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 4, 1.
   1 2 3 • 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 24 multiple choice questions, ranging from two points to four points in value. The test is counted out of 75 points, and there are 11 bonus points available.
   2) The time allowed is 120 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 in Canvas within one day after the exam.
NOTE: Be sure to bubble the answers to questions 1–24 on your scantron.

Questions 1 – 19 are worth 4 points each.

1. Let \( f(x) = \begin{cases} \frac{2x - 2}{\sqrt{2x - 1} - \sqrt{x}} & x \neq 1 \\ Kx + 2 & x = 1 \end{cases} \).

Find the value of \( K \) so that \( f \) will be continuous at \( x = 1 \).

a. \( K = 1 \)  
   b. \( K = 2 \)  
   c. \( K = 3 \)  
   d. \( K = 4 \)  
   e. \( K = 5 \)

2. Find the slope of the normal line to the curve \( y = \frac{e^{2x^2 + 1}}{x} \) at \( x = 1 \).

a. \(-\frac{1}{3e^3}\)  
   b. \(-\frac{1}{5e^3}\)  
   c. \(3e^3\)  
   d. \(5e^3\)  
   e. 0

3. If \( f(x) = \frac{x^2 - 5x + 4}{x - x^3} \), which of the following is/are true?

   P. \( f(x) \) has a removable discontinuity at \( x = 1 \).

   Q. \( \lim_{x \to 0^+} f(x) = -\infty \).

   R. \( f(x) \) can be made continuous at \( x = 1 \) be defining \( f(1) = \frac{3}{2} \).

a. P only  
   b. R only  
   c. P and R only  
   d. Q and R only  
   e. P and Q only
4. Let \( p = \lim_{x \to 0} \left( \frac{x - 4}{x^2 - 2x} - \frac{2}{x} \right) \) and \( q = \lim_{x \to 2^+} \frac{x^2 + x - 6}{|2 - x|} \).

Find \( p \) and \( q \).

a. \( p = 0 \) and \( q = 5 \) \hspace{1cm} b. \( p = \infty \) and \( q = -5 \) \hspace{1cm} c. \( p = -\frac{1}{2} \) and \( q = -5 \)

d. \( p = \frac{1}{2} \) and \( q = 5 \) \hspace{1cm} e. \( p = 0 \) and \( q = \infty \)

5. Find all horizontal asymptotes of \( f(x) = \frac{\sqrt{2x^2 + x}}{8x - 1} \).

Be sure to consider both \( \lim_{x \to \infty} f(x) \) and \( \lim_{x \to -\infty} f(x) \).

a. \( y = \sqrt{2} \) and \( y = -\sqrt{2} \) \hspace{1cm} b. \( y = \frac{\sqrt{2}}{8} \) and \( y = -\frac{\sqrt{2}}{8} \) \hspace{1cm} c. \( y = 0 \)

d. \( y = \frac{1}{8} \) and \( y = -\frac{1}{8} \) \hspace{1cm} e. \( x = \frac{\sqrt{2}}{8} \) and \( x = -\frac{\sqrt{2}}{8} \)

6. A cylinder is being flattened so that its volume does not change. Find the rate of change of the radius when \( r = 3 \) inches and \( h = 4 \) inches, if the height is decreasing at 0.4 in/sec.

a. \( \frac{dr}{dt} = 0.1 \) in/sec \hspace{1cm} b. \( \frac{dr}{dt} = 0.15 \) in/sec \hspace{1cm} c. \( \frac{dr}{dt} = 0.2 \) in/sec

d. \( \frac{dr}{dt} = 0.25 \) in/sec \hspace{1cm} e. \( \frac{dr}{dt} = 0.3 \) in/sec
7. Find the linearization of the function \( f(x) = \sqrt[3]{1 - 2x} \) at \( a = 0 \).

a. \( L(x) = \frac{2}{3}x - 1 \)  
   b. \( L(x) = \frac{2}{3}x + 1 \)  
   c. \( L(x) = -\frac{2}{3}x - 1 \)

d. \( L(x) = -\frac{2}{3}x + 1 \)  
   e. \( L(x) = \frac{2}{3}x \)

8. If \( f(x) = x\sqrt{9 - x} \), then \( f'(x) = \frac{18 - 3x}{2\sqrt{9 - x}} \) and \( f''(x) = \frac{3(x - 12)}{4(9 - x)^{3/2}} \).

Which of the following statements is/are true about \( f(x) \)? Be sure to consider domain!

P. \( f(x) \) has critical numbers at \( x = 6 \) only.

Q. \( f(x) \) has a local maximum at \( x = 6 \) and no local minimum.

R. \( f(x) \) is concave down on \((-\infty, 9)\).

a. P only  
   b. Q only  
   c. R only

d. Q and R only  
   e. P, Q and R

9. Evaluate: \( \lim_{x \to \infty} x \cdot \ln \left( \frac{2x + 1}{2x} \right) = \)

a. \( \infty \)  
   b. 0  
   c. \(-2\)  
   d. \(-\frac{1}{2}\)  
   e. \( \frac{1}{2} \)
10. Use logarithmic differentiation to find the equation of the tangent line to the graph of \( f(x) = x^{\ln x} \) when \( x = e \).

a. \( y = 2x - e \)  

b. \( y = \frac{2}{e}x - 2 + e \)  

c. \( y = 2x - 3e \)

d. \( y = 2ex - 2e^2 + e \)  

e. \( y = \frac{2}{e}x - 3 + e \)

11. Find the minimum distance from the point \((4, 0)\) to the curve \( y = \sqrt{4x - 2} \).

a. \( \sqrt{12} \)  

b. 4  

c. 3  

d. \( \sqrt{15} \)  

e. \( \sqrt{10} \)

12. Find the absolute extreme values of \( f(x) = x^2e^{1-x^2} \) on \([0, 2]\) first and we have

\[
A \leq \int_{0}^{2} x^2e^{1-x^2} \, dx \leq B
\]

using the comparison property for integrals. What is the value of \( B \)?

a. \( B = 0 \)  

b. \( B = 1 \)  

c. \( B = 2 \)  

d. \( B = \frac{4}{e^3} \)  

e. \( B = \frac{8}{e^3} \)

13. Find the area of the region enclosed by the curves \( y = x^2 - 2x \) and \( y = 3x \).

a. 125  

b. \( \frac{125}{6} \)  

c. \( \frac{25}{3} \)  

d. \( \frac{25}{2} \)  

e. 25
14. Determine the intervals on which \( f(x) = \int_0^{x^2} t(t - 4) \, dt \) is increasing.

a. \((-\infty, -2) \cup (2, \infty)\)  
   b. \((-2, 0) \cup (2, \infty)\)  
   c. \((-\infty, -2) \cup (0, 2)\)  
   d. \((0, \infty)\)  
   e. \(( -2, 2)\)

15. A particle moves in a straight line so that its velocity at time \( t \) is given by \( v(t) = t - 3 \) inches per second. Find the displacement of the particle and the total distance traveled during the first five seconds (the time interval \( 0 \leq t \leq 5 \)).

<table>
<thead>
<tr>
<th>displacement</th>
<th>total distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ( \frac{5}{2} ) in</td>
<td>( \frac{13}{2} ) in</td>
</tr>
<tr>
<td>b. ( -\frac{3}{2} ) in</td>
<td>( \frac{13}{2} ) in</td>
</tr>
<tr>
<td>c. ( \frac{3}{2} ) in</td>
<td>( \frac{5}{2} ) in</td>
</tr>
<tr>
<td>d. ( -\frac{5}{2} ) in</td>
<td>( \frac{13}{2} ) in</td>
</tr>
<tr>
<td>e. ( -\frac{5}{2} ) in</td>
<td>10 in</td>
</tr>
</tbody>
</table>

16. Use the definition of the definite integral to evaluate the limit:

\[
\lim_{n \to \infty} \sum_{i=1}^{n} \frac{1}{n} \sqrt{1 + \frac{3i}{n}}
\]

a. \( \frac{14}{3} \)  
   b. \( \frac{8}{3} \)  
   c. \( 8 \)  
   d. \( \frac{14}{9} \)  
   e. \( \frac{8}{9} \)
17. If the slope of the tangent line to $y = f(x)$ at any point is $\frac{e^x - e^{-x}}{e^x}$ and the curve $y = f(x)$ passes through the point $(0, 1)$, find $f(1)$.

   a. $\frac{2}{e^2}$  
   b. $1 + \frac{2}{e^2}$  
   c. $\frac{5}{2} - \frac{1}{2e^2}$  
   d. $1 + \frac{1}{2e^2}$  
   e. $\frac{3}{2} + \frac{1}{2e^2}$

18. A soft drink dispenser pours a soft drink at the rate of $\frac{8t}{1 + 2t^2}$ ml/sec, where $t$ is the time elapsed in seconds. How much of the drink is dispensed in the first two seconds?

   a. $\frac{80}{81}$ ml  
   b. $8\ln(3)$ ml  
   c. $4\ln(3)$ ml  
   d. $8\ln(2)$ ml  
   e. $\frac{1}{4}$ ml

19. Evaluate the integral: $\int_1^{\pi^2} \frac{\sin(\sqrt{x})}{\sqrt{x}} \, dx$

   a. $-2\sin(1)$  
   b. $2(\cos(1) + 1)$  
   c. $-2\cos(1)$  
   d. $\frac{1}{2}\sin(1)$  
   e. $\frac{1}{2}(\cos(1) - 1)$
Questions 20 – 24 are worth 2 points each.

20. Suppose that $f$ is an even function and $f$ is continuous on $(-\infty, \infty)$.

If $\int_{0}^{5} f(x) \, dx = 4$ and $\int_{10}^{5} f(x) \, dx = 2$, find $\int_{-5}^{10} f(x) \, dx$.

a. 2   b. 4   c. 6   d. 8   e. 10

21. The graph of $y = f(t)$ on $[-1, 5]$ is given below. If $g(x) = \int_{-1}^{x} f(t) \, dt$, find the $x$-value where $g$ has local maximum.

![Graph of $y = f(t)$]

a. $x = 1$   b. $x = 2$   c. $x = 3$   d. $x = 4$   e. none

22. Using substitution, the integral $\int_{0}^{4} \frac{x}{\sqrt{1 + 2x}} \, dx$ is equivalent to

a. $\frac{1}{4} \int_{1}^{9} \frac{u - 1}{\sqrt{u}} \, du$

b. $\frac{1}{4} \int_{0}^{4} \frac{u - 1}{\sqrt{u}} \, du$

c. $\frac{1}{2} \int_{1}^{9} \frac{1}{\sqrt{u}} \, du$

d. $\frac{1}{2} \int_{1}^{9} \frac{u - 1}{\sqrt{u}} \, du$

e. $\frac{1}{2} \int_{0}^{4} \frac{1}{\sqrt{u}} \, du$
23. \( \frac{d}{dx} \left( \cos^2(\ln(x)) \right) = \) 

a. \(- \frac{\cos(\ln(x)) \sin(\ln(x))}{x}\)  
b. \( \frac{2 \cos(\ln(x)) \sin(\ln(x))}{x}\)  
c. \(- \frac{\sin(\ln(x))}{x}\)  
d. \(2 \sin(\ln(x))\)  
e. \(- \frac{2 \cos(\ln(x)) \sin(\ln(x))}{x}\)

24. Evaluate the limit: \(\lim_{h \to 0} \frac{\sin^2 \left( \frac{\pi}{6} + h \right) - \frac{1}{4}}{h}\)

a. \(- \frac{1}{2}\)  
b. \(- \frac{\sqrt{3}}{2}\)  
c. \(\frac{1}{2}\)  
d. \(\frac{\sqrt{3}}{2}\)  
e. 0

Have a Happy Holiday!