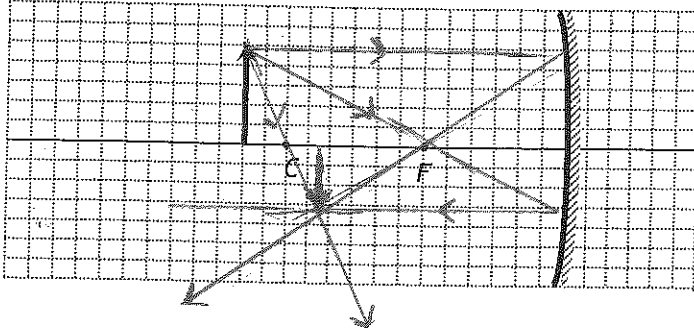


# Problems

1. Locate the image and identify its characteristics by drawing ray diagrams for the following objects placed in front of a mirror. For each question assume 1 scale division = 1.0 m. Complete the charts. [Appendix A]

a.

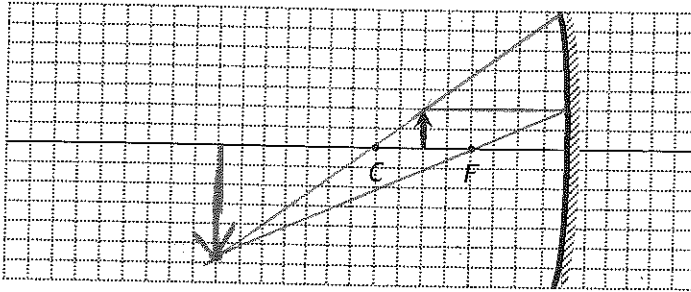


concave - converging

Characteristics
inverted
smaller
actual

Dimensions
$d_i = 10.6$
$h_i = -4.0$

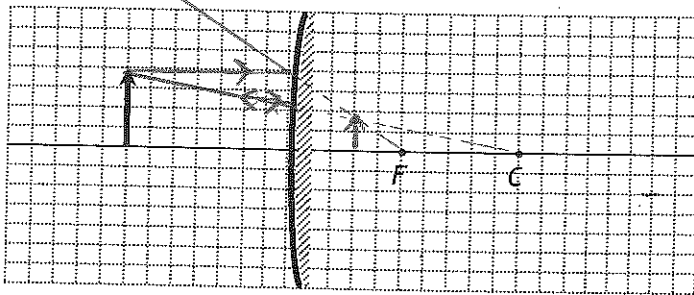
b.



Characteristics
inverted
larger
actual

Dimensions
$d_i = 12.0$
$h_i = -4.0$

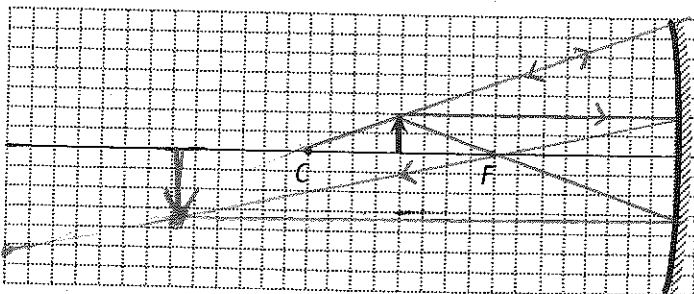
c.



Characteristics
upright
smaller
virtual

Dimensions
$d_i = -3.0$
$h_i = +1.2$

2. A 2.0 cm tall candle, is placed 12 cm in front of a concave mirror with a focal length of 8.0 cm. Use a scale diagram to determine the image's characteristics. Complete the chart. [Appendix A]



Characteristics
inverted
larger
real

Dimensions
$d_i = 24.2$
$h_i = -4.0$

3. An object, 5.0 cm high, is located 15.0 cm from a converging (concave) mirror with a focal length of 10.0 cm. Determine the characteristics and dimensions of the image (complete the charts) using
- a scale diagram.
  - the curved mirror formula (algebraically). [Appendix A]

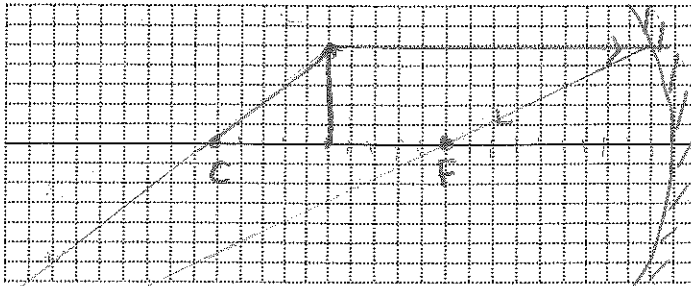


Image Dimensions

	Graphically	Algebraically
$d_i$	31	30
$h_i$	-11	-10
M	2.0x	2.0x

Characteristics
inverted
larger
real

5

4. An object, 2.0 cm high, is located 3.0 cm from a diverging (convex) mirror with a focal length of 4.6 cm. Determine the characteristics and dimensions of the image (complete the charts) using
- a scale diagram.
  - the curved mirror formula (algebraically). [Appendix A]

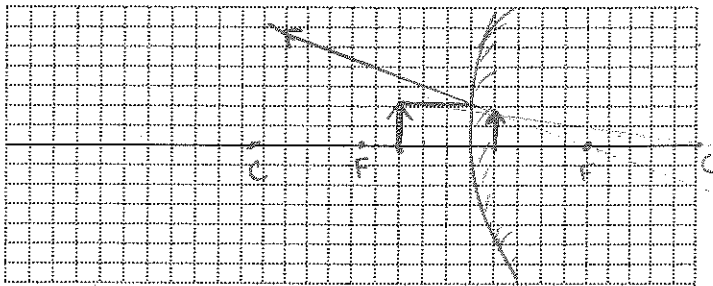


Image Dimensions

	Graphically	Algebraically
$d_i$	-2.1	-1.8
$h_i$	1.0	1.2
M	0.50x	0.61x

Characteristics
upright
smaller
virtual

5

5. A 6.5 cm high object is 15 cm from a concave mirror with a 20.0 cm radius. Determine the  
 a. image distance from the mirror. [30 cm]  
 b. image size. [-13 cm]

$C = 20 \text{ cm}$   
 $f = 10 \text{ cm}$   
 $h_o = 6.5 \text{ cm}$   
 $d_o = 15 \text{ cm}$   
 $d_i = ?$   
 $h_i = ?$

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

$\frac{1}{10} - \frac{1}{15} = \frac{1}{d_i}$

$\frac{1}{10} - \frac{1}{15} = \frac{1}{d_i}$

$d_i = 30 \text{ cm}$

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

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

$h_i = \frac{6.5 \text{ cm} \times -30 \text{ cm}}{15 \text{ cm}} = -13 \text{ cm}$

$h_i = -13 \text{ cm}$  2

6. An object is placed 20 cm from a spherical concave mirror. It produces an image that is 15 cm away from the mirror. Determine the focal length of the mirror. [8.6 cm]

$d_i = 15 \text{ cm}$   
 $d_o = 20 \text{ cm}$   
 $f = ?$

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

$f = 8.57 \text{ cm}$

$\frac{1}{f} = \frac{1}{20} + \frac{1}{15}$

$f = 8.6 \text{ cm}$  1

7. A 5.0 cm tall object is placed 4.0 cm in front of a mirror having a focal length of -6.0 cm.

- a. Identify the type of mirror used. [Appendix A] *convex*  
 b. Identify the type of image produced. [Appendix A] *upright, virtual, smaller*  
 c. Determine the distance to the image produced. [-2.4 cm]  
 d. Determine the size of the image produced. [3.0 cm]

$d_o = 4.0 \text{ cm}$   
 $h_o = 5.0 \text{ cm}$   
 $f = -6.0 \text{ cm}$   
 $d_i = ?$   
 $h_i = ?$

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

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

$\frac{1}{d_i} = \frac{1}{-6 \text{ cm}} - \frac{1}{4.0}$

$d_i = -2.4 \text{ cm}$

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

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

$h_i = \frac{5.0 \text{ cm} \times -(-2.4 \text{ cm})}{-4.0 \text{ cm}}$

$h_i = 3.0 \text{ cm}$  4

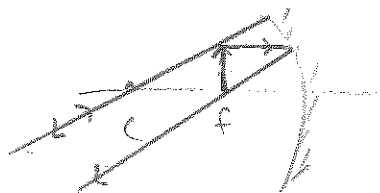
8. Fill in the blank. The main mirror on the Hubble's Space Telescope has a radius of curvature of 115.2 m. Its focal length is 57.6. [Appendix A]

9. A 5.0 cm high object is 20.0 cm in front of a mirror with a -15 cm focal length. Determine the
- image distance from the mirror. [-8.6 cm]
  - image size. [2.1 cm]

10. A 5.00 cm tall object is 10.3 cm from a concave mirror with a 10 cm focal length. Determine the
- distance to the image. [343 cm]
  - size of the image. [-167 cm]

11. An object is placed at the focal point of a concave mirror. Will an image be observed? Explain. [Appendix A]

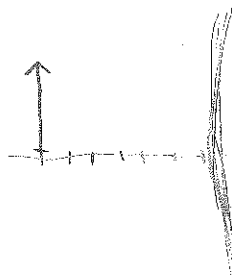
no image produced



reflected lines are parallel  
∴ no image ✓

12. A 3.0 cm tall object is placed 6.0 cm in front of mirror. A virtual image is produced that is 1.0 cm tall.

- Determine the focal length. [-3.0 cm]
- Identify the type of mirror. [Appendix A]



$$\begin{aligned} h_o &= 3 & \frac{d_i}{d_o} &= \frac{h_i}{h_o} & 2 \\ h_i &= 1 \\ d_o &= 6 \\ d_i &= ? & d_i &= -2.0 \text{ cm} \end{aligned}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \quad \text{convex}$$

$$f = -3.0 \text{ cm}$$

(3)