1. Evaluate each of the following exactly. Show your work.
   a) \( \int_{1}^{2} x^4 \, dx \)
   
   b) \( \int_{0}^{1} e^{2x} \, dx \)
   
   c) \( \int_{0}^{\pi} \sin x \, dx \)

2. The rate of change of a population is given by \( r(t) = 5000 - 20t \) people per year, where \( t \) is measured in years. At time \( t = 0 \), the population is 400,000.
   a) What is the population at time \( t = 10 \)?
   
   b) When is the population largest? How large is it at that time?

3. An object’s velocity is decreasing. Some data are shown in the table below.

<table>
<thead>
<tr>
<th>t (seconds)</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v(t) ) (feet/sec)</td>
<td>50</td>
<td>30</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

   a) Give the best possible underestimate for the distance the object has traveled.

   b) Give the best possible overestimate for the distance the object has traveled.