1. The graph of a function, \( f(x) \), is increasing and concave down on the interval \([a,b]\). Put the following quantities in increasing order: \( L_{100}, R_{100}, T_{100}, M_{100} \), 
\[
\int_{a}^{b} f(x) \, dx .
\]

2. Let \( I = \int_{1}^{2} x^3 \, dx \).
   
a) Use the Fundamental Theorem of Calculus to evaluate \( I \) exactly.

   b) Write out and add up the four terms in the approximating sums

   \( L_{4} = \)

   \( R_{4} = \)
3. Evaluate. [Your final answer should not contain any integrals]:

a) \( \int x \sqrt{4 - 9x^2} \, dx \)

b) \( \int \frac{\sec^2(x)}{\sqrt{\tan(x)}} \, dx \)

4. Evaluate \( \int_0^{\pi/2} x \cos(x^2) \, dx \)
5. Use Euler’s method with four steps on the differential equation $y' = y + t$ to estimate $y(2.0)$ if $y(1.0) = 0$ by filling in the table.

<table>
<thead>
<tr>
<th>Step</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T$</td>
<td></td>
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<td></td>
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<tr>
<td>$y'(t)$</td>
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</tr>
<tr>
<td>$y(t)$</td>
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</tbody>
</table>

6. Write (but do NOT evaluate) an integral that gives the arc length of the graph of $y = \sqrt{x}$ over the interval $[0,3]$. 
7. If A is the region bounded by the graphs of $y = x^3$, $y = 1$, and $x = 2$, what is the volume of the solid obtained when A is revolved around the y-axis?

8. Find the solution of the initial value problem:

$$y' - \frac{x}{y^2} = 0 \text{ with } y(0) = 2$$
10. Let $A$ be the region bounded by the graphs of $y = \sqrt{r^2 - x^2}$ and $y = 0$. Using the techniques developed in class, find the volume of the sphere generated when $A$ is rotated about the $x$-axis.