THE DEMONSTRATION CORNER

Induction Puzzle

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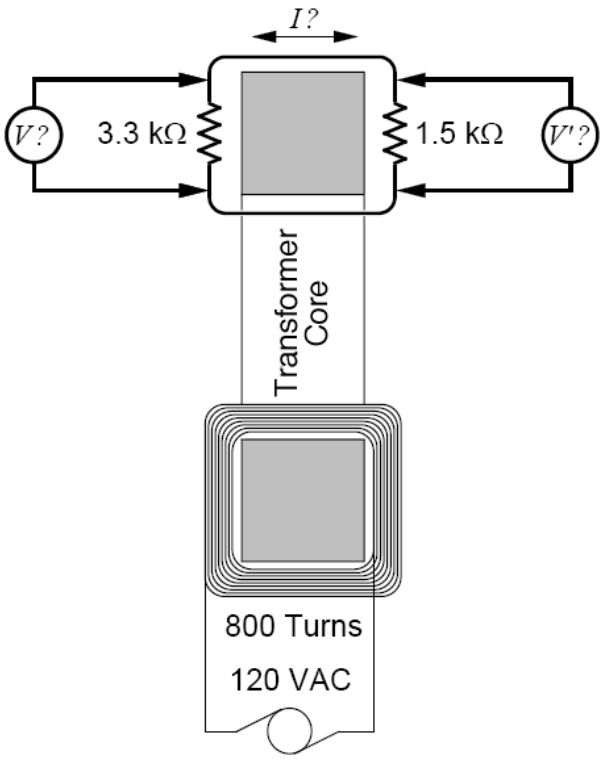

Here's a demonstration that will make your students think more carefully about the meanings of the terms voltage, electromotive force, and potential difference. A transformer is necessary for the demonstration. Any discarded transformer with 120-volt primary winding is suitable. If the secondary can be stripped and the core left bare it will greatly improve the clarity of the apparatus. At SFU we use a dissectible transformer.[1]

Two resistors with different resistances are soldered together as a one-loop secondary as shown in the diagram. Two digital AC voltmeters are connected across the resistors as shown. The primary is then connected to the mains, and *the voltmeters read different values*! The calculation (shown below) is straightforward, but the student must think long and hard to understand why two voltmeters connected to the same terminals in a circuit should exhibit different readings. The student who does so will learn much about the difference between "emf" or "voltage," and the concept of "potential difference" which is inapplicable in this time-dependent case.

$$\text{emf} = \frac{120\ \text{V}}{800} = 150\ \text{mV}$$

$$I = \frac{150\ \text{mV}}{3.3\ \text{k}\Omega + 1.5\ \text{k}\Omega} = 31.3\ \mu\text{A}$$

$$V = 31.3\ \mu\text{A} \times 3.3\ \text{k}\Omega = 103\ \text{mV}$$

$$V' = 31.3\ \mu\text{A} \times 1.5\ \text{k}\Omega = 47\ \text{mV}$$

[1] A similar apparatus is listed by Sergeant-Welch. See http://www.sargentwelch.com and search for "Dissectible Transformer."

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Submissions describing demonstrations will be gladly received by the column editor.