LAST NAME (print): ____________________________________________

FIRST NAME (print): ____________________________________________

SIGNATURE: ________________________________________________

INSTRUCTOR: ________________________________________________

SECTION NUMBER: _____

INSTRUCTIONS

1. In Part 1 (Problems 1–11), mark the correct choice on your ScanTron form using a No. 2 pencil. Record your choices on your exam. Scantrons will not be returned.

2. Be sure to write your name and section number on your ScanTron.

3. In Part 2 (Problems 12 – 15), present your solutions in the space provided. Show all your work neatly and concisely and box your final answer. You will be graded not merely on the final answer, but also on the quality and correctness of the work leading to it.

4. THE USE OF CALCULATORS, BOOKS OR NOTES OF ANY SORT IS NOT PERMITTED IN THIS EXAMINATION. TURN OFF and HIDE YOUR CELL PHONES.
1. Compute the definite integral \( \int_1^e x^2 \ln x \, dx \)

(a) \( \frac{2e^3 - 1}{3} \)

(b) \( \frac{e^3 - 1}{9} \)

(c) \( \frac{2e^3 + 1}{9} \)

(d) \( \frac{e^3 + 1}{9} \)

(e) \( \frac{2e^3 + 1}{3} \)

2. Evaluate the definite integral \( \int_0^4 \frac{x}{\sqrt{1 + 2x}} \, dx \)

(a) \(-5/3\)

(b) \(10/3\)

(c) \(1/3\)

(d) \(4\)

(e) \(0\)

3. If \( f \) is continuous and \( \int_0^4 f(x) \, dx = 10 \), find \( \int_0^2 f(2x) \, dx \)

(a) \(5\)

(b) \(10\)

(c) \(2\)

(d) \(1\)

(e) \(20\)
4. Evaluate the definite integral $\int_{1}^{e} \frac{\ln x}{x} \, dx$

(a) $1/e$
(b) $e^2/2$
(c) $-1$
(d) $1/2$
(e) $e^2/2 - 1$

5. Find the area of the region bounded by the line $y = 2x$ and the parabola $y = x^2 - 4x$.

(a) 63
(b) 36
(c) 25
(d) 52
(e) 48

6. The base of a solid is the parabolic region between the graphs of $y = 1$ and $y = x^2$. Cross-sections perpendicular to the $y$-axis are squares. Find the volume of the solid.

(a) 2
(b) $4/3$
(c) 3
(d) 1
(e) $1/3$
7. Using **cylindrical shells** which integral gives the volume of the solid obtained by rotating the region bounded by \( y = x, \ y = x^2 \) about the line \( y = 1 \)?

(a) \( 2\pi \int_0^1 y(y - y^2)dy \)

(b) \( 2\pi \int_0^1 (x - 1)(x - x^2)dx \)

(c) \( 2\pi \int_0^1 (1 - y)(\sqrt{y} - y)dy \)

(d) \( 2\pi \int_0^1 y(\sqrt{y} - y)dy \)

(e) \( 2\pi \int_0^1 x(x - x^2)dx \)

8. A cable that weighs 2 lb/ft is used to lift 800 lb of coal up a mineshaft 500 ft deep. Find the work done.

(a) 400,000 ft-lb

(b) 250,000 ft-lb

(c) 500,000 ft-lb

(d) 750,000 ft-lb

(e) 650,000 ft-lb

9. Find the average value of the function \( f(x) = x \sin x \) on the interval \([0, \pi/2]\).

(a) 1

(b) \( \frac{\pi}{2} \)

(c) \( \frac{4}{\pi} \)

(d) \( \frac{2}{\pi} \)

(e) \( \frac{\pi}{4} \)

[Exam continues on next page]
10. Evaluate the definite integral \( \int_{0}^{\pi/4} \sin^2 x \, dx \)

(a) \( \pi/4 \)
(b) \( \pi/8 \)
(c) \( \pi/4 - 1 \)
(d) \( \pi/8 - 1/2 \)
(e) \( \pi/8 - 1/4 \)

11. If the work required to stretch the spring 1 ft beyond its natural length is 15 ft-lb, how much work is needed to stretch it 8 in. beyond its natural length?

(a) \( 27/4 \) ft-lb
(b) \( 4/27 \) ft-lb
(c) \( 20/3 \) ft-lb
(d) \( 3/20 \) ft-lb
(e) 30 ft-lb
12. Let $\mathcal{R}$ denote the region bounded by $y = \ln x$, $y = 0$, $x = 2$.

(a) (2 pts) Sketch the region $\mathcal{R}$.

(b) (5 pts) Using disks set up (do not evaluate) the integral that gives the volume of the solid generated by rotating the region $\mathcal{R}$ about the $x$-axis.

(c) (7 pts) Using washers set up (do not evaluate) the integral that gives the volume of the solid generated by rotating the region $\mathcal{R}$ about the line $x = 3$. 
13. Let $\mathcal{R}$ denote the region bounded by $y = e^x$, $y = e^{-x}$ between $x = -1$ and $x = 2$.

(a) (3 pts) Sketch the region $\mathcal{R}$.

(b) (3 pts) Set up the integral that gives the area of the region $\mathcal{R}$.

(c) (3 pts) Find the area of the region $\mathcal{R}$. 
14. (9 pts) The tank in a shape of hemisphere with radius 5 ft is full of water. Find the work done in pumping all the water to the top of the tank. Use the fact that water weighs 62.5 lb/ft$^3$.

15. Evaluate the indefinite integrals.

(a) (8 pts) $\int x^2 e^{3x} \, dx$
(b) (8 pts) $\int \sin^3 x \sqrt{\cos x} \, dx$

(c) (8 pts) $\int \tan^2 x \sec^4 x \, dx$
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-11.</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

LAST NAME (print): __________________________

FIRST NAME (print): __________________________

SECTION NUMBER: ______