This examination will be machine processed by the University Testing Service. Use only a number 2 pencil on your scantron. On your scantron identify your name, this course (Math 110) and the date. Code and blacken the corresponding circles on your scantron for your student I.D. number and class section number. Code in your test form.

There are 20 multiple choice questions each worth five points. For each problem four possible answers are given, only one of which is correct. You should solve the problem, note the letter of the answer that you wish to give and blacken the corresponding space on the answer sheet. Mark only one choice; darken the circle completely (you should not be able to see the letter after you have darkened the circle). Check frequently to be sure the problem number on the test sheet is the same as the problem number of the answer sheet.

THE USE OF A CALCULATOR, CELL PHONE, OR ANY OTHER ELECTRONIC DEVICE IS NOT PERMITTED IN THIS EXAMINATION.

THE USE OF NOTES OF ANY KIND IS NOT PERMITTED DURING THIS EXAMINATION.

There are 20 problems on 8 pages, including this one. Check your booklet now.
1. Suppose the first derivative of \( f(x) \) is given by \( f'(x) = \frac{x(x - 1)(x + 2)^2}{x^2 + 1} \). Find the relative maxima and relative minima of \( f(x) \).

   a) relative maximum at \( x = 0 \); relative minimum at \( x = -1 \) and at \( x = -2 \)
   b) relative maximum at \( x = 1 \) and at \( x = -2 \); relative minimum at \( x = 0 \)
   c) relative maximum at \( x = 0 \); relative minimum at \( x = 1 \)
   d) no relative maxima or minima

2. Let \( f(x) = x^3 - 3x^2 \). Find the intervals where \( f \) is increasing and where \( f \) is decreasing.

   a) Increasing on \( (2, \infty) \) decreasing elsewhere
   b) Increasing on \( (-\infty, 0) \) and \( (3, \infty) \), decreasing on \( (0, 3) \)
   c) Increasing on \( (-\infty, 0) \) and \( (2, \infty) \), decreasing on \( (0, 2) \)
   d) Increasing on \( (0, 2) \), decreasing elsewhere

3. Find the relative extrema (if any) of the function \( g(x) = 5x + \frac{125}{x} + 300 \).

   a) relative maximum at \( x = -5 \); relative minimum at \( x = 5 \)
   b) relative maximum at \( x = -5 \); no relative minimum
   c) relative minimum at \( x = 5 \); relative maximum at \( x = 25 \)
   d) there are no relative extrema
4. Suppose the second derivative of \( f(x) \) is given by \( f''(x) = \frac{2x^2 - 10x}{(x^2 + 1)^3} \). Determine the intervals of concavity of \( f \).

   a) \( f \) is concave up on \((-\infty, -1)\) and on \((5, \infty)\); concave down on \((-1, 5)\)
   b) \( f \) is concave down on \((-\infty, 5)\); concave up on \((5, \infty)\)
   c) \( f \) is concave up on \((-\infty, 0)\) and on \((5, \infty)\); concave down on \((0, 5)\)
   d) \( f \) is concave down on \((-\infty, 0)\); concave up on \((0, 5)\) and on \((5, \infty)\)

5. Which function best fits the given graph?

   a) \( \frac{x^2 - 4}{x^2 - 9} \)
   b) \( \frac{x}{x^2 - 4} \)
   c) \( \frac{x^2 - 9}{x^2 - 4} \)
   d) \( \frac{x^2}{x^2 - 4} \)

6. Determine all vertical and horizontal asymptotes of the function \( g(x) = \frac{4x(x - 2)}{x^2 - x - 20} \).

   a) no vertical asymptote; horizontal asymptote \( y = 4 \)
   b) vertical asymptotes \( x = 5 \) and \( x = -4 \); horizontal asymptotes \( y = 0 \) and \( y = 2 \)
   c) vertical asymptotes \( x = 0 \) and \( x = 2 \); no horizontal asymptote
   d) vertical asymptotes \( x = 5 \) and \( x = -4 \); horizontal asymptote \( y = 4 \)
7. Find the absolute maximum and absolute minimum values of the function \( f(x) = x^4 - 2x^2 + 5 \) on \([0, 2]\).

a) absolute maximum is 20; absolute minimum is 5
b) absolute maximum is 13; absolute minimum is \(-2\)
c) absolute maximum is 5; absolute minimum is 4
d) absolute maximum is 13; absolute minimum is 4

8. What is the maximum possible value of \( A = (x - 1)(y - 2) \) if \( x > 0 \) and \( xy = 98 \).

a) 36
b) 49
c) \( \frac{49}{2} \)
d) 72

9. Find the \( x\)-coordinates of all inflection point(s) of the graph of the function \( f(x) = 3x^4 - 4x^3 + 1 \).

a) \( x = \frac{2}{3} \)
b) \( x = 0, x = 1 \)
c) \( x = 0 \)
d) \( x = 0, x = \frac{2}{3} \)
10. Determine the critical points for the function \( f(x) = x^3 + 3x^2 - 24x \).

   a) \( x = 0, x = -4, \) and \( x = 2 \)
   
   b) \( x = 0 \) and \( x = 2 \)
   
   c) \( x = -4 \) and \( x = 2 \)
   
   d) \( x = 4 \) and \( x = -2 \)

11. A rectangular box with square base and no top must hold 4 cubic feet. What dimensions minimize the total surface area (the base plus the four sides)?

   a) \( \frac{3}{4} \times \frac{3}{4} \times \frac{64}{9} \)
   
   b) \( 1 \times 1 \times 4 \)
   
   c) \( 2 \times 2 \times 1 \)
   
   d) \( \frac{3}{2} \times \frac{3}{2} \times \frac{16}{9} \)

12. If \( f'(5) = 0 \) and \( f''(5) > 0 \) then which of the following statements is true?

   a) \( f \) has an inflection point at 5.

   b) \( f \) has a relative minimum at 5.

   c) \( f \) has a relative maximum at 5.

   d) \( f \) has an absolute maximum at 5.
13. If \( R(x) = -x^2 + 100x + 60000 \) is the revenue in dollars when \( x \) passengers travel, what is the maximum revenue for the travel agency?

a) $125,000  
b) $65,000  
c) $62,500  
d) $60,000

14. Simplify \( A = \log_3{27} + \ln\left(\frac{1}{e^4}\right) - \log_5{1} \).

a) 1  
b) -1  
c) 0  
d) 6

15. If \( 3^{t^2-4} = 27^t \), what is \( t \)?

a) \( t = -1, 3 \)  
b) \( t = -1, -4 \)  
c) \( t = -2, 4 \)  
d) \( t = -1, 4 \)
16. Find the interest rate needed for an investment of $4000 to double in 6 years if interest is compounded continuously.

a) rate = \( \frac{\ln(\frac{1}{2})}{6} \).

b) rate = \( \frac{\ln(2)}{6} \).

c) rate = \( \frac{\ln(\frac{1}{2})}{6} \).

d) rate = \( \frac{1 + (\frac{1}{2})^{72}}{72} \).

17. Find the derivative of \( f(x) = (5 - e^{-4x})^5 \).

a) \( 5(5 - e^{-4x})^4 \)

b) \( -5e^{-4x}(5 - e^{-4x})^4 \)

c) \( 20e^{-4x}(5 - e^{-4x})^4 \)

d) \( -80e^{-4x}(5 - e^{-4x})^4 \)

18. Find the derivative of \( f(x) = \frac{e^x}{e^x + 1} \).

a) \( \frac{e^x}{(e^x + 1)^2} \)

b) \( \frac{-e^x}{(e^x + 1)^2} \)

c) \( \frac{2e^x}{(e^x + 1)^2} \)

d) \( \frac{1}{(e^x + 1)^2} \)
19. If $5000 is invested at 4.5% per year compounded monthly, what will be the accumulated amount after 6 years?

   a) $5000e^{4.5}$
   b) $5000(1.045)^6$
   c) $5000 \left(1 + \frac{.045}{12}\right)^{72}$
   d) $5000(1.045)(^{.045)(72)}$

20. Find an equation of the tangent line to the graph of $y = x^2 \ln x$ at the point (1, 0).

   a) $y = 2x + 1$
   b) $y = x - 1$
   c) $y = 2x - 1$
   d) $y = x + 1$