
Challenge 1: Solution Guide

1. *What is the shape of a flashlight's reflector? Find and verify the equation of this shape.*

Students will probably start with a parabola. They will need to measure key points, for example, the x-intercepts on the “diameter” and the vertex. To find the vertex, they should use the “depth” of the reflector.

Using these three points, students can determine a parabolic equation to model the cross section of the reflector. However, the reflector’s cross section is not necessarily a parabola. Students should choose other points on the line of the reflector’s cross section to test their model. To find other points, students might project the image of the reflector on a large sheet of graph paper, using the overhead projector, and trace the curve of the reflector. Then they can choose several points to develop and test their models. They should test other conics to see which fits the curve best.

2. *Is the light source at the focal point of the cone of light?*

Students should measure to find the coordinates of the light source. If possible, they should use the filament of the bulb as the light source, not the bulb itself.

Shine the light on the wall. How does the shape on the wall change as you change the angle of the flashlight? Creating a circle of light may be easy, but how would you change the circle to an ellipse? Can you make a parabola?

The shape on the wall changes as the angle changes. The shape of the flashlight’s beam is a cone. When the beam strikes a plane, such as a sheet of paper, the plane acts like a knife, cutting a cross-section through the cone. A circle appears if the plane is perpendicular to the axis of the cone. A hyperbola appears if the plane is parallel to the axis of the cone. An ellipse appears if the plane cuts through the side of the cone at an acute angle. A parabola appears if the plane cuts through the bottom of the cone.

3. *Trace the reflections on a piece of paper and determine the conics you have created. Justify your choice of conic by determining and verifying the equation of each.*

Students should create a circle, an ellipse, and a parabola by changing the angle of the flashlight. They can trace the reflections on graph paper, choose several points for finding a model, and pick other points to test their models.

Extend this challenge by asking students to create a hyperbola. One way to obtain a hyperbola is by using a table lamp with a shade.

4. *Find out about a satellite dish in your area and use the dimensions of the dish to determine which conic it resembles.*

Some students may have access to satellite dishes for television reception, or they might find photos of satellite dishes which they could use for measuring. Students could contact local telecommunications networks for information about satellite dishes or search the Internet for satellite-dish retailers whose online catalogues provide specifications for the dishes.

Challenge 2: Solution Guide

Find a picture in a magazine, or a logo, that includes a curve that you think resembles a conic—an ellipse, a parabola, or a hyperbola. ...

Students might bring in old magazines for clipping pictures (so that photos are not taken from library sources). Students may want to choose several pictures to find one that is a “good fit” for a conic.

Make a conjecture about the type of conic. ...

In choosing a picture, students probably had a particular conic in mind. They should write their conjectures and state why they chose a particular conic as a model.

Trace the curve on a piece of paper. Then draw an x-y plane on graph paper. Centre the curve about the origin of the coordinate plane. ...

Students must trace accurately to get accurate data points. Using “fine” graph paper, that is, graph paper with a narrow grid system, may help. Encourage students to line up the conic so that its vertex, and hopefully other points, pass through visible intersection points on the grid paper.

Choose several points on the curve and model the curve by determining an equation. ...

Choosing accurate points is important for deciding an appropriate model. Students should choose three or four points for modelling the curve. They should test these points for their original conjecture.

Test other points on the curve to see how well they “fit” your algebraic model or equation. ...

Now students should choose several other points and substitute them in their equations to determine whether the model is a good “fit.” They might decide that another conic is more appropriate and then test the new model.

Make a conclusion about the appropriateness of your model and justify your reasoning. ...

Students should confirm or reject their original conjectures and discuss their explorations, including any models that they tested.

Present your results as a poster and be sure to include the original picture or a photocopy.

Students should also submit a written explanation of their explorations.