Reflection: measuring angles from the normal

Student activity • investigation and reasoning

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The question

How does the reflected angle compare with the incident angle?

Trace a narrow light beam at a plane mirror and measure both angles from the normal.

Equipment

- LED ray box, mounted mirror, paper, ruler and protractor

Use low-voltage LED ray boxes, not lasers. Keep beams on the bench and never look into them. Check mirrors for chips and keep them mounted. Secure leads and switch off before moving equipment. Leave room lighting sufficient for safe movement.

Course coverage: Shared Physics / Double Award: 3.9, 3.14, 3.15. Reflection and the law of reflection.

Plan, model or apparatus sketch

Draw the apparatus and wave or ray directions; label the normal or equilibrium position where relevant.

Method and reasoning

Read the whole sequence before starting

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1. In ten groups of three, place a mounted plane mirror on plain paper. Mark the reflecting surface position and draw a normal perpendicular to it at the intended point of incidence.

2. Use a low-voltage LED ray box with a single slit. Aim the beam along the paper at about 20° to the normal, keeping the mirror fixed and the beam below eye level.

3. Mark two well-separated points on each incident and reflected ray. Switch off and remove the mirror before joining the points with a ruler and adding direction arrows.

4. Measure incidence and reflection angles from the same normal, record the actual readings and calculate r − i. Do not substitute the target angle for your measurement.

5. Repeat on fresh diagrams at about 35°, 50° and 65°. At one setting, repeat the complete tracing after repositioning the mirror to assess repeatability.

6. Compare the measured angles and discuss beam width, mirror alignment and protractor resolution. Explain why angles from the surface would be complementary to those from the normal.

Cleanup

- Switch off, collect mirrors safely in their holders and retain labelled ray traces.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The law of reflection is i = r, with both angles measured from the normal. A rear-silvered mirror can produce a faint secondary reflection; use the main reflected beam and record the limitation. Equal angles are the model prediction, not values to copy into the results.

Target i / °	Measured i / °	Measured r / °	r – i / °
20			
35			
50			
65			
Repeat one			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Where is the normal drawn?

2. What does the law predict?

3. What is wrong with measuring from the mirror surface?

4. Why mark widely separated points?

5. Why repeat the whole tracing?

6. If i = 35°, what is the predicted r?