Problem 1: 120 points

We consider an EV with a 40-kWh battery pack, a 90-% efficiency drivetrain and a 1-kW hotel load. The total car mass is 1,800 kg including the driver’s weight. The manufacturer data specify that $C_d = 0.28$ and the frontal area is $2.28 \, m^2$. The EV is used to travel on a flat, Midwestern highway. The driver is instructed to ensure that the battery charge does not drop below the 20 % level. The power requirements to provide the needed traction force under the conditions stated above are determined and are presented below for three distinct cruising speeds:

<table>
<thead>
<tr>
<th>speed in mph</th>
<th>required traction power in kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>3.67</td>
</tr>
<tr>
<td>70</td>
<td>16.10</td>
</tr>
<tr>
<td>75</td>
<td>40.50</td>
</tr>
</tbody>
</table>

The driver must reach the destination without a charging stop and he knows he can do so at the 45 mph cruising speed. **Determine** the ratio of the range the driver can attain with respect to the range at 45 mph at the two higher speeds. **State** and **justify** any assumptions you wish to make. **Show** all your work.
Problem 2: 80 points

For the statements below, circle each correct statement. We discourage guesses and it helps if you provide a justification of why you chose to circle or not circle the statement.

A. The 2020 US electricity generation had
   • about 40 % from CO$_2$-free source
   • about 60 % from fossil fuel as the primary energy source
   • hydroelectric generation as the largest source of renewable energy
   • solar energy provided nearly 4 times as much energy as that provided by wind

B. The following statements are on the US GHG emissions expressed in metric tons CO$_2$e:
   • the transportation sector GHG emissions exceed those from the electricity sector since 2013
   • the estimated 2021 GHG emissions indicate an increase over the actual 2020 value
   • during the 2019 – 2021 period, the GHG emissions from buildings were about equal to those from the electric power sector
   • the estimated 2021 GHG emissions indicate an increase over the actual 2019 value