1. \[ \int_0^1 3x^2 \, dx = x^3 \big|_0^1 = 1^3 - 0^3 = 1. \]

2. \[ \text{Present value} = \int_0^{10} (50+100t)e^{-0.05t} \, dt = \]
\[ = \left. \frac{1}{0.05} 50e^{-0.05t} \right|_0^{10} - \left. \frac{1}{0.05} (100te^{-0.05t}) \right|_0^{10} \]
\[ + \frac{1}{0.05} \int_0^{10} 100e^{-0.05t} \, dt \]
\[ = \frac{1}{0.05} 50e^{-0.05t} \big|_0^{10} - \frac{100}{0.05} e^{-0.05t} \big|_0^{10} - \frac{100}{0.05^2} e^{-0.05t} \big|_0^{10} \]
\[ = -81000(e^{-0.5} - 1) - 2000(10e^{-0.5}) + 40000(1 - e^{-0.5}) \]
\[ = 1000 + 4000 + (-1000 - 20000 - 40000)e^{-0.5} \]
\[ = 41000 - 61000e^{-0.5} \approx 4001.63. \]

3. The maximum and minimum occur either at a critical point or at the end point. For the critical points:
\[ f'(x) = e^{-x^{3/2}} + 10(-xe^{-x^{3/2}}) = (1-x^2)e^{-x^{3/2}} = 0 \]
where \( 1-x^2 = 0 \), that is, at \( x = -1 \) and \( x = 1 \). Tabulating the candidates for maximum and minimum:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>( \approx -1.9 \times 10^{-21} )</td>
</tr>
<tr>
<td>0</td>
<td>( \approx 1.9 \times 10^{-21} )</td>
</tr>
<tr>
<td>-1</td>
<td>( \approx -0.065 ) - minimum</td>
</tr>
<tr>
<td>1</td>
<td>( \approx 0.065 ) - maximum</td>
</tr>
</tbody>
</table>
4. \( P(0) = 6 \). \( P'(t) = 6 \cdot 0.03 e^{0.13t} \Rightarrow P'(0) = 0.078 \)
\( P(10) = 6 e^{0.13 \cdot 10} \approx 6.833 \); \( P'(10) = 6 \cdot 0.13 e^{0.13 \cdot 10} \approx 0.888 \).
These numbers mean that, in 1999, the population was 6 billion and growing at the rate of about 0.078 billion = 780 million per year.
In 2007, the predicted population will be 6.833 billion, and the population will be growing at the rate of about 88,800,000 per year.

5. (a) We compute \( \frac{dS}{dH} = q e^{-bH} + (aH)(-be^{-bH}) = 0 \)
\( \Rightarrow (q - abH)e^{-bH} = 0 \).

The maximum would then have to occur where \( a - bH = 0 \), that is, where \( H = \frac{1}{b} \).

(b) Increasing \( a \) increases the maximum value.

(c) The maximum value is \( S \mid H = \frac{1}{b} = \frac{qe^{-1}}{b} \). Thus, increasing \( a \) does not change the maximum value.