Express your answers (a) by a three-ray diagram, and (b) by calculation with the imaging formula.

Set I: Spherical Mirrors and Refractive Surfaces

1. An object 3 cm high is placed 20 cm from (a) a convex and (b) a concave spherical mirror, each of 10-cm focal length. Determine the position and nature of the image in each case. (Example 2-1, page 30)

2. A person whose face is 25 cm away looks into the bowl of a soupspoon and sees his/her image reflected with magnification –0.064. What is the approximate radius of curvature of the spoon?

3. Example 2-2 (Refraction at a spherical surface)

4. HW#3 Crystal Ball

A fortune teller's "crystal ball" (actually just glass) is 13 cm in diameter. Her secret ring is placed 6 cm from the edge of the ball.

An image of the ring appears on the opposite side of the crystal ball. How far is the image from the center of the ball?
Set II: A Thin Lens

Example 1: Object outside Focal Point (of a Convergent/Positive Lens)

A 1-mm-high object is placed on the optical axis, 200 mm left of a thin lens (f = 50 mm). Where is the image formed, and what is the transverse magnification?

![Example 1 Diagram](image1.png)

Figure 1.2 Example 1 (f = 50 mm, s = 200 mm, s'' = 66.7 mm)

Example 2: Object inside Focal Point (of a Convergent/Positive Lens)

The same object is placed 30 mm left of the same lens. Where is the image formed, and what is the transverse magnification?

![Example 2 Diagram](image2.png)

Figure 1.3 Example 2 (f = 50 mm, s = 30 mm, s'' = −75 mm)
Example 3: Object at Focal Point (of a Divergent/Negative Lens)

A 1-mm-high object is placed on the optical axis, 50 mm left of a thin lens (f = 50 mm). Where is the image formed, and what is the magnification?

![Image of lens and object setup](image.png)

Figure 1.3 Example 2 (f = 50 mm, s = 30 mm, s′ = −75 mm)

Set III: Lens Combination

1. Example 2-3 & Lab Appendix II
Extra Credit.

Lenses, Glasses, and Total Internal Reflection. (0.2 point)
due in class on Sep. 20

For the combination of two lenses shown below, find the location and size of the final image when the object, length 1 cm, is located as shown in the figure.