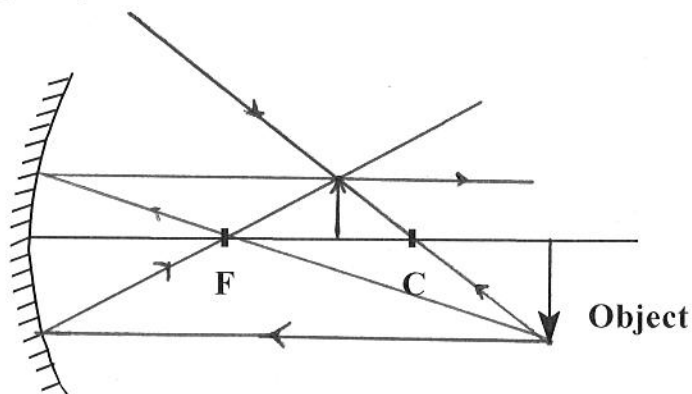


### Optics Assignment 3

1. You want to project a real image of an object using a concave mirror. This object is placed below the principal axis of the mirror.



Locate and draw the image by means of the appropriate ray diagram.

2. An object, 45.0 cm high, is placed in front of a convex mirror. A virtual image, 15.0 cm high, is formed.

The focal length of the mirror is -30.0 cm.

At what distance is the object from the mirror?

A) 20.0 cm

B) 60.0 cm

C) 90.0 cm

D) 120.0 cm

$$\frac{h_i}{h_o} = \frac{-d_i}{d_o} \quad \frac{15.0\text{cm}}{45.0\text{cm}} = \frac{-d_i}{d_o}$$

$$\frac{1}{3} = \frac{-d_i}{d_o}$$

$$d_o = -3d_i$$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

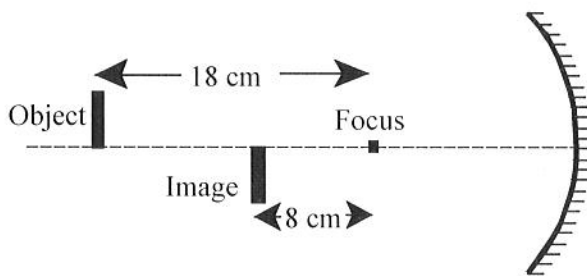
$$\frac{1}{-30} = \frac{1}{d_i} + \frac{1}{-3d_i}$$

$$\frac{-1}{30} = \frac{2}{3d_i}$$

$$d_i = -20\text{cm}$$

$$d_o = 60\text{cm}$$

3. An object with a height of 6.00 cm is placed in front of a spherical, concave lens at  $d_o = 30.00$  cm. Its image forms at  $d_i = 20.00$  cm.



**Note:** The diagram is not to scale.

What is the height of the image?

A) 4.00 cm

B) 2.67 cm

C) 9.00 cm

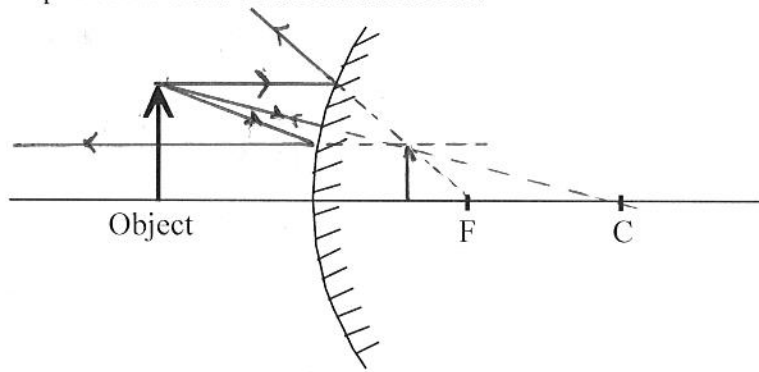
D) 0.33 cm

$$\frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

$$\frac{h_i}{6.00\text{cm}} = \frac{-20.00\text{cm}}{30.00\text{cm}}$$

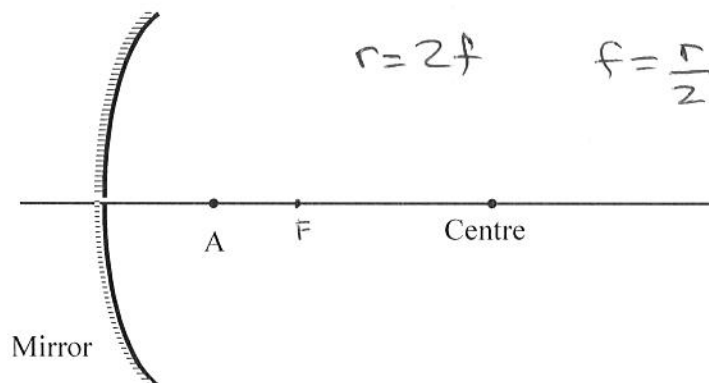
$$h_i = -4.00\text{cm}$$

4. An object is placed in front of a convex mirror.



- Trace the direction of the appropriate rays to locate the position of the image on the diagram.
  - Determine the height of the image in cm.  $\sim 0.7 \text{ cm}$
5. An object is placed in front of a plane mirror. Which statement **correctly** describes the characteristics of the image?

- The image is real, upright, smaller than the object and located in front of the mirror.
  - The image is virtual, inverted, larger than the object and located behind the mirror.
  - The image is real, inverted, the same size as the object and located in front of the mirror.
  - The image is virtual, upright, the same size as the object and located behind the mirror.
6. An object is placed at point A in front of a concave mirror, as shown in the diagram below.

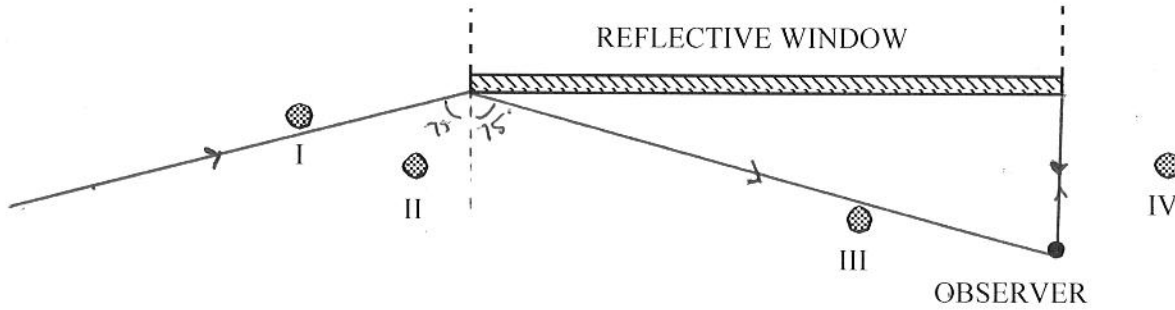


Which of the following characteristics will the image have?

Object between  
F + V :

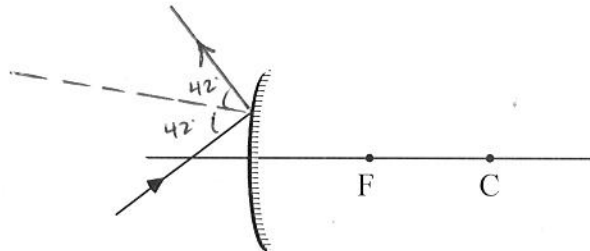
- Virtual and inverted
- Virtual and upright (larger)
- Real and inverted
- Real and upright

7. An observer is standing in front of a reflective window in which he can see the images of some shrubs.

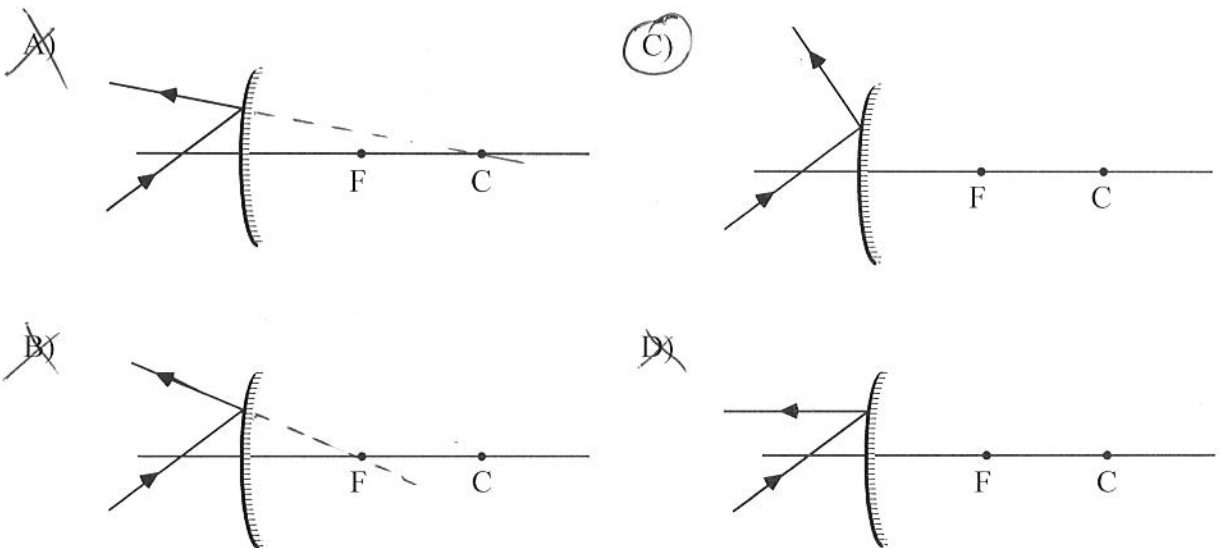


Based on the above diagram, the images of which shrubs can be seen by the observer?

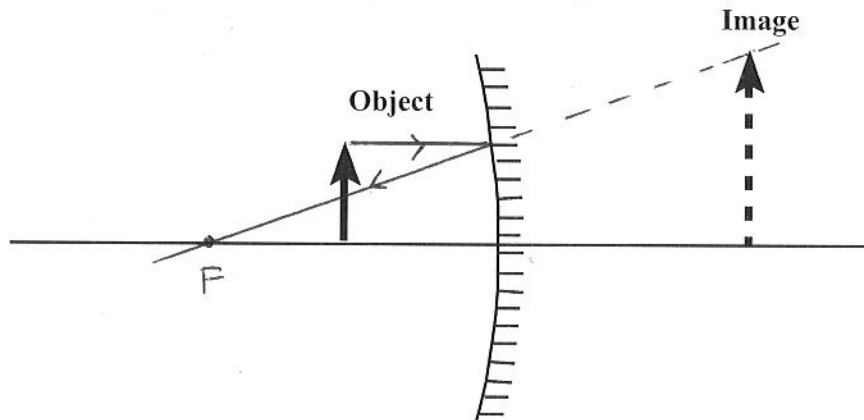
- A) III only
  - B) II and III only
  - C) III and IV only
  - D) I, II, III and IV
8. The diagram below shows a light ray incident on a convex mirror.



Which of the following diagrams best represents the path of the reflected ray?



9. The following diagram represents an object and its image formed by a concave mirror.



Indicate the position of the principal focus of this mirror by drawing the appropriate light rays.

10. A convex mirror produces an image that is 6 times smaller than the object. The focal length of the mirror is 40 cm.

What is the image position?

11. A concave mirror produces an image that is 15 cm from the object. The focal length of the mirror is 8.0 cm.

Determine the object and image position.

$$10. f = -40 \text{ cm}$$

$$M = +\frac{1}{6} = -\frac{d_i}{d_o}$$

$$d_o = -6d_i$$

$$\frac{1}{-40} = \frac{1}{-6d_i} + \frac{1}{d_i}$$

$$-\frac{1}{40} = \frac{5}{6d_i}$$

$$d_i = -33.3 \text{ cm}$$

$$11. d_o = d_i + 15 \rightarrow$$

$$\text{or } d_o = d_i - 15$$

$$\frac{1}{8} = \frac{1}{d_i} + \frac{1}{d_i - 15}$$

$$\frac{1}{8} = \frac{2d_i - 15}{d_i(d_i - 15)}$$

$$d_i^2 - 15d_i = 8d_i - 120$$

$$d_i^2 - 23d_i + 120 = 0$$

$$d_i = 26.5 \text{ cm} \text{ or } d_i = 4.55 \text{ X}$$

$$d_o = 11.5 \text{ cm}$$

$$\frac{1}{8} = \frac{1}{d_i} + \frac{1}{d_i + 15}$$

$$\frac{1}{8} = \frac{d_i + 15 + d_i}{d_i(d_i + 15)}$$

$$\frac{1}{8} = \frac{2d_i + 15}{d_i(d_i + 15)}$$

$$d_i(d_i + 15) = 16d_i + 120$$

$$d_i^2 + 15d_i = 16d_i + 120$$

$$d_i^2 - d_i - 120 = 0$$

$$d_i = \frac{1 \pm \sqrt{1^2 - 4(1)(-120)}}{2}$$

$$d_i = \frac{1 \pm \sqrt{481}}{2}$$

$$d_i = \frac{1 \pm 21.9}{2}$$

$$d_i = 11.5 \text{ cm} \text{ or } d_i = -10.5 \text{ cm}$$

$$d_o = 26.5 \text{ cm}$$

$$d_o = 4.55 \text{ cm}$$