Homework 1: Road Vehicle Performance

Textbook Assignment

<table>
<thead>
<tr>
<th>Problem</th>
<th>Value</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>10</td>
<td>Final weight = 2210.45 lb</td>
</tr>
<tr>
<td>2.7</td>
<td>10</td>
<td>185 ft-lb engine = 13.33 ft/sec²; 215 ft-lb engine = 14.15 ft/sec²</td>
</tr>
<tr>
<td>2.13</td>
<td>10</td>
<td>8.01 ft/sec²</td>
</tr>
<tr>
<td>2.14</td>
<td>10</td>
<td>219.9 mph</td>
</tr>
<tr>
<td>2.25</td>
<td>10</td>
<td>About 207 ft</td>
</tr>
<tr>
<td>2.28</td>
<td>10</td>
<td>You figure this one out</td>
</tr>
</tbody>
</table>

Additional Required Work (40 points)

Your final write-up should concise and to-the-point. Key answers and assumptions should be clearly stated and supporting calculations should be included after the write-up and referenced in the write-up.

Part 1

Pick a vehicle of your choice. Using Microsoft Excel (or a similar program) plot this vehicle’s theoretical braking distance (in feet) vs. speed (in mph) for speeds of 0 to 120 mph. Assume there are two people in the vehicle. Assume the following parameters:

- Braking efficiency = 95% for antilock brakes, 80% for non-antilock brakes
- Coefficient of road adhesion = 0.70
- Grade = 0% (flat)
- Air density = 0.0024 slugs/ft³
  - note: 1 slug = 1 lb force / (1 ft/s² acceleration)
  - note also: 1 lb force = 1 slug·ft/s² = 4.448 Newtons
- Mass factor = 1.04 (accounts for moments of inertia during braking)

This assignment will require you to look up the following vehicle characteristics:

- Coefficient of drag
- Frontal area = (height – ground clearance) × width
- Weight (unloaded and with two people in it)

Part 2

On the same graph, plot practical braking distance (in feet) vs. speed (in mph) for speeds of 0 to 120 mph. Use the AASHTO braking distance formula:

\[ d = \frac{V^2}{30 \left( \frac{a}{g} \right) \pm G} \]

where:
- \( V \) = vehicle speed in miles/hour
- \( a \) = deceleration rate in ft/sec² (use 11.2 ft/sec²)
- \( g \) = acceleration due to gravity (use 32.2 ft/sec²)
- \( G \) = grade in decimal form (e.g., 6% = 0.06)