This exam should have 16 questions. The first 14 questions are multiple choice questions worth 5 points each. The last two questions are hand graded and are worth 15 points each. Please check to see that your exam is complete. If you do not have a pencil to mark your card please request your proctor for one.

Write your ID number (not your SS number) on the six blank lines at the top of your answer card using one blank for each digit. Shade in the corresponding boxes below. Also print your name at the top of your card.

As you work the exam, lightly shade in the correct answers on your answer card. At the end of your exam when you are certain of all your choices darken all your answer boxes. If your card becomes damaged please ask your proctor for a new one.
1. Evaluate \( \int_0^a x \sqrt{a^2 - x^2} \, dx \) using the substitution \( u = a^2 - x^2 \).

(A) 0  
(B) \( a \)  
(C) \( a^2 \)  
(D) \( a^3 \)  
(E) \( a/2 \)  
(F) \( a^2/3 \)  
(G) \( a^3/3 \)  
(H) \( a^4/5 \)  
(I) \( a^2 - a \)  
(J) \( (a^2 - a)/2 \)
2. Evaluate the integral \( \int_{-1}^{1} e^{x^3} \, dx - \int_{-1}^{1} e^{-x^2} \, dx \).

(A) 0  
(B) 1  
(C) \( e \)  
(D) \( e^2 \)  
(E) \( e^2/2 \)  
(F) \( e - e^{-1} \)  
(G) \( (e - e^{-1})/2 \)  
(H) \( \frac{1}{e} \)  
(I) \( \frac{1}{e} \)  
(J) One can not evaluate this integral.
3. Integrate by parts and compute $\int_0^{\pi/2} t^2 \sin t \, dt$.

(A) 0
(B) 1
(C) $\pi$
(D) $\pi/2$
(E) $\pi - 1$
(F) $1 - \pi$
(G) $\pi - 2$
(H) $2 - \pi$
(I) $\frac{\pi}{2} - 1$
(J) $1 - \frac{\pi}{2}$
4. Given that \( f(1) = 0, f(2) = 1, \int_1^2 f(x) \, dx = 0 \) and \( f' \) is continuous, compute \( \int_1^2 x f'(x) \, dx \) using integration by parts.

(A) 0  
(B) 1  
(C) 2  
(D) 3  
(E) 4  
(F) 5  
(G) 6  
(H) 7  
(I) 8  
(J) 9
5. Use integration by parts to compute \( \int_1^2 \ln x \, dx \).

(A) \( \ln 2 \)
(B) \( 2 \ln 2 \)
(C) \( \ln 2 + 1 \)
(D) \( \ln 2 + 2 \)
(E) \( 2 \ln 2 - 1 \)
(F) \( \ln 2 - 1 \)
(G) \( \ln 2 - 2 \)
(H) \( 2 \ln 2 - 2 \)
(I) \( -\ln 2 \)
(J) \( -\ln 2 + 1 \)
6. Evaluate using the substitution $u = \tan x$, \( \int_{\pi/4}^{\pi/2} \tan^2 x \sec^4 x \, dx \).

(A) \( \frac{1}{15} \)

(B) \( \frac{2}{15} \)

(C) \( \frac{3}{15} \)

(D) \( \frac{4}{15} \)

(E) \( \frac{5}{15} \)

(F) \( \frac{6}{15} \)

(G) \( \frac{7}{15} \)

(H) \( \frac{8}{15} \)

(I) \( \frac{9}{15} \)

(J) \( \frac{10}{15} \)
7. Use partial fractions to evaluate \( \int_2^3 \frac{dx}{x^2 - 1} \).

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

(B) \( \ln \frac{3}{2} \)

(C) \( \frac{1}{2} \ln \frac{1}{2} \)

(D) \( \frac{1}{2} \ln \frac{3}{2} \)

(E) \( \frac{1}{2} \ln \frac{5}{3} \)

(F) \( \frac{1}{2} \ln \frac{7}{3} \)

(G) \( \frac{1}{2} \ln \frac{9}{5} \)

(H) \( \frac{1}{2} \ln \frac{11}{2} \)

(I) \( \frac{1}{2} \ln \frac{13}{2} \)

(J) \( \frac{1}{2} \ln \frac{15}{2} \)
8. Use midpoint rule with \( n = 4 \) to approximate \( \int_{1}^{2} \frac{dx}{x} \). Pick the value closest to your answer, since calculators may differ.

(A) 0.134
(B) 0.254
(C) 0.392
(D) 0.421
(E) 0.518
(F) 0.642
(G) 0.734
(H) 0.892
(I) 0.991
(J) 1.002
9. Use Simpson's rule with \( n = 4 \) to find an approximation of the integral \( \int_{0}^{4} \frac{dy}{1+y^2} \). Pick the value closest to your answer, since calculators may differ.

(A) 3.0012  
(B) 2.9857  
(C) 2.7634  
(D) 2.4321  
(E) 2.0091  
(F) 1.8753  
(G) 1.5672  
(H) 1.4210  
(I) 1.2093  
(J) 1.0257
10. We approximate the integral \( \int_0^1 e^{x^2} \, dx \) by dividing the integral from 0 to 1 into \( n \) equal parts and using the midpoint rule. Let \( E_M \) be the error estimate. What should be the smallest \( n \) so that \( |E_M| \leq 0.0025 \)?

(A) \( n \geq \sqrt{e} \)
(B) \( n \geq 2\sqrt{e} \)
(C) \( n \geq 3\sqrt{e} \)
(D) \( n \geq 4\sqrt{e} \)
(E) \( n \geq 5\sqrt{e} \)
(F) \( n \geq 6\sqrt{e} \)
(G) \( n \geq 7\sqrt{e} \)
(H) \( n \geq 8\sqrt{e} \)
(I) \( n \geq 9\sqrt{e} \)
(J) \( n \geq 10\sqrt{e} \)
11. Decide whether the following integral is convergent and evaluate it if it is. \( \int_0^\infty \frac{e^x}{e^{2x} + 3} \, dx \).

(A) The integral diverges.
(B) The integral converges but cannot calculate the value.
(C) \( \pi \)
(D) \( \frac{2}{3} \)
(E) \( \frac{\pi}{3\sqrt{3}} \)
(F) \( \frac{2}{\pi} \)
(G) \( \frac{\pi}{3\sqrt{3}} - \frac{2}{\pi} \)
(H) \( 1 - \frac{\pi}{2} \)
(I) \( \frac{\pi}{2} - 1 \)
(J) \( \infty \)
12. Evaluate \( \int_0^\pi \sin^2 x \, dx \).

(A) 0
(B) \( \pi \)
(C) \( \pi^2 - 1 \)
(D) \( \pi/2 \)
(E) \( \frac{1}{\pi} \)
(F) \( \pi^2 - 2 \)
(G) \( \pi^2 - \pi \)
(H) \( \pi - \frac{1}{\pi} \)
(I) \( \frac{1}{\pi^2} \)
(J) \( \pi^2 - \frac{1}{\pi^2} \)
13. Decide whether the following integral is convergent and if it is evaluate it. \( \int_1^\infty \frac{1}{1 + \sin^2 x} \, dx \).

(A) The integral diverges
(B) \( \sin \pi/4 \)
(C) \( \cos \pi/4 \)
(D) \( 1 + \sin^2 \pi/4 \)
(E) \( 1 + \cos^2 \pi/4 \)
(F) \( \sin \pi/3 \)
(G) \( \cos \pi/3 \)
(H) \( 1 + \sin^2 \pi/3 \)
(I) \( 1 + \cos^2 \pi/3 \)
(J) \( \frac{1}{1 + \sin^2 \pi/3} \)
14. Given
\[
\frac{4}{(x - 1)^2(x + 1)} = \frac{A}{(x - 1)^2} + \frac{B}{x - 1} + \frac{C}{x + 1},
\]

\((A, B, C)\) is

(A) \((1, 1, 1)\)
(B) \((2, 1, 1)\)
(C) \((2, -1, 1)\)
(D) \((2, 1, -1)\)
(E) \((1, -2, 1)\)
(F) \((1, -2, -1)\)
(G) \((1, 1, 1)\)
(H) \((1, 1, -2)\)
(I) \((1, 1, -1)\)
(J) \((1, 2, -2)\)
These are two free response problems 15 and 16 each worth 15 points. Write your answers on the test page. Show your work neatly and cross out irrelevant scratch work, false starts etc.

Please put your name on each of the following pages, since they may be separated during grading.

Also please add your Discussion Section Letter on each page.

Name: _______________ ID Number: __________
Discussion Section Letter: ___

15. Find the values of $p \geq 0$ for which the integral $\int_0^1 \frac{dx}{x^p}$ converges and evaluate the integral for those $p$. 
16. By completing the square and making a trigonometric substitution evaluate \( \int \frac{x}{\sqrt{3-2x-x^2}} \, dx \).