A. Sign your bubble sheet on the back at the bottom in ink.

B. In pencil, write and encode in the spaces indicated:

1) Name (last name, first initial, middle initial)

2) UF ID number

3) Section number

C. Under “special codes” code in the test ID numbers 1, 1.

   • 2 3 4 5 6 7 8 9 0
   • 2 3 4 5 6 7 8 9 0

D. At the top right of your answer sheet, for “Test Form Code”, encode A.

   • B C D E

E. 1) This test consists of 14 multiple choice questions, ranging from one point to five points in value, plus two sheets (three pages) of free response questions worth 31 points. The test is counted out of 80 points, and there are eight bonus points available.

2) The time allowed is 90 minutes.

3) You may write on the test.

4) Raise your hand if you need more scratch paper or if you have a problem with your test. DO NOT LEAVE YOUR SEAT UNLESS YOU ARE FINISHED WITH THE TEST.

F. KEEP YOUR BUBBLE SHEET COVERED AT ALL TIMES.

G. When you are finished:

1) Before turning in your test check carefully for transcribing errors. Any mistakes you leave in are there to stay.

2) You must turn in your scantron and tearoff sheets to your discussion leader or exam proctor. Be prepared to show your picture I.D. with a legible signature.

3) The answers will be posted online within one day after the exam. Your discussion leader will return your tearoff sheet with your exam score in discussion. Your score will also be posted in e-Learning within one week of the exam.
NOTE: Be sure to bubble the answers to questions 1–14 on your scantron.

Questions 1 – 10 are worth 5 points each.

1. Find each x-value on [0, 2π) at which \( f(x) = \frac{\cos x}{\cos x - \sin 2x} \) has a vertical asymptote.
   a. \( x = \frac{\pi}{6}, \frac{2\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{6} \)
   b. \( x = \frac{\pi}{3}, \frac{2\pi}{3} \)
   c. \( x = 0, \frac{\pi}{6}, \frac{\pi}{2}, \pi, \frac{11\pi}{6} \)
   d. \( x = \frac{\pi}{3}, \frac{3\pi}{6}, \frac{5\pi}{6} \)
   e. \( x = \frac{\pi}{6}, \frac{5\pi}{6} \)

2. Solve the inequality using a number line: \( \frac{x^2}{2 - x} \geq 1 \)
   a. \((-\infty, -2] \cup [1, 2)\)
   b. \([-2, 1] \cup (2, \infty)\)
   c. \((-\infty, -2] \cup [1, \infty)\)
   d. \([-2, -1] \cup (2, \infty)\)
   e. \((-\infty, -1] \cup (2, \infty)\)

3. If \( f(x) = \frac{1}{2x - 1} \) and \( g(x) = \frac{1}{x + 2} \), find \((f \circ g)(x)\) and its domain.
   a. \((f \circ g)(x) = \frac{x + 2}{4 - x}; \text{ domain: } x \neq -2 \text{ and } x \neq 4\)
   b. \((f \circ g)(x) = \frac{x + 2}{4 - x}; \text{ domain: } x \neq 4\)
   c. \((f \circ g)(x) = \frac{1}{(2x - 1)(x + 2)}; \text{ domain: } x \neq -2 \text{ and } x \neq \frac{1}{2}\)
   d. \((f \circ g)(x) = \frac{x + 2}{-x}; \text{ domain: } x \neq -2 \text{ and } x \neq 0\)
   e. \((f \circ g)(x) = \frac{x + 2}{-x}; \text{ domain: } x \neq 0\)
4. A local creamery is designing a new logo for the window of their shop. It will be an ice cream cone, formed by a semicircle atop an isosceles triangle as indicated. If the height of the triangle is to be 30 inches, express the area of the logo in terms of the angle \( \theta \). Hint: find \( x \) in terms of \( \theta \).

a. Area = \( \frac{900}{\tan \theta} + \frac{450\pi}{\tan^2 \theta} \) square inches

b. Area = \( 900 \tan \theta + 450\pi \tan^2 \theta \) square inches

c. Area = \( \frac{900}{\tan \theta} + \frac{900\pi}{\tan^2 \theta} \) square inches

d. Area = \( 450 \tan \theta + 900\pi \tan^2 \theta \) square inches

e. Area = \( 900 \cos \theta + 900\pi \cos^2 \theta \) square inches

5. Let \( f(x) = \begin{cases} 
  x + 2 & x < -1 \\
  \frac{2}{x + 2} & -1 < x \leq 0 \\
  \frac{\sqrt{x+9} - 3}{x} & x > 0 
\end{cases} \)

Which of the following statements is/are true?

P. \( f(x) \) is continuous from the left at \( x = 0 \).

Q. \( f(x) \) could be made continuous at \( x = -1 \) by defining \( f(-1) = 2 \).

R. \( \lim_{x \to 0^+} f(x) = \frac{1}{6} \).

a. R only 

b. Q only 

c. P and R only 

d. P and Q only 

e. P, Q and R
6. Evaluate: \( \lim_{x \to 0} \frac{\sin^2(2x)}{3x^2 \sec(3x)} \)

a. 0  

b. \( \frac{4}{3} \)  

c. \( \frac{4}{9} \)  

d. \( \frac{2}{9} \)  

e. The limit does not exist.

7. If \( f(x) = \frac{x^2 + 3x}{|x|} \), which of the following statements is/are true?

P. \( \lim_{x \to 0^-} f(x) = -3 \).

Q. \( f \) has a removable discontinuity at \( x = 0 \).

R. \( \lim_{x \to -\infty} f(x) = -\infty \).

a. P and R  

b. P and Q  

c. R only  

d. Q only  

e. P only

8. Find each horizontal asymptote of \( f(x) = \frac{2e^{2x}}{4 - 3e^{2x}} \).

Be sure to evaluate \( \lim_{x \to \pm\infty} f(x) \).

a. \( y = -\frac{2}{3} \) and \( y = 0 \)  

b. \( y = -\frac{2}{3} \) only  

c. \( y = 0 \) only  

d. \( y = \frac{4}{3} \) and \( y = \frac{1}{2} \)  

e. \( y = \frac{1}{2} \) only
9. Use the Squeeze Theorem to find \( \lim_{x \to +\infty} f(x) \) if, for all \( x > 100, \) 
\[
\frac{x}{x + \sqrt{4x^2 + x}} \leq f(x) \leq \frac{1 + 2x^5}{x^3 + 6x^5}.
\]
a. \( \frac{1}{6} \)  

b. 1  

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

d. 2  

e. There is not enough information to find \( \lim_{x \to +\infty} f(x) \).

10. Which of the following statements is/are true?

P. If \( f(x) \) is an odd function so that \( f(2) = -5 \), then \( f^{-1}(5) = -2 \).

Q. \( \cos^{-1}\left(\frac{7\pi}{6}\right) = \frac{-\pi}{6} \).

R. If \( f(x) = \frac{2}{x + 1} \), then the domain of the inverse of \( f(x) \) is \( (-\infty, 0) \cup (0, \infty) \). Hint: consider the graph of \( f(x) \).

a. Q only  

b. P and Q only  

c. R only  

d. P and R only  

e. P, Q and R

Continue to the bonus questions on the next page.
Bonus Questions:

11. (2 points) Find the exact value of $\cos \left( \sin^{-1} \left( -\frac{3}{5} \right) \right)$.

   a. $\frac{4}{5}$  b. $-\frac{3}{4}$  c. $\frac{12}{25}$  d. $-\frac{4}{5}$  e. $\frac{3}{4}$

12. (2 points) $\lim_{x \to 0^-} \tan^{-1} \left( \frac{1}{x} \right) = ________

   a. 0  b. $+\infty$  c. $\frac{\pi}{2}$  d. $-\infty$  e. $-\frac{\pi}{2}$

13. (2 points) Evaluate the limit: $\lim_{x \to 0^+} \frac{x + 2}{\ln x}$

   a. 1  b. 0  c. $-\infty$  d. $+\infty$

14. (1 point) True or False:

   The Intermediate Value Theorem guarantees that the function $f(x) = \ln(x) - e$ has a zero on the interval $(e^2, e^3)$.

   a. True  b. False
1. (10 points) Let \( f(x) = \begin{cases} 
3 + e^{x+2} & x \leq -2 \\
1 - |x + 1| & -2 < x < 1. \\
\ln(x - 1) & x > 1
\end{cases} \)

(a) Sketch the graph of \( f(x) \).

(b) Find the limits:

1) \( \lim_{x \to -2^-} f(x) = \) __________

2) \( \lim_{x \to -2^+} f(x) = \) __________

3) \( \lim_{x \to 1^+} f(x) = \) __________

4) \( \lim_{x \to 1^-} f(x) = \) __________

5) \( \lim_{x \to \infty} f(x) = \) __________

(c) List all discontinuities of \( f(x) \) and state whether they are jump, infinite, or removable.
2. (10 points) (a) Write the function \( y = x^2 + 4x + 6 \) in standard form \( y = (x - h)^2 + k \).

\[ y = \underline{\quad} \]

(b) The function \( f(x) = x^2 + 4x + 6 \) with a restricted domain \( x \leq a \) is one-to-one. Find the largest \( a \) value.

\[ a = \underline{\quad} \]

(c) Find the inverse of \( f(x) \). Be sure to use the restricted domain from part (b).

\[ f^{-1}(x) = \underline{\quad} \]

(d) Sketch the graph of \( f \) and \( f^{-1} \).

(e) Find the domain and range of \( f^{-1} \).
(Enter your answers using interval notation.)

Domain: \( \underline{\quad} \)

Range: \( \underline{\quad} \)
3. (7 points) The position of a particle at time $t$ seconds is $s(t) = \frac{1}{2t-1}$ (in inches), $t > \frac{1}{2}$.

(a) Find the average velocity of the particle on the interval from $t = 1$ to $t = 1 + h$ (for $h \neq 0$) and be sure to simplify and include units in your answer.

Average velocity =

(b) Use a limit to find the velocity of the particle at the instant $t = 1$ and be sure to include units in your answer.

Instantaneous velocity =

4. (4 points) Solve the equation $2 \log(x) - \log(16 - 2x) = \log(2)$.

$x =$