Finding Smiley Lab

Teacher's Guide

Topic:

Reflection and Mirrors

The following information is provided to the student:

> **Question:**
> How can a graphical representation of object distance and image distance be interpreted? What meaning can be gleaned from the graph?
>
> **Purpose:**
> To graphically represent the relationship between the object distance and the image distance (for a concave mirror) and to glean meaningful information from the graph.
>
> A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion/Discussion. The Data section should include a table of d_{object} and d_{image} data and a plot of image distance vs. object distance. A best fit line should be included on the plot; strategic locations and distances should be marked (for subsequent reference in the Discussion section). The Conclusion/Discussion section should describe the relationship between the two quantities and extract a wealth of meaning regarding object-image distance relationships. Writing should be clear, specific and thorough.

Materials Required:

Small concave mirror (focal length of 15 cm-20 cm; diameter of 4 to 6 cm); mirror holder; 7-Watt night light bulb; bulb base; large note card; meter stick.

Description of Procedure:

The meter stick is placed upon the lab table. The mirror and mirror holder are positioned at the 0.0-cm mark on the meter stick. The light bulb (affectionately known as "Smiley") is placed at the 100.0-cm mark on the meter stick. The light reflected from the mirror is projected onto a note card. The note card is slowly moved from the mirror backward along the meter stick until a focused image of Smiley is observed on the card. Once found, both object and image distances are recorded in a data table. The object is moved closer to the mirror (by 5.0 or 10.0 cm) and the procedure of finding the image is repeated. Data is recorded. The procedure continues for smaller and smaller object distances. Once the image distance begins to make considerable movement from one trial to the next, the object distances are altered less and less from trial to trial. Data collection ceases when the object is so close to the mirror that the image is virtual (and not projectable). The data are plotted and the questions raised in the Purpose of the lab are answered.

Alternative Materials and Procedure:

Some schools may have access to sophisticated optics bench equipment which makes the task of data acquisition quicker and easier.

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.
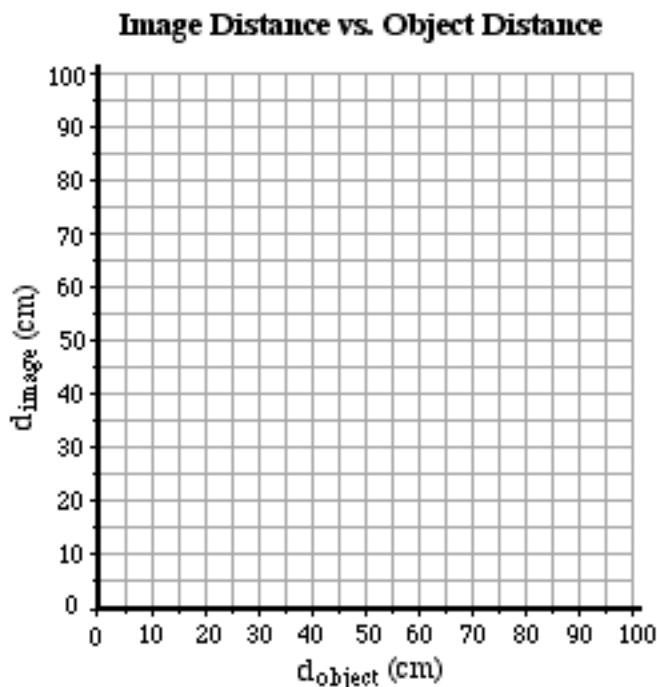
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Suggestions, Precautions, Notes:
1. Night light bulbs can be purchased at home stores and department stores. A permanent marker can be used to draw a picture of a smiley face on the part of the bulb facing the mirror.
2. Some students will tend to place the note card in between the mirror and the light bulb, blocking the light from reaching the mirror. It may be necessary to slightly adjust the mirror so that it reflects light along a different line than the line from Smiley to the mirror.
3. If students sight in the mirror at the image of Smiley and observe it to be upright, then Smiley is positioned inside of the focal point and the image is virtual.
4. This lab represents an exercise in the interpretation of graphs. The graph can be constructed the day of the activity and referred to throughout the discussion of curved mirrors. Students may not have immediate insight into the subtle meanings of the graph. At first, it will likely look like a pretty curve.
5. Label the mirrors using a marker, giving each a unique number or letter. Have students record the number or letter of the mirror which they used. The same mirror can be used in subsequent labs.

Auxiliary Materials:

The following page is provided to the student for completion and inclusion in the Data section of their lab notebook.

Image Distance vs. Object Distance

[A blank graph with d_{image} (cm) on the vertical axis ranging from 0 to 100 and d_{object} (cm) on the horizontal axis ranging from 0 to 100.]

Scoring Rubric:

RM9. **Finding Smiley Lab**	Score
____ Included, labeled and organized all parts of the lab report. ____ Data section includes a table of data; columns are labeled; units are stated. A plot of image distance vs. object distance is included; axes are labeled; best fit line is drawn. Strategic locations on the graph are labeled (for example, the m=1 line, the two asymptotes, etc,). Locations are used in the	____/____

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<table>
<tr>
<td>____</td>
<td>Discussion section.
Conclusion/Discussion section describes the relationship between the two quantities. Seemingly hidden information is extracted from the graph and described clearly and accurately. Writing is clear and organized. All conclusions are supported by constructions made on the graph in the Data section; the logical connections between data and conclusions are explained.</td>
<td></td>
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Connections to The Physics Classroom Tutorial:

The following reading is a suitable accompaniment to this lab:

http://www.physicsclassroom.com/Class/refln/u13l3f.cfm

http://www.physicsclassroom.com/Class/refln/u13l4d.cfm

Connections to Minds on Physics Internet Modules:

Sublevels 7 and 10 of the Reflection and Mirrors module are suitable accompaniments to this lab:

http://www.physicsclassroom.com/mop/module.cfm