Check that you have all five pages. SHOW ALL YOUR WORK. Write complex answers in $a + bi$ form.

1. (6 points) Perform the division: $(3x^3 - 8x^2 - 7) ÷ (x - 3)$:
   Quotient= ________________, Remainder= __________.

2. (12 points) $f(x) = x^3 + 2x^2 - 12x - 16$.
   (a) Use the rational-zeros test to find a rational zero of $f$. List all the possible rational zeros given by the test, as well as the actual zeros.

   (b) Find the remaining zeros of $f$ (including complex zeros).

3. (10 points) Factor into linear factors (using complex numbers where necessary):
   (a) $5x^2 + 7x - 6 =$

   (b) $x^4 - x^2 - 2 =$

4. (10 points) (a) Find the slope of the line passing through $(3, -1)$ and $(-1, 7)$.

   (b) An equation for the line in (a) is $y = ______________$. 
5. (8 points) (a) Find the critical values for the inequality $x^3 \leq 4x$.

(b) Solve the inequality in (a). Sketch the solution below (remember to indicate the status of endpoints).

6. (10 points) Find all $x$ satisfying the equation: $\frac{2x}{x - 3} - \frac{18}{x^2 - 3x} = \frac{5}{x}$.

7. (12 points) Provide the following information and use it to graph $g(x) = \frac{3x^2}{x^2 - 16}$.

(a) The $x$-intercept(s) and $y$-intercept(s):

(b) Equations for all the vertical asymptotes:

(c) Equation of the horizontal asymptote:

(d) Symmetry: Is $g(x)$ even, odd or neither?

8. (12 points) For the following functions find the vertical, horizontal and oblique asymptotes (write an equation for the asymptote in the space provided or N/A if there is not an asymptote of that type):

<table>
<thead>
<tr>
<th>$f(x)$</th>
<th>Vertical</th>
<th>Horizontal</th>
<th>Oblique</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x) = \frac{2x^2 + 3x}{x - 3}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$f(x) = \frac{5x - 10}{x^2 - 5x}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. (9 points) Solve the inequality $|2x - 7| \leq 5$. Give your answer in interval notation.

10. (10 points) Find all the real numbers $x$ which satisfy the equation $\sqrt{x + 2} + 4 = x$.

11. (12 points) (a) Simplify: $\frac{x + 1}{4} - \frac{x - 1}{3}$.

(b) Perform the subtraction and simplify: $\frac{4}{y^2 - 4} - \frac{5}{y^2 + y - 6}$.

12. (10 points) Simplify so that only positive rational exponents occur (assume that $x$ and $y$ are positive):

(a) $\frac{(x^3y^2)^2}{x^2y^3}$

(b) $\sqrt[3]{y\sqrt{y^3}}$
13. (8 points) (a) Find the critical values for the inequality $1 \leq \frac{3}{x + 1}$.

(b) Solve the inequality in (a). Sketch the solution below (remember to indicate the status of endpoints).

14. (9 points) The graph of $y = f(x)$ is shown in the first picture. Sketch the graphs requested on the other two. Underneath describe the transformations in words.

15. (16 points) (a) Write as a single logarithm: $\frac{1}{3} \ln x - 3 \ln y + 2 \ln z =$

(b) Express in terms of natural logarithms: $\log_5 19 =$

(c) Solve the logarithmic equation $\log_2(x + 5) - \log_2(x) = 3$.

16. (8 points) Use the method of elimination or substitution to solve the system of equations

\begin{align*}
7x + 5y &= 4 \\
3x + 2y &= 1
\end{align*}
17. (12 points) (a) If \( f(x) = x^2 + x + 3 \) and \( g(x) = x - 1 \), then the composition \( (f \circ g)(x) = \) 

(b) If \( h(x) = \sqrt[3]{3x - 2} \), then the inverse function \( h^{-1}(x) = \)

18. (10 points) A savings account offers an annual rate of 3.25% compounded continuously. 
(a) If $10,000 is deposited in the account what will be the balance after 5 years?

(b) What is the tripling time (i.e., the time for the amount in the account to triple)?

19. (8 points) (a) Give the augmented matrix for the system of equations: 
\[
\begin{align*}
3x - 2y + 5z &= 8 \\
2x + y - 3z &= 1 \\
x - 3y - 2z &= 2.
\end{align*}
\]

(b) Use your calculator to find the reduced row-echelon form of the matrix in (a).

(c) Use (b) to solve the system of equations in (a): \( x = \), \( y = \), \( z = \).

20. (8 points) (a) Write the system as a matrix equation \( AX = B \)
\[
\begin{align*}
2x + y - 3z &= 2 \\
x - y + z &= 5 \\
x - z &= 1.
\end{align*}
\]

(b) Use your calculator to find \( A^{-1} \), the inverse of the coefficient matrix \( A \), then \( A^{-1}B \).

\[
A^{-1} = \quad \quad \quad \quad A^{-1}B =
\]

(c) Use (b) to solve the system of equations in (a): \( x = \), \( y = \), \( z = \).