Homework 8 Solution

1. **Identify** a similarity and a difference between levels 1 and 2 chargers.

   Both level 1 and 2 are AC and can be in the home or at work; both are also on board.

   Level 1 is at a lower voltage and at lower power than level 2.

2. The circuit below depicts a Zeta converter. Recall that for the periodic steady-state conditions, the following relations hold: \( \langle v_L \rangle = 0 \) and \( \langle i_C \rangle = 0 \). Note also that Kirchhoff’s voltage law applies for the average conditions equally well. **Determine** \( \langle V_t \rangle \), the average of the voltage across the capacitor \( C_t \).

   ![Zeta Converter Circuit](image)

   \[ \langle v_L \rangle + \langle V_c \rangle + \langle L_2 \rangle + \langle V_{out} \rangle = 0 \]

   \[ V_t = -V_{out} \]

3. Consider an energy buffer for a 6-kW, level 2 onboard charger. The battery has a 400-V nominal voltage. The distribution grid operates at a frequency of 60 Hz and a peak voltage ripple of 8 V. **Determine** how large of a capacitor is needed to buffer the twice line-frequency power.
\[ C = \frac{P}{2\pi f \cdot V_{ei} \Delta V} = \frac{6000}{2\pi \cdot 60 \cdot 400 \cdot 8} \]
\[ = 5 \text{ mF} \]