Name:_____________________________  uNID:_________________

Instructions:

• Please show all of your work as partial credit will be given where appropriate, and there may be no credit given for problems where there is no work shown.

• You do not need to simplify unless otherwise stated.

• No calculators or electronics of any kind (phones off).

• The exam has 100 total possible points.
1. (10 points) **Finding Equations for a Rational Functions from a Graph:** Write down a rational function $f(x)$ which has the graph given below:

![Graph of a rational function](image)

2. (10 points) **Graphing Rational Functions:** Let $f(x) = \frac{x-1}{x^2-x-6}$. Fill in the information below, then graph the function.

- **Domain:**
- **$x$-intercept:**
- **$y$-intercept:**
- **Vertical Asymptote(s):**
- **Hole(s):**
- **Horizontal Asymptote(s):**
3. **Finding End Behavior:** Let \( f(x) = \frac{3x^2-x-2}{6x^2+x-1} \). Answer the following:

(a) (5 points) As \( x \to \infty \), \( f(x) \to _____ \)

(b) (5 points) As \( x \to -\infty \), \( f(x) \to _____ \)

4. (10 points) **Solving Rational Inequalities:** Find all \( x \) which satisfy the inequality

\[
\frac{x + 8}{x + 2} \leq 3.
\]

Please write your answer in interval notation.
5. (10 points) **Graphing Exponential Functions:** Let \( f(x) = e^{x+1} - 2 \). Graph the function, then fill in the information below:

Domain: __________________________

\( x \)-intercept: __________________________

\( y \)-intercept: __________________________

Vertical Asymptote(s): __________________________

Horizontal Asymptote(s): __________________________

6. (10 points) **Graphing Logarithmic Functions:** Let \( f(x) = \log_2(x + 3) - 1 \). Graph the function, then fill in the information below:

Domain: __________________________

\( x \)-intercept: __________________________

\( y \)-intercept: __________________________

Vertical Asymptote(s): __________________________

Horizontal Asymptote(s): __________________________
7. *Evaluating Logarithmic Expressions*: Evaluate the following logarithmic expressions. If the expression cannot be evaluated, write "Does not exist".

(a) (2 points) \( \ln e = \)

(b) (2 points) \( \log_{18} 1 = \)

(c) (2 points) \( \log_3 \frac{1}{9} = \)

(d) (2 points) \( \log_2 \sqrt[3]{4} = \)

(e) (2 points) \( \log_6 (-4) = \)

8. (10 points) *Solving Logarithmic Equations*: Solve for \( x \) in the following equation:

\[
\log_4 x + \log_4 (x - 1) = \frac{1}{2}.
\]
9. (10 points) **Solving Exponential Equations:** Solve for $x$ in the following equation:

$$3(5^{x+1}) + 2 = 77.$$ 

10. **Applications of Exponential Functions:** Suppose a radioactive substance has a half-life of 6 days.

(a) (5 points) What portion of the substance will remain after 9 days?

(b) (5 points) After how many days will there be $\frac{1}{8}$ of the original substance remaining?