2}; \cot \theta = -\frac{2\sqrt{21}}{21} \)
   d. \( \sin \theta = \frac{1}{2}; \cos \theta = \frac{\sqrt{3}}{2}; \tan \theta = \frac{\sqrt{3}}{3}; \csc \theta = 2; \sec \theta = \frac{2\sqrt{3}}{3}; \cot \theta = \sqrt{3} \)
38.  
   a. \textbf{Amplitude} = 5; \textbf{Period} = \pi; \textbf{Phase Shift} = 0
   b. \textbf{Amplitude} = \pi; \textbf{Period} = 8; \textbf{Phase Shift} = 0
   c. \textbf{Amplitude} = 3; \textbf{Period} = \pi; \textbf{Phase Shift} = +\frac{\pi}{2}

39.  
   a.  
   \begin{align*}
   \text{Domain: All Real Numbers}
   \end{align*}
b.  \( \text{Domain: All Real Numbers} \)

c.  \( \text{Domain: All Real Numbers} \)
d. Domain: All Real Numbers

e. Domain: All Real Numbers
f. \[ \text{Domain: } \{ x \mid x \neq n\pi \text{ where } n \text{ is an odd integer} \} \]

g. \[ \text{Domain: } \{ x \mid x \neq \frac{\pi(3n+2)}{6} \text{ where } n \text{ is an odd integer} \} \]
h. \[ h(x) = \frac{1}{x} \]

Domain: \( \{ x \mid x \neq 4n \text{ where } n \text{ is an integer} \} \)

i. \[ i(x) = \frac{1}{\sqrt{x}} \]

Domain: \( \{ x \mid x \neq \frac{\pi (4n-1)}{4} \text{ where } n \text{ is an integer} \} \)
40.  
   \( \tan^2 \theta \sec^2 \theta = (\frac{\sin^2 \theta}{\cos^2 \theta})(\frac{1}{\cos^2 \theta}) = \frac{\sin^2 \theta}{\cos^2 \theta} \)
   
   \( \sin^2 \theta \cot \theta + \frac{\cos^3 \theta}{\sin \theta} = \sin^2 \theta \left( \frac{\cos \theta}{\sin \theta} \right) + \frac{\cos^3 \theta}{\sin \theta} = \frac{\sin^2 \theta \cos \theta}{\sin \theta} + \frac{\cos^3 \theta}{\sin \theta} = \frac{\sin^2 \theta \cos \theta + \cos^3 \theta}{\sin \theta} = \)
   
   \( \frac{\cos \theta (\sin^2 \theta + \cos^2 \theta)}{\sin \theta} = \frac{\cos \theta}{\sin \theta} = \cot \theta \)
   
   \( \sec^2 \theta \csc^2 \theta = \frac{1}{\sin^2 \theta} = \frac{\sin^2 \theta}{\cos^2 \theta} = \tan^2 \theta = \sec^2 \theta - 1 \)
   
   \( \cos \theta \sin \theta + \cos^3 \theta \csc \theta = \cos \theta \sin \theta + \frac{\cos^3 \theta}{\sin \theta} = \frac{\cos \theta \sin^2 \theta}{\sin \theta} + \frac{\cos^3 \theta}{\sin \theta} = \frac{\cos \theta \sin^2 \theta + \cos^3 \theta}{\sin \theta} = \frac{\cos \theta}{\sin \theta} = \cos \theta \csc \theta \)

41.  
   a.  \( x = \frac{\pi}{2}, \frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6} \)
   
   b.  \( x = \frac{3\pi}{2} \)
   
   c.  \( x = \frac{\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6} \)
   
   d.  \( x = \text{no solution} \)
   
   e.  \( x = \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3} \)
   
   f.  \( x = \frac{3\pi}{4}, \frac{5\pi}{4} \)

42.  
   a.  \( x = 0 \)
   
   b.  \( x = 0, \frac{\pi}{3}, \pi \)
   
   c.  \( x = \frac{\pi}{18}, \frac{13\pi}{18}, \frac{17\pi}{18} \)
   
   d.  \( x = \frac{3\pi}{4}, \frac{5\pi}{4} \)
43. 
   a. \( x = \frac{\pi}{6} + 2n\pi, \frac{5\pi}{6} + 2n\pi \) where \( n \) is an integer
   b. \( x = \frac{3\pi}{4} + 2n\pi, \frac{5\pi}{4} + 2n\pi \) where \( n \) is an integer
   c. \( x = \frac{\pi}{3} + n\pi \) where \( n \) is an integer
   d. \( x = n\pi \) where \( n \) is an odd integer

44. 
   a. \( \frac{\pi}{3} \)
   b. \( \frac{\pi}{3} \)
   c. \( \frac{\pi}{4} \)
   d. \( -\frac{\pi}{2} \)
   e. 0
   f. \( \frac{5\pi}{6} \)
   g. \( \frac{\pi}{4} \)
   h. \( \frac{5}{12} \)
   i. \( \frac{\sqrt{x^2 + 1}}{x} \)
   j. \( \frac{\pi}{4} \)
   k. \( \frac{2}{3} \)

45. 
   a. \(-\sin \theta\)
   b. \(\sin \theta\)

46. 
   a. \( \sin 2u = -\frac{24}{25}; \cos 2u = \frac{7}{25}; \sin \frac{u}{2} = \frac{\sqrt{10}}{10}; \cos \frac{u}{2} = -\frac{3\sqrt{10}}{10} \)
   b. \( \sin 2u = \frac{120}{169}; \cos 2u = -\frac{119}{169}; \sin \frac{u}{2} = \frac{2\sqrt{3}}{13}; \cos \frac{u}{2} = \frac{3\sqrt{3}}{13} \)
   c. \( \sin 2u = -1; \cos 2u = 0; \sin \frac{u}{2} = \frac{\sqrt{2 + \sqrt{2}}}{2}; \cos \frac{u}{2} = \frac{\sqrt{2 - \sqrt{2}}}{2} \)
   d. \( \sin 2u = \frac{120}{169}; \cos 2u = -\frac{119}{169}; \sin \frac{u}{2} = \frac{3\sqrt{3}}{13}; \cos \frac{u}{2} = -\frac{2\sqrt{3}}{13} \)

47. \( \cos^2 \theta = \frac{1 + \cos 2\theta}{2} \)

48. Answers may vary in last decimal place due to rounding errors
   a. \( C = 151^\circ; a = 4.36; b = 0.72 \)
   b. \( B = 8.00^\circ; C = 159.00^\circ; c = 33.46 \)
   c. \( A = 69.52^\circ; B = 68.48^\circ; b = 20.85 \) or \( A = 110.48^\circ; B = 27.52^\circ; b = 10.36 \)
   d. \( A = 27.66^\circ; B = 111.80^\circ; C = 40.54^\circ \)

49. 5.6 ft
50. 44.4°
51.

b. 27.4 m

52. 128.1 ft