INSTRUCTIONS

1. DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO DO SO.

2. CAREFULLY MARK YOUR STUDENT ID ON YOUR SCANTRON.

3. This exam has 7 pages, including the cover sheet. There are 18 multiple-choice questions, each worth 5 points, and 2 workout questions, worth a total of 10 points. No partial credit will be given on the multiple choice questions.

4. You will have 60 minutes to complete the exam. No notes or books are allowed. TI-30Xa and TI-30XIIS scientific calculators are allowed. NO other calculators are allowed.

5. When you are finished, check your work carefully. Then, slide your scantron inside the exam packet before returning the exam to YOUR instructor.

USEFUL FORMULAS

- \( y = mx + b \)
- \( y - y_0 = m(x - x_0) \)
- \( A^2 - B^2 = (A + B)(A - B) \)
- \( A^3 + B^3 = (A + B)(A^2 - AB + B^2) \)
- \( A^3 - B^3 = (A - B)(A^2 + AB + B^2) \)
- \( d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \)
- \( \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \)
- \( (x - h)^2 + (y - k)^2 = r^2 \)
- \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)
- \( I = Prt \)
- \( A = P + Prt \)
- \( a^2 + b^2 = c^2 \)
- \( \frac{f(x + h) - f(x)}{h} \)
- \( d = rt \)
- \( f(x) = a(x - h)^2 + k \)
- \( \left( \frac{-b}{2a}, f \left( \frac{-b}{2a} \right) \right) \)
- \( \log_a MN = \log_a M + \log_a N \)
- \( \log_a \frac{M}{N} = \log_a M - \log_a N \)
- \( \log_a M^p = p \log_a M \)
- \( \log_a M = \frac{\log_b M}{\log_b a} \)
- \( \log_a a = 1, \quad \log_a 1 = 0 \)
- \( \log_a a^x = x, \quad a^{\log_a x} = x \)
Multiple Choice Section:

1. Find \( f^{-1}(x) \) given that \( f(x) = 2x - 1 \).
   
   (a) \( f^{-1}(x) = \frac{x - 2}{2} \) \( \quad \) \( y = 2x - 1 \)
   (b) \( f^{-1}(x) = x - 2 \) \( \quad \) \( x = 2y - 1 \)
   (c) \( f^{-1}(x) = \frac{x - 1}{2} \) \( \quad \) \( x + 1 = 2y \)
   (d) \( f^{-1}(x) = \frac{x + 1}{2} \) \( \quad \) \( \frac{x + 1}{2} = y = f^{-1}(x) \)
   (e) \( f(x) \) does not have an inverse.

2. Determine the horizontal asymptote, if any, of the function \( f(x) = \frac{3x^2 - 7}{4x^3 + 1} \).
   
   (a) \( y = \frac{3}{4} \)
   (b) \( y = 0 \)
   (c) \( y = \frac{4}{3} \)
   (d) \( y = -7 \)
   (e) There is no horizontal asymptote.

3. Solve and write your answer in interval notation: \( x^2 \geq 8 - 2x \).
   
   (a) \( (-\infty, -4] \cup [2, \infty) \)
   (b) \( [-4, 2] \)
   (c) \( [-2, 4] \)
   (d) \( (-\infty, -2] \cup [4, \infty) \)
   (e) No solution

4. Convert the equation \( 8 = \log_a Q \) to an exponential equation.
   
   (a) \( 8^Q = a \)
   (b) \( a^Q = 8 \)
   (c) \( 8^a = Q \)
   (d) \( Q^8 = a \)
   (e) \( a^8 = Q \)
5. Express \( \log_a x^3y^2z \) as a sum or difference of logarithms.

(a) \( \log_a 3x + \log_a 2y + \log_a z \)

(b) \( 3 \log_a x + 2 \log_a y - \log_a z \)

(c) \( \log_a 3x + \log_a 2y - \log_a z \)

(d) \( 3 \log_a x + 2 \log_a y + \log_a z \)

(e) \( \log_a (3x + 2y + z) \)

6. Determine the y-intercept of the function \( g(x) = (x - 1)^2(x + 1)^4 \).

\( g(0) = (0 - 1)^2 (0 + 1)^4 = (-1)^2 (1)^4 = 1 \)

(a) (0, 0)

(b) (0, -1)

(c) (0, 1)

(d) (1, 0)

(e) The function has no y-intercepts

7. Find \( \log_2 \frac{1}{8} \).

(a) -2

(b) -3

(c) \( \frac{1}{3} \)

(d) 3

(e) 2

8. Use the Intermediate Value Theorem to determine if the function \( f(x) = 5x^3 + 9x^2 - 3x - 4 \) has at least one real zero between \( x = -2 \) and \( x = -1 \).

\( f(-2) = -2 \)

\( f(-1) = -9 \)

(a) \( f(-2) \) and \( f(-1) \) have opposite signs, therefore it cannot be determined if the function \( f \) has a real zero between \(-2\) and \(-1\).

(b) \( f(-2) \) and \( f(-1) \) have the same sign, therefore the function \( f \) has a real zero between \(-2\) and \(-1\).

(c) \( f(-2) \) and \( f(-1) \) have opposite signs, therefore the function \( f \) has a real zero between \(-2\) and \(-1\).

(d) \( f(-2) \) and \( f(-1) \) have the same sign, therefore it cannot be determined if the function \( f \) has a real zero between \(-2\) and \(-1\).
9. Identify the end behavior for the function \( P(x) = -x^3 + x^5 - \frac{1}{2}x^6 \).

10. Solve the exponential equation: \( 2^{3x-7} = 32 \).

   (a) \( x = 0 \)
   \[
   \frac{2x-7}{2} = 5
   \]

   (b) \( x = 13 \)
   
   (c) \( x = \frac{11}{4} \)
   
   (d) \( x = 4 \)
   \( x = 4 \)

   (e) \( x = 5 \)

11. Find the real zeros of \( f(x) = x^3 - 2x^2 - 9x + 18 \).

   (a) \(-3, 0, 2\), \( f(x) = x^2(x-2) - 9(x-2) \)

   (b) \(-3, 2, 3\)

   (c) \(-2, 2, 3\)

   (d) \(-3, -2, 2\)

   (e) \(-3, -2, 0\)

   \[ x = 2 \quad x = -3 \quad x = 3 \]

12. Find \( \ln \sqrt{e} \).

   (a) 1

   (b) 0

   (c) \( \frac{1}{2} \)

   (d) 2

   (e) \( e \)
13. Find the maximum number of zeros and the maximum number of turning points that the graph of the function \( f(x) = 9 + x^3 + 5x^2 + 8x^6 \) can have.

(a) Zeros: 7; Turning points: 6
(b) Zeros: 7; Turning points: 8
(c) Zeros: 6; Turning points: 6
(d) Zeros: 6; Turning points: 7
(e) Zeros: 5; Turning points: 5

14. Express \( \ln 54 - \ln 6 \) as a single logarithm and, if possible, simplify.

(a) \( \ln \frac{54}{6} = \ln 9 \)
(b) \( \ln 60 \)
(c) \( \ln 324 \)
(d) \( \ln 9 \)
(e) \( e \)

15. Determine the vertical asymptote(s) of the function \( g(x) = \frac{x + 5}{x^2 + 4x - 32} \).

(a) \( x = -8, \quad x = -5, \quad x = 4 \)
(b) \( x = -5, \quad x = 0 \)
(c) \( x = -5 \)
(d) \( x = -4, \quad x = 8 \)
(e) \( x = -8, \quad x = 4 \)

16. Convert the equation \( 16 = 2^x \) to a logarithmic equation.

(a) \( \log_2 16 = x \)
(b) \( \log_{16} 2 = x \)
(c) \( \log_2 x = 16 \)
(d) \( \log_{16} x = 2 \)
(e) \( \log_x 2 = 16 \)
17. Determine the horizontal asymptote, if any, of the function \( g(x) = \frac{x^5}{x^2 + 2} \).

(a) \( y = 0 \)  
(b) \( y = 1 \)  
(c) \( y = \frac{5}{2} \)  
(d) \( y = -1 \)

(e) There is no horizontal asymptote

18. Use the Horizontal Line Test to determine whether the function whose graph is shown is one-to-one.

(a) \( f(x) \) is one-to-one

(b) \( f(x) \) is not one-to-one

(c) Cannot be determined

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**Workout Section:** You must show all your work. No work, no credit.

19. Solve the rational inequality, determine the interval(s) for which the inequality is satisfied, and write your answer in interval notation.

\[ f(x) = \frac{2x}{x-3} \geq 0 \]

\[ \text{numerator: } 2x = 0 \quad \text{denominator: } x-3 = 0 \]

\[ x = 0 \quad x = 3 \]

Critical values: \( 0, 3 \)

\[ \begin{array}{c|c|c|c}
\text{Intervals} & (-\infty, 0) & (0, 3) & (3, \infty) \\
\hline
\text{Test value} & -1 & 1 & 4 \\
\text{Sign of function} & + & - & + \\
\hline
\text{Solution} & (-\infty, 0] \cup (3, \infty) \\
\end{array} \]
20. Solve for $x$: \[ \log x - \log(x + 2) = 1. \]

\[
\log \frac{x}{x+2} = 1
\]

\[10^x = 10
\]

\[10^x = \frac{x}{x+2}
\]

\[10(x+2) = x
\]

\[10x + 20 = x
\]

\[9x = -20
\]

\[x = \frac{-20}{9}
\]