This review, produced by the Broward Teaching Center, contains a collection of questions which are representative of the type you may encounter on the exam. Other resources made available by the Teaching Center include:

- Walk-In tutoring at Broward Hall
- Private-Appointment, one-on-one tutoring at Broward Hall
- Walk-In tutoring in LIT 215
- Supplemental Instruction
- Video resources for Math and Science classes at UF
- Written exam reviews and copies of previous exams

The teaching center is located in the basement of Broward Hall:

You can learn more about the services offered by the teaching center by visiting https://teachingcenter.ufl.edu/
1. Write each function piecewise without absolute value bars.
   (a) \( f(x) = |2x + 1| \)
   (b) \( g(x) = \frac{|10x + 8|}{5x + 4} \)

2. Find the domain of each function below.
   (a) \( f(x) = \ln(x^3 - 1) \)
   (b) \( g(x) = \sqrt{\frac{x + 1}{x^2 + x - 6}} \)
   (c) \( h(\theta) = \cot(\pi \theta) \)
   (d) \( v(t) = \frac{1 + t}{\sqrt{1 - t^2}} \)

3. Simplify each expression, leaving positive exponents only.
   (a) \(-x^{-1}(1 + x^2)^{-2/3} - 2x^{-3}(1 + x^2)^{1/3}\)
   (b) \(x^2(1 - 2x)^{-3/2} + (1 - 2x)^{-1/2}\)

4. Solve the following equations for the indicated variable.
   (a) \( y = \frac{x + 2}{x - 1} \) for \( x \).
   (b) \( 2\sin^2(\theta) + 3\sin(\theta) = -1 \) for \( \theta \in [-\pi, \pi] \).
   (c) \( |x - 2| = 1 \) for \( x \).
   (d) \( e^{x^2+1} = (e^2)^t \) for \( t \).

5. Solve the following inequalities.
   (a) \( 2\sin(x) > 3\cot(x) \) for \( x \in [0, 2\pi] \).
   (b) \( \frac{1}{x} \leq \frac{3}{x + 2} \).
   (c) \( \left| \frac{x + 1}{1 - x} \right| \geq 1 \).
   (d) \( \ln(x - 3) > 2 \).
6. Sketch the graph of each function below. Label any asymptotes or discontinuities.
   (a) \( f(x) = \ln(1-x) \)
   (b) \( g(x) = 3^{-x} + 1 \)
   (c) \( h(x) = \begin{cases} \frac{1}{2^x} & x < -\pi/2 \\ \cos(x) & -\pi/2 \leq x < 0 \\ e^{-x} & x > 0 \end{cases} \)

7. Let \( f(x) = \ln(x) \) and \( g(x) = e^{2x} \).
   (a) Determine \( (f \circ g)(x) \) and its domain.
   (b) Determine \( (g \circ f)(x) \) and its domain.
   (c) Repeat parts (a) and (b) with \( f(x) = \sin(x) \) and \( g(x) = \sin^{-1}(x) \).

8. The number of bacteria living on Gleb’s kitchen counter doubles every three hours. When
   initially counted, there are 100 bacteria.
   (a) Assuming no bacteria die, find an exponential function that models the number of bacteria
   on Gleb’s counter \( t \) hours after the initial counting.
   (b) How many bacteria will reside on Gleb’s counter after 15 hours?
   (c) How long will it take for the population of bacteria on Gleb’s counter to reach 50,000?

9. Find a function \( D(x) \) which gives the distance from any point \((x, y)\) on the graph of
   \( y = \sqrt{x} \) to the point \((4, 0)\).

10. A container in the shape of a cylinder is to be made using \( 3\pi \text{ cm}^2 \) of aluminum. Express the
    volume of the cylinder as a function of its radius only.

11. Consider the function \( f(x) = \frac{x^2 - x - 2}{|2 - x|} \)
    (a) Find the domain of \( f(x) \).
    (b) Express \( f(x) \) as a piecewise function without absolute value bars.
    (c) Calculate \( \lim_{x \to 2^+} f(x) \) and \( \lim_{x \to 2^-} f(x) \).
    (d) Does \( \lim_{x \to 2} f(x) \) exist? Why or why not?
    (e) Is \( f(x) \) continuous? If not, determine where \( f(x) \) is discontinuous and describe the dis-
        continuity.
    (f) Sketch the graph of \( f(x) \).
12. For what real numbers $A$ is the function $f(x) = \begin{cases} \frac{|x-1|}{x^2-1} & x < 1 \\ Ax^2 + 6 & x \geq 1 \end{cases}$ continuous at $x = 1$? Is there a choice of $A$ which makes $f(x)$ continuous everywhere?

13. The position of a particle in one-dimensional motion is given by $s(t) = -10t^2 + 25t + \sqrt{t} + 2$.
   (a) Calculate the average velocity of the particle on the time interval $[2, 7]$.
   (b) Calculate the average velocity of the particle on the time interval $[2, 2+h]$.
   (c) Send $h \to 0$ in part (b). What is the value of the limit? What does this describe?
   (d) Find the equation of the line tangent to $h(t)$ at $t = 2$.

14. Evaluate the limits below. If the limit does not exist, indicate why.
   (a) $\lim_{x \to 2} \frac{x^2 + x - 6}{x - 2}$
   (b) $\lim_{x \to 0} \left( \frac{1}{x} - \frac{1}{x^2 + x} \right)$
   (c) $\lim_{x \to -4} \frac{\sqrt{x^2 + 9} - 5}{x + 4}$

15. Suppose $4x - 9 \leq f(x) \leq x^2 - 4x + 7$ for all $x > 0$.
   (a) Is this sufficient information to calculate $\lim_{x \to 4} f(x)$? If so, what is the value of the limit? If not, explain why.
   (b) Is this sufficient information to calculate $\lim_{x \to 1} f(x)$? If so, what is the value of the limit? If not, explain why.

16. Evaluate the limits below. If the limit does not exist, indicate why.
   (a) $\lim_{x \to \infty} e^x$
   (b) $\lim_{x \to \infty} e^{-x}$
   (c) $\lim_{x \to \infty} \ln(x)$
   (d) $\lim_{x \to 0^+} \ln(x)$
17. Evaluate the limits below. If the limit does not exist, indicate why.

(a) \[ \lim_{x \to \infty} \frac{7x^3 + x^2 - 5}{x^3 - 2x + 1} \]

(b) \[ \lim_{x \to -\infty} \frac{4x^7}{3 - 2x^4} \]

(c) \[ \lim_{x \to \infty} \frac{2x^2 + 1}{3x - 5} \]

(d) \[ \lim_{x \to \infty} e^{\tan^{-1}(x)} \]

18. The profit generated by selling \( x \) Florida Gators branded keychains is given by

\[ P(x) = 100x + \frac{10,000}{x + 1} \]

(a) Find the average change in profit if vendors go from selling \( x \) keychains to \( x + h \) keychains.

(b) How is profit changing when vendors are selling exactly 50,000 keychains?

19. Use (either) of the limit definition(s) of the derivative to calculate the derivatives of each function below.

(a) \( f(x) = x^2 \)

(b) \( g(x) = \sqrt{x} \)

(c) \( h(x) = \sin(x) \quad \text{[Hint: } \sin(x+h)=\sin(x)\cos(h) - \sin(h)\cos(x), \lim_{h \to 0} \frac{\sin(h)}{h}=1, \text{ and } \lim_{h \to 0} \frac{\cos(h)-1}{h}=0] \)

20. In this problem we will work with the functions from the previous problem.

(a) For what values of \( x \) (if any) do each of the functions have horizontal tangent lines?

(b) For what values of \( x \) (if any) do each of the functions have vertical tangent lines?