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HEAT ABSORPTION AND RADIATION

CAT NO. PH0467HAR



Experiment Guide

KIT CONTENTS

ITEM	QUANTITY	DESCRIPTION
1	1	Thermal absorption/radiation apparatus
2	1	White screen
3	1	Instructions

ADDITIONAL MATERIALS NEEDED:

Two Celsius thermometers
12-V power supply
Stopwatch
Graph paper

OVERVIEW / SUGGESTIONS FOR USE

The thermal absorption and radiation apparatus offers a unique way to demonstrate the conversion of radiant energy to thermal energy. When a thermometer is placed behind each reflector, and the light bulb is turned on, students can easily see that more radiant energy is absorbed by the black reflector and converted to thermal energy. The apparatus allows comparison of thermal absorption and thermal radiation rates.

SAFETY

- The light bulb will become hot during the demonstration DO NOT TOUCH the bulb until it has cooled.
- The port for the thermometers is metallic. Insert the thermometers carefully so that they do not break.

BACKGROUND

When light shines on a surface, some radiant energy is absorbed by the object, while some is reflected. Black absorbs all colors and the most radiant energy when placed in front of a light. The radiant energy absorbed is converted to heat. White or shiny surfaces reflect many colors and do not absorb as much radiant energy. A substance emits thermal energy at the same rate at which it absorbs thermal energy.

The apparatus allows two thermometers to be placed in the ports (A) behind the reflectors. (See Figure 1, below.) The temperature of the reflectors can be easily measured at any time intervals. The light bulb (B) is centered between the two reflectors so that both receive the same amount of radiant energy at the same distance.

The sample data below shows the temperature changes that occurred during one demonstration. Your results may vary.

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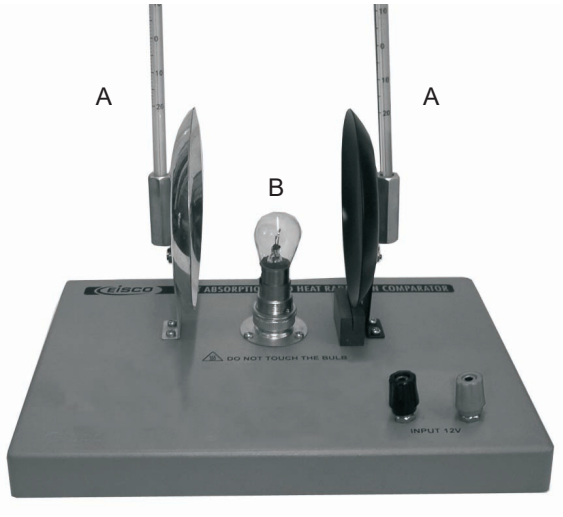
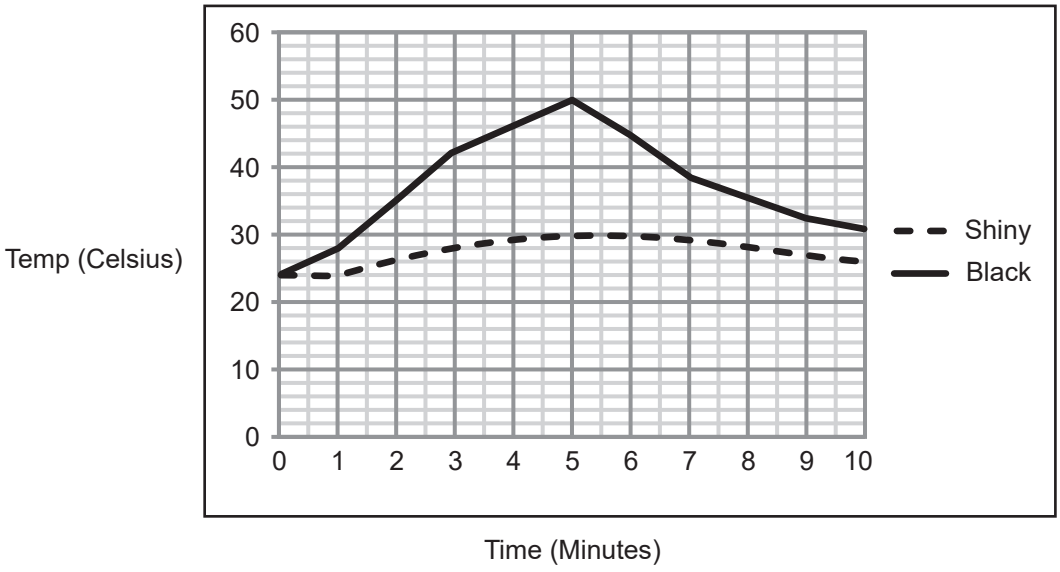


Figure - 1: Parts of the Apparatus

Sample Data : Temperature Versus Time

Voltage : 10 V

Time	Temperature of Shiny Reflector (°Celsius)	Temperature of Black Reflector (°Celsius)
0	24	24
1	24	28
2	26	32
3	28	40
4	29	42
5	30	45
6	30	42
7	29	39
8	28	36
9	27	33
10	26	31



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MATERIALS

- Heat absorption and radiation apparatus
- Two Celsius thermometers
- Stopwatch
- 12-V power supply
- Graph paper

PRIOR TO EXPERIMENT

1. Place all the materials in a central location.
2. Carefully insert the two thermometers as indicated in Figure 1.
3. Connect a 12-V power supply to the banana-plug ports on the apparatus. (AC or DC will work.)
4. Have the stopwatch ready.
5. Make a chart on the board similar to the one on page 2, so students can record data from the demonstration

INTRODUCTION

Ask the following questions prior to the demonstration:

- Will these two reflectors heat up at the same rate when the bulb between them is turned on?
- How will the rate of cooling compare to the rate of heating?

DEMONSTRATION

Note: A voltage of 10 V yields a good amount of heat without being too bright. The instructions below detail a 10-minute process, but this can be extended. The longer the demonstration continues, the more impressive the results.

1. Record the temperature of the two reflectors on the board.
2. Turn on the power supply and start the stopwatch.
3. Record the temperature of both reflectors at 1-minute intervals for 5 minutes.
4. At the end of 5 minutes, turn off the bulb and record the temperature of both reflectors at 1-minute intervals for another 5 minutes.
5. Ask the students, "Based on the results so far, which reflector do you think will completely cool faster?"
6. At the end of the demonstration, have students graph the results.

FOLLOW UP QUESTIONS

- Can you make any predictions about how the rate of heating any object compares to the rate of cooling?
- If the experiment were to be repeated with a thin white barrier in front of the black reflector, how would the results be affected? (If you have time, this is a good extension of the experiment.)

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