Name_____ Period_____ Date_____

CONCEPTUAL PHYSICS **Experiment**

22.4 Heat Transfer: Emission of Radiant Energy

CANNED HEAT: COOLING DOWN

Purpose

In this experiment, you will compare the ability of different surfaces to radiate thermal energy.

Required Equipment and Supplies

radiation cans: silver and black
thermometer
access to hot water
paper towel
graph paper

Discussion

Does the color of a surface make a difference in how well it radiates thermal energy? If so, how? The answer to these questions could help you decide what color coffee pot will best keep its heat and what color might be used to radiate heat away from a computer chip. In this experiment, we will compare the thermal radiation ability of two surfaces: silver and black. We'll do this by filling cans with these surfaces with hot water, then letting the water cool down. We'll measure the temperature of the water in both cans while they're cooling down and see if there's a difference in the rate at which the temperatures decrease.

Procedure

1. In which of the two cans do you think the water will cool down at the faster rate?

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2. In which of the two cans do you think the water will cool down at the slower rate?

Step 1: Carefully fill the cans with hot water and wipe up any spills. Quickly measure the initial temperature of the water in each of the cans and record it in Table A. Place the thermometer in the silver can.

Step 2: At the 1-minute mark, read the temperature of the water in the silver can and record it in Table A. Quickly move the thermometer to the black can. Gently swirl the water in the can with the thermometer.

Step 3: At the 2-minute mark, read the temperature of the water in the black can and record it in Table A. Quickly move the thermometer to the white can. Gently swirl the water in the can with the thermometer.

Step 4: Repeat steps 2–3 until the 20-minute mark temperature reading is made.

Table A

Silver Can Temperatures (°C)	Black Can Temperatures (°C)
Initial	Initial
T at 1:00	T at 2:00
T at 3:00	T at 4:00
T at 5:00	T at 6:00
T at 7:00	T at 8:00
T at 9:00	T at 10:00
T at 11:00	T at 12:00
T at 13:00	T at 14:00
T at 15:00	T at 16:00
T at 17:00	T at 18:00
T at 19:00	T at 20:00

3. Plot your data for both cans on a single temperature vs. time graph.

Step 5: Determine the change in temperature for the water in each can while it was allowed to cool.

4. Determine the temperature change in the silver can. Subtract the 1-minute mark temperature reading from the 19-minute mark temperature reading.

   Temperature change in silver can: _____°C

5. Determine the temperature change in the black can. Subtract the 2-minute mark temperature reading from the 20-minute mark temperature reading.

   Temperature change in black can: _____°C

Summing Up

1. In which can did the water cool down at the faster rate? In which can did the water cool down at the slower rate? Did your observations match your predictions?

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2. What color should the surface of a coffee pot be in order to keep the hot water inside it hot for the longest time?

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3. The central processing units (CPUs) in personal computers sometimes get very hot. To prevent damage and improve processing speed, they need to be kept cool. Often, a piece of metal is placed in contact with the CPU to draw some heat away. The metal then radiates its heat to the surroundings. To best remove heat from the CPU, should the metal's surface be colored black or left silvery?
