Infrared emission: black and shiny surfaces

Student activity • observation and reasoning

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The question

How do surfaces at the same temperature differ in infrared emission?

Use a warm Leslie cube and an infrared radiation detector to compare a matt black face with a polished face at the same distance.

Equipment

- Leslie cube, contact thermometer, warm water and tray
- Infrared radiation detector with stand and ruler

Staff fill and handle the warm cube on a stable tray. Avoid contact with hot surfaces; allow cooling before draining. Keep electrical detector connections dry. No open flame or radiant heater is used.

Course coverage: Shared Physics / Double Award: 4.6, 4.8, 4.9. Radiation and surface properties.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Observe the staff-mounted Leslie cube on a spill tray. Identify the black and shiny faces and measure the room temperature.

2. Staff fill the cube with water at no more than 60 °C, within its marked capacity, and measure the water temperature using a contact thermometer. Wait for the faces to warm.

3. Place the infrared detector on its stand at the same marked distance and orientation from the centre of the black face. Record its stable signal and unit.

4. Repeat at the shiny face. Keep other hot objects and people out of its reflected field. Alternate black and shiny readings three times while monitoring the water temperature.

5. Compare the signals, noting any cooling or background changes. Explain why a shiny surface can reflect radiation from its surroundings.

6. Distinguish a detector signal from a true surface-temperature reading. Discuss why coloured paper wrapped round cooling tubes would also change conduction and convection.

Cleanup

- Staff allow the cube to cool before draining. Dry the tray and store the detector.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The two faces are approximately at a common temperature. Record the detector's actual signal unit. An infrared thermometer with a fixed emissivity setting can display a misleading apparent temperature on a shiny surface; it is not evidence that the shiny face is physically colder.

Trial	Black signal / unit	Shiny signal / unit	Water / °C
1			
2			
3			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Why use faces of the same cube?

2. Which surface is normally the stronger emitter?

3. Why fix detector distance?

4. Does radiation require air?

5. Why avoid reflected warm objects?

6. Can a cooling-tube test isolate radiation perfectly?