<table>
<thead>
<tr>
<th>Problem</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>105</strong></td>
<td>**       **</td>
</tr>
</tbody>
</table>
Show all work.

1. Compute the following limits showing all necessary steps. (12 points, 6 each)
   
   a) \( \lim_{x \to 0} \frac{e^{2x} - \cos x}{\sec x - 1} \)

   b) \( \lim_{x \to 1} \left( \frac{1}{x - 1} - \frac{1}{\ln x} \right) \)

For problems 2, 3, 4 in doing integrals you must reduce each problem to one or more of the basic 18 integrals. Calculator answers alone are worth only 1 point.

2. Compute showing all steps (20 points, 10 each)
   
   a) \( \int \frac{x^3}{x^2 + x - 12} \, dx \)
b) \[ \int \frac{1}{(x - 3)(x^2 + 1)} \, dx \]

3. Determine if the following integrals are convergent or divergent, and evaluate them if they are convergent.
(24 points, 8 each)

a) \[ \int_{0}^{\infty} \frac{x^2}{(x^3 + 1)} \, dx \]

b) \[ \int_{0}^{\infty} xe^{-x^2} \, dx \]
c) \[ \int_0^3 \left( \frac{1}{\sqrt{3-x}} - \frac{1}{\sqrt{x}} \right) dx \]

4. Determine for which numbers \( s \) the integral

\[ \int_0^\infty xe^{(1-s)x} \, dx \]

converges and for which \( s \) it diverges, and evaluate the integral when it converges (Hint: Integration by parts).

(12 points)
5. Consider the region bounded by the curves $y = x$, $y = 2x + 1$, $x = 1$, $x = 2$. Graph the region and compute (15 points, 5 each)

a) The area of this region

b) The volume generated by revolving the region around the $x$ axis

c) The volume generated by revolving the region around the $y$ axis
6. Find the area between the curves \( y^2 - 2y = x \) and \( x + y = 2 \). 
(10 points)

7. Find the volume generated by revolving the region bounded by the curves 
\( x = \frac{1}{y^2} \), \( y = x \), and \( y = 3 \) around the \( x \)-axis. 
(12 points)