Work as many of the following problems as you can in one hour. To assure partial credit, show your work.
No calculators are permitted for this exam.

<table>
<thead>
<tr>
<th>page</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**1.** Evaluate the integral: \( \int_{0}^{\pi/2} \sin^2 \theta \cos^2 \theta d\theta \).
(15) 2. Evaluate the integral: $\int \frac{\sqrt{x^2 - 4}}{x} dx$
3. Evaluate the integral: \[ \int \frac{9x}{(x + 1)^2(x - 2)} \, dx \]
4. This problem concerns the area of the surface obtained by revolving the graph of \( y = e^x \) around the \( x \)-axis, from \( x = 0 \) to \( x = 1 \).

(8) (a) Set up the integration for this problem. That is, write down an expression for the surface area as a certain definite integral.

(8) (b) Show how to get from the integral in part (a), by a process involving substitution, to the definite integral of a certain trigonometric function. (You need not perform the actual integration.)
5. Evaluate the following limits. That is, determine whether or not the limit is a real number, and if it is, determine the number.

(a) \( \lim_{x \to \infty} \frac{x}{\sqrt{4x^2 - 1}} \)

(b) \( \lim_{x \to 0^+} \frac{x}{\ln x} \)

(c) \( \lim_{x \to 0^+} (2 + x)^{1/x} \)

(d) \( \lim_{x \to \infty} \frac{e^x}{9x^{1000}} \)
6. Find the volume of the solid obtained by revolving the graph of \( y = \frac{1}{x^2} \) around the \( x \)-axis, from \( x = 1 \) to \( \infty \). (Is the volume infinite? If not, what is it?)

7. For each of the following sequences \( \{a_n\}_{n=1}^{\infty} \), determine whether the sequence converges or diverges. If it converges, to what number does it converge?

(a) \( a_n = e^{-n} \)

(b) \( a_n = \frac{n}{n-1} - \frac{n}{n+1} \)

(c) \( a_n = (1.00001)^n - (0.99999)^n \)