Problem 1. Tarun decided to run a marathon. However, he started off way too fast and so his speed decreased throughout the race. Below is a table showing how many miles he had run at various times during the race:

<table>
<thead>
<tr>
<th>time (min.)</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>150</th>
<th>180</th>
<th>210</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td>distance (miles)</td>
<td>5</td>
<td>9</td>
<td>12.5</td>
<td>15.5</td>
<td>18.5</td>
<td>21</td>
<td>23.5</td>
<td>25.5</td>
</tr>
</tbody>
</table>

Let \( s(t) \) denote Tarun’s distance from the starting line (in miles) \( t \) minutes after the beginning of the race.

(a) What is the practical interpretation of \( s'(120) \) in the context of this problem? [3 pts.]

(b) Estimate \( s'(120) \). (Show your work.) [3 pts.]

(c) What is the practical interpretation of \( s^{-1}(7) \) in the context of this problem? [3 pts.]

(d) Estimate \( s^{-1}(7) \). [3 pts.]

(e) What does the derivative of \( s^{-1}(x) \) at \( x = 7 \) represent in the context of this problem? [3 pts.]

(f) Estimate the derivative of \( s^{-1}(x) \) at \( x = 7 \). [3 pts.]
Problem 2. Write the limit definition of $f'(a)$. [4 pts.]

Problem 3. Suppose $f$ is a function with the following properties:
- $f$ is continuous and has a derivative everywhere.
- $f'(x) < 0$ for all $x$ in $[1, 5]$.
- $f''(x) > 0$ for all $x$ in $[1, 5]$.
- $f(1) = 9$
- $f(5) = 3$

(a) Sketch a possible graph for $f$. [4 pts.]

(b) What is the average rate of change of $f(x)$ on the interval $1 \leq x \leq 5$? [3 pts.]

(c) Which is greater, $f'(2)$ or $f'(4)$? Explain. [3 pts.]

(d) What is the interval of all possible values for $f(3)$? Explain using the known properties of $f$. [4 pts.]

(e) What is the interval of all possible values for $f'(3)$? Explain. [4 pts.]