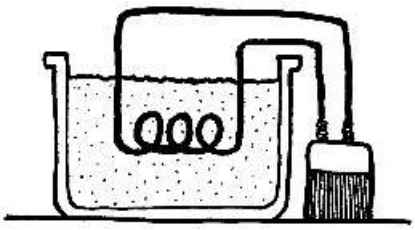
NAME _____ DATE _____

Scenario

Carlos bends a wire of conductive material into a coil and connects the wire directly to the battery's terminals. He finds that the coil becomes hot when connected to the battery. He immerses the coil into water in order to heat the liquid water from $0°\text{C}$ *to* $100°\text{C}$ *and observes that it takes a time* t *to bring the water from* $0°\text{C}$ *to* $100°\text{C}$.



Carlos supposes that using a longer wire with the same thickness will result in the water heating faster. Upon using a longer wire, he is surprised to discover that the water takes longer to go from $0°\text{C}$ *to* $100°\text{C}$.

Argumentation

PART A: By citing, but NOT manipulating, specific equations about resistance, potential difference, current, and power, explain qualitatively why it is that a longer wire causes an increase in the time to bring the water from $0°\text{C}$ to $100°\text{C}$. Frame this explanation as a paragraph-length response and discuss specific quantities that increase, decrease, or remain the same as the wire is lengthened.

Quantitative Analysis

PART B: Suppose that the wire has a cross-sectional area A, length L, and resistivity ρ. The potential difference of the battery is V. The amount of energy required to bring the water from $0°\text{C}$ to $100°\text{C}$ is E. Derive an equation that gives the time t in terms of A, L, ρ, V, and E.

Design an Experiment

PART C: Using your equation as evidence, name two things (other than decreasing the length of the wire) that Carlos could do to decrease the time it takes for the water to go from $0°\text{C}$ to $100°\text{C}$.