ECE 398GG Electric Vehicles Prof. G. Gross
Quiz 5 Spring 2023
Thursday, April yy, 9:30 a.m.
TIME 20 minutes

name: **last 4 digits of the UIN:**

Problem 1: 120 points

This problem requires you to either **prove** or **disprove** the statement in the last sentence of each part of this problem. You must **show** all your work and **state with justification** any assumptions you wish to introduce. Each of the three parts is worth **40 points**.

a. According to the *EPA*, the 2021 *GM Bolt* has a fuel efficiency of 29 *kWh*/100 *mi*. The corresponding fuel efficiency figure of merit in *mpge* (miles per gallon equivalent) is above 115 *mpge*.

b. Consider the use in 2020 in the Midwest of an *EV* with 25 *kWh*/100 *mi* fuel efficiency. The *EV* is charged with the electricity of the region with CO_2 total output emission rate of 984.98 *lb*/*MWh*, which is above the national average of 818.29 *lb/MWh*. The *EV*'s tailpipe emissions exceed 100 *g/mi*.

c. A possible replacement for fossil fuels is biomass, which can be burned in a steam generation plant. One such plant can convert each 1 *kg* of biomass into 1 *kWh* of electricity. We consider an *EV*, whose consumption is 25 *kWh*/100 *mi*, charged at a charger connected to the distribution grid with the electricity generated by the biomass steam plant. For an input of 20 *kg* of biomass into the plant, the *EV* can travel less than 25 *mi*. You may use in your proof the assumed efficiency values in the *w-t-w* analysis in the handouts.

Problem 2: 80 points

For the statements below, **circle** each correct statement. To receive full marks for each answer, we not only discourage guesses, but you **must** provide a justification of why you chose to circle or not circle each statement.

- We use the *EPA* fuel efficiency ratings in the *w-t-w* analysis for both the *ICEV*s and the *EV*s.

- An *EV* which is charged by CO_2–free electricity generated by renewable wind and solar resources and whose batteries are manufactured by CO_2-free electricity has life cycle emissions of 0 *g/mi*.

- The lower the electricity consumption in units of *kWh*/100 *mi*, the lower is the fuel efficiency in units of *mpge* (miles per gallon equivalent).

- The *w-t-w* analysis for an *ICEV* and an *EV* are identical and the decomposition is carried out into the same two components.

- The resource generation mix of the electricity where a vehicle is used impacts equally the efficiency and emissions analysis of both the *ICEV*s and the *EV*s.