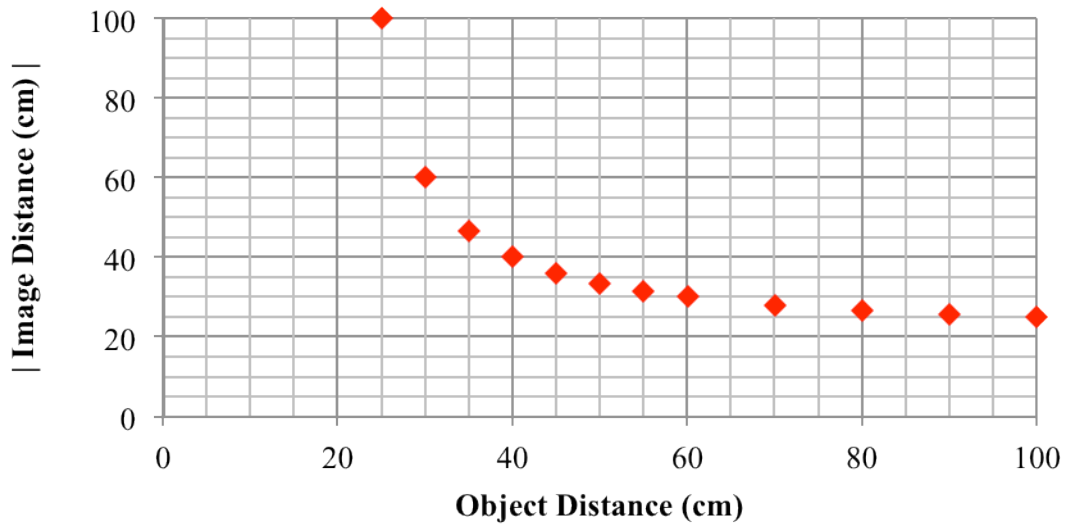


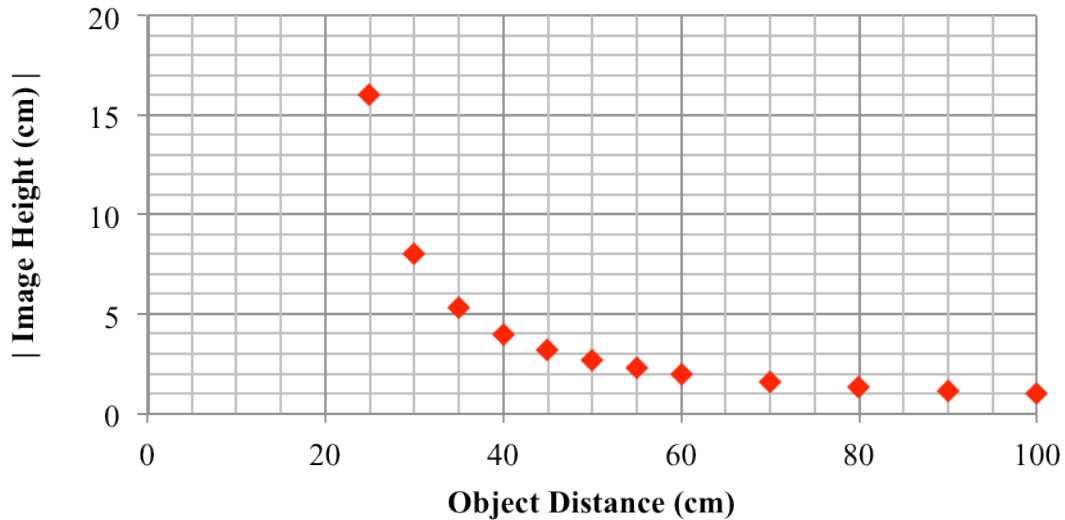
### Object-Image Relationships

Two physics students are conducting an investigation on how the characteristics of the images formed by a concave mirror depend upon the object's distance from the mirror. They acquire a small concave mirror with a 20.0-cm focal length ( $f$ ) and mount it on a lab bench. They place a 4.0-cm high light bulb at varying distances from the mirror and project the image of the light bulb onto a note card. They measure the object distance ( $d_o$ ) to the mirror, the image distance ( $d_i$ ) to the mirror, and the image height ( $h_i$ ). **Figure 1** and **Figure 2** show a representation of their data.

**Figure 1**



**Figure 2**





### Questions:

- Which statement describes the relationship between image height and object distance?
  - They are directly related.
  - They are inversely related.
  - They do **not** affect one another.
  - There is no predictable relationship.
- Which two changes are observed in the image as the object is moved closer to the surface of the mirror?
  - Both the image height and the image distance increase.
  - Both the image height and the image distance decrease.
  - The image height increases and the image distance decreases.
  - The image height decreases and the image distance increases.
- How does the size of the image compare to the size of the object when the object is placed a distance of three focal lengths ( $3 \cdot f$ ) from the mirror?
  - The image is larger than the object.
  - The image is smaller than the object.
  - They are the same size.
  - No such prediction can be made with this info.
- Where is the image located when it is the largest?
  - The image is equally large at all locations.
  - The image is largest when it is positioned closest to the mirror.
  - The image is largest when it is positioned furthest from the mirror.
  - There is no way to predict since there is no relationship between image size and location.
- At what object distance is the image the same size as the object?
  - The object and the image are never the same size.
  - The object and image are the same size when the object distance is 20 cm.
  - The object and image are the same size when the object distance is 40 cm.
  - The object and image are the same size when the object distance is 90 cm.
- At what position must the object be located in order for the image to be one-half the size of the object?
  - The image is never one-half the size of the object.
  - The image is one-half the object's size when the object distance is approximately 30 cm.
  - The image is one-half the object's size when the object distance is approximately 40 cm.
  - The image is one-half the object's size when the object distance is approximately 60 cm.
- Based on the trend observed for the largest object distances, what might be expected if the object distance is increased beyond 100 cm?
  - The image distance would not decrease below 20 cm.
  - The image distance would approach a very large value.
  - The image distance would be equal to the object distance.
  - The image distance would begin to increase again.

8. How does the size of the image compare to the size of the object when the image is a distance of 100 cm from the mirror?
- a. The image is two times larger than the object.
  - b. The image is four times larger than the object.
  - c. The image is 16 times larger than the object.
  - d. The image size cannot be compared to the object size using the given information.
9. How *tall* is the image when it is located 25.0 cm from the mirror?
- a. Approximately 1.0-cm tall.
  - b. Approximately 4.0-cm tall.
  - c. Approximately 9.0-cm tall.
  - d. Approximately 16.0-cm tall.
10. Use **Figure 1** and **Figure 2** to estimate the image height when the image is located a distance of 80.0 cm from the mirror.
- a. Approximately 1 cm
  - b. Approximately 12 cm
  - c. Approximately 27 cm
  - d. Approximately 32 cm