## ECE 398GG

# **Homework 5 Solution**

#### Date due: Friday, March 10, 2023

2. *EPA* designated the 2019 *Chevrolet Cruze* as the *most fuel-efficient* mass-produced diesel vehicle with *FE* of 37 *mpg* diesel. **Show** that the improvement of its performance with respect to the average car on the road that had a 25-*mpg* gasoline performance in 2019 is 30.8 %.

#### Solution

 $37 \text{ mi/gal}_D \ge 1 \text{ gal}_D \text{ energy} = 37 \text{ mi/gal}_D \ge 1 \text{ gal}_D \text{ energy} / (1.13 \ge 1 \text{ gal}_G \text{ energy})$  $= 32.7 \text{ mi/gal}_G$  $32.7 \text{ mi/gal}_G / 25 \text{ mi/gal}_G = 1.308 == 30.8 \% \text{ higher FE than that of the average}$ car with 25 mpg performance

**3.** If we wish to take advantage of the higher energy efficiency of diesel fuel, we can use it as a fuel to power a diesel generator to produce electricity. Consider a generator that consumes 0.34-*gal* diesel to produce a continuous 4.5 *kW* electricity output. In the operation of this generator over an hour period, the injection of 0.34 *gal* diesel, with its energy contents of 0.34 *gal* x 38.3 *kWh/gal* = 13.02 *kWh*, results in the generator output of 4.5 *kWh*. As such, the generator efficiency is 34.6 %. Suppose we use the diesel generator output to directly charge the Tesla 3 LR vehicle with the *FE* of 25 *kWh*/100 *mi*. We assume a charging efficiency of 85 %. Show that the Tesla 3 charged by this generator travels 22 % farther than the *Chevrolet Cruze* for each diesel *gal* of fuel.

### Solution

 $1 gal_D \ge 38.3 \ kWh / gal_D \ge 0.346 \ge 0.85 \ge 100 \ mi / 25 \ kWh = 45 \ mi$