Problem Definition

Problem 43. **Velocity and Acceleration** The velocity (in feet per second) of an automobile starting from rest is modeled by

\[ \frac{ds}{dt} = \frac{90t}{t + 10} \]

Create a table showing the velocity and acceleration at 10 second intervals during the first minute of travel? What can you conclude?

**Solution Step 1:**

The acceleration is found by computing the second derivative of the position variable, \( s \), or the first derivative of the velocity with respect to \( t \). The acceleration is given by

\[ \frac{d^2s}{dt^2} = \frac{d}{dt} \frac{90t}{t + 10} = \frac{90(t + 10) - 90t(1)}{(t + 10)^2} = \frac{900}{(t + 10)^2} \]

We will use the given velocity and this function to fill in the table.

**Solution Step 2:**

Using \( \frac{ds}{dt} \) and \( \frac{d^2s}{dt^2} \) the following table can be filled in.

<table>
<thead>
<tr>
<th>( t )</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>( s'(t) )</td>
<td>0</td>
<td>45</td>
<td>60</td>
<td>67.5</td>
<td>72</td>
<td>75</td>
<td>77.1</td>
</tr>
<tr>
<td>( s''(t) )</td>
<td>10</td>
<td>2.25</td>
<td>1</td>
<td>0.56</td>
<td>0.36</td>
<td>0.25</td>
<td>0.18</td>
</tr>
</tbody>
</table>

The interpretation is that the velocity is increasing. However, the acceleration is tending to zero. So, the car is approaching some cruising velocity.