1. (15 points) Name the vertical asymptotes, the horizontal asymptotes, the oblique asymptotes, and the holes for each of the following functions:

   (a) \( f(x) = \frac{x^2 - 4x}{x^3 - x} \)  
   (b) \( f(x) = \frac{2x^3}{x^2 + 1} \)  
   (c) \( f(x) = \frac{x - 2}{(x + 1)(x - 2)} \)

2. (10 points) Consider the following exponentials:
   (a) On the same axis system graph the functions \( y = e^{x+4} \) and \( y = e^x + 4 \)
   (b) Sketch a 6th degree polynomial with a negative leading coefficient, a single root at \( x = 1 \), a double root at \( x = 2 \), and a triple root at \( x = 3 \).
   (c) Find an exponential function of the form \( b a^x + c \) that has the given graph:

   ![Exponential Graph](image)

3. (6 points) One hundred elk, each 1 year old, are introduced into a game preserve. The number \( N(t) \) alive after \( t \) years is predicted to be \( N(t) = 100(0.9)^t \).
   
   (a) Estimate the number of elk in 2 years.
   
   (b) What percentage of the herd dies each year?

4. (6 points) Consider the following logarithmic and exponential functions:
   
   (a) Change to exponential form: \( \log_3(x + 2) = 5 \)
   
   (b) Solve for \( t \) using base \( a \) logarithms: \( K = H - Ca^t \)

5. (18 points) Solve for \( x \)
   
   (a) \( 4x = \log 100 \)  
   (b) \( 16x - 2 = 10^{1+\log 3} \)  
   (c) \( \ln x = 1 + \ln(x + 1) \)  
   (d) \( 5x = \frac{\log_7 32}{\log_7 2} \)  
   (e) \( 3^{-x} = 81 \)  
   (f) \( 4^x + 12(4^{-x}) = 8 \)
6. (15 points) The following are not necessarily related:

(a) The weight $W$ (in kilograms) of a female African elephant at age $t$ (in years) is approximated by $W = 2600(1 - 0.5e^{-0.075t})^3$. Approximate the weight at birth.

(b) Due to people practicing, learning, and generally getting more efficient, their production increases. In a certain manufacturing process the number of items produced is given by the equation $f(n) = 3 + 20(1 - e^{-0.1n})$, where $a$, $b$, and $c$ are constants and $n$ is the number of days on the job. What happens to the number of items produced as the number of days on the job increases without bound?

(c) In economics the demand $D$ for a product is often related to its selling price $P$ by an equation of the form: $\log_a D = \log_a c - k\log_a P$, where $a$, $c$, and $k$ are positive constants. Solve for $D$ and answer the question: What happens as $P \to 0$?

7. (9 points) Consider the function $f(x) = 4x^4 - 17x^2 + 4$

(a) Find all the intercepts of $f(x)$ and sketch its graph.

(b) Use the Intermediate Value Theorem to show that there exists a root between $x = 0$ and $x = 1$.

(c) Using arrow notation describe the end behavior of this function.

8. (6 points) From a rectangular piece of cardboard having dimensions 20 inches by 30 inches, an open box is to be made by cutting out an identical square of area $x^2$ from each corner and turning up the sides.

(a) Express the volume of the box, $V$, as a function of $x$.

(b) Find all positive values of $x$ such that $V(x) > 0$.

9. (9 points) IF the following functions have an inverse, find it. If no inverse exists, state why.

(a) $y = 4 - x^2$, $x \leq 0$.  
(b) $y = |4 - x^2|$, $x \leq 0$  
(c) $f(x) = -\sqrt{4 - x^2}$, $-2 \leq x \leq 0$.

10. (6 points) Which of the following are non-polynomials? Write their corresponding letters in your blue book (no work required):

(a) $y = x$  
(b) $f(x) = \frac{1}{x}$  
(c) $A(r) = \pi r^2$  
(d) $y = 19x^5 - 2x^3 + \frac{3}{4}x - \frac{1}{2}$  
(e) $g(x) = -5x^2 + ex$  
(f) $L(t) = 3x^{-5} + 5x^{-3}$