1) Find all solutions to the following equation on the interval \([-\pi, \pi]\),
\[
2 \sin^2(\theta) + 3 \sin(\theta) = -1
\]

2) Find all solutions to the following equation: \(\ln(x) + \ln(x + 1) = \ln(20)\)

3) Solve the inequalities:
   a) \(\frac{1}{x} \leq \frac{3}{x + 2}\)
   b) \(2 \sin x > 3 \cot x\) on \([0, 2\pi]\)

4) Given the functions:
   \[k(x) = \sqrt{1 - x^2}\] on \([0, 1]\), \(f(x) = e^{3x+1}\)
   a) Find \(k^{-1}(x)\).
   b) What are the domain and range of \(k^{-1}(x)\)?
   c) Find \(f^{-1}(x)\).
   d) What are the domain and range of \(f^{-1}(x)\)?

5) Write the function \(g(x)\), if \(g(x)\) is the graph of \(f(x) = (x - 1)^3 - 5\) reflected across the y-axis, reflected across the x-axis, shifted right 3 units, then down 1 unit.

6) You have a square sheet of material with 10 inch sides and want to fold it into a box (by cutting out squares from the corners). The price of the material is $2.50 per square inch. Write equations for the volume and the total cost of the box.

7) Determine if the following functions are even, odd, or neither:
   a) \(f(x) = x + \tan(x)\)
   b) \(h(x) = e^x + e^{-x}\)

8) A mysterious substance undergoes an experiment where it becomes radioactive, and decays exponentially with a half-life of 20 hours. If you start off with 18 grams of the substance, address the following...
   a) Find a formula for the amount of substance \(t\) hours after the experiment began.
   b) How much of the substance will remain after 40 hours?
   c) When will there be 12g of the substance? Leave your answer in pure form, that is, no decimals.

9) It is known that for a particular cone-shaped object, its diameter and height are always equal. Find an equation for the volume of this object in terms of its radius.
10) Find the domain of each function below:
   a) \( g(x) = \frac{|x|}{x^2} \) Also, graph this function.
   b) \( a(x) = \begin{cases} 
   x + 9 & \text{if } x < -3 \\
   -2x & \text{if } |x| \leq 3 \\
   -6 & \text{if } x > 3 
   \end{cases} \)
   c) \( f(g(x)) \) and \( g(f(x)) \) where \( f(x) = \frac{1}{\sqrt{x-1}} \) and \( g(x) = \frac{2}{x^2} \).
   d) \( f(x) = \ln \left( \frac{x-3}{x+2} \right) \)

11) Complete the following actions given the following function.
   \( f(x) = \frac{x^2 - x - 2}{|2 - x|} \)
   a) What is the domain of the function?
   b) Write the function in its piece-wise defined form.
   c) Find \( \lim_{x \to 2} f(x) \).
   d) Find \( \lim_{x \to 2} f(x) \).
   e) Find \( \lim_{x \to 2} f(x) \).
   f) Sketch the graph of \( f(x) \).

12) A strange alien projectile is thrown from the ground with an initial velocity of 25 \( ft/s \) and an acceleration of 10 \( ft/s^2 \), but the “alien-ness” provides a unique motion. Its height, \( h(t) \), after \( t \) seconds is given by:
   \[ h(t) = -10t^2 + 25t + \sqrt{t + 2} \]
   a) Find the average velocity from the time interval \([2,7]\).
   b) Find the average velocity from the time interval \([2, 2 + h]\).
   c) Use limit and part (b) to find the instantaneous velocity after 2 seconds.
   d) What would be the equation of the tangent line to \( h(t) \) at \( t = 2 \)?

13) Find the value of \( a \) for which the following piecewise function will be continuous at \( x = 1 \).
   \( f(x) = \begin{cases} 
   \frac{|x - 1|}{x^2 - 1} & \text{if } x < 1 \\
   ax^2 + 6 & \text{if } x \geq 1 
   \end{cases} \)

14) Explain why the Intermediate Value Theorem does or does not guarantee a solution of the given equation in the specified interval:
   a) \((x - 1)^4 + x - 4 = 0\) on the interval \((2,3)\)
   b) \(\tan(x) = 0\) on the interval \((\frac{\pi}{4}, \frac{3\pi}{4})\)
   c) \(\sqrt{x - 2} = 3 - x\) on the interval \((-2, -1)\)
15) Let

\[ f(x) = \begin{cases} 
  x^2 - 9 & \text{if } x < -3 \\
  x + 3 & \text{if } -3 \leq x < 1 \\
  x^2 - 2x - 8 & \text{if } x \geq 1 \\
  x^2 - 7x + 12 & \text{if } x < -3
\end{cases} \]

a) Sketch \( f(x) \).
b) Find the following limits:
\[ \lim_{x \to 1} f(x) \quad \text{and} \quad \lim_{x \to 3} f(x) \]
c) Find and describe any discontinuities of \( f(x) \).
d) If possible, make \( f(x) \) continuous at its points of discontinuity.
e) Find each interval on which \( f \) is continuous (including from the left and right).

16) Consider the function

\[ f(x) = \frac{x^2 + 2x - 8}{x^2 - 2x} \]

a) What is \( \lim_{x \to 2} f(x) \)?
b) What is \( \lim_{x \to 0^-} f(x) \)?
c) What is \( \lim_{x \to 0^+} f(x) \)?
d) What is \( \lim_{x \to 4} f(x) \)?
e) What is \( \lim_{x \to -\infty} f(x) \)?
f) Identify the removable discontinuities and vertical asymptote(s)

17) Use algebra and/or other simplification techniques to evaluate the following limits:

a) \[ \lim_{x \to 3} \frac{\sqrt{x} - \sqrt{3}}{x^2 - 9} \]
b) \[ \lim_{x \to 0} e^{\frac{1}{x}} \]
c) \[ \lim_{x \to 1} \arccos \left( \frac{\sqrt{x} - 2}{1 + \sqrt{x}} \right) \]
d) \[ \lim_{x \to 4} f(x) \quad \text{where} \quad f(x) = \begin{cases} 
  \frac{x^2 - 16}{x - 4} & \text{if } x \neq 4 \\
  \frac{3}{x - 4} & \text{if } x = 4
\end{cases} \]

What is the type of discontinuity this function has at \( x = 4 \)?