Q3W1-Light and Reflection-Qs Bank

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Which portion of the electromagnetic spectrum is used in a television?
a. infrared waves
b. X rays
c. radio waves
d. gamma waves

____ 2. Which portion of the electromagnetic spectrum is used in a microscope?
a. infrared waves
b. gamma rays
c. visible light
d. ultraviolet light

____ 3. Which portion of the electromagnetic spectrum is used to identify fluorescent minerals?
a. ultraviolet light
b. X rays
c. infrared waves
d. gamma rays

____ 4. What is the frequency of infrared light of 1.0×10^{-4} m wavelength?
a. 3.0×10^{-13} Hz
b. 3.0×10^{2} Hz
c. 3.0×10^{4} Hz
d. 3.0×10^{12} Hz

____ 5. What is the frequency of an electromagnetic wave with a wavelength of 1.0×10^{5} m?
a. 3.3×10^{-4} Hz
b. 3.0×10^{3} Hz
c. 1.0×10^{13} Hz
d. 3.0×10^{13} Hz

____ 6. What is the wavelength of an infrared wave with a frequency of 4.2×10^{14} Hz?
a. 7.1×10^{5} m
b. 1.4×10^{6} m
c. 7.1×10^{-7} m
d. 1.4×10^{-6} m

____ 7. In a vacuum, electromagnetic radiation of short wavelengths
a. travels as fast as radiation of long wavelengths.
b. travels slower than radiation of long wavelengths.
c. travels faster than radiation of long wavelengths.
d. can travel both faster and slower than radiation of long wavelengths.

____ 8. When red light is compared with violet light,
a. both have the same frequency.
b. both have the same wavelength.
c. both travel at the same speed.
d. red light travels faster than violet light.

____ 9. If you know the wavelength of any form of electromagnetic radiation, you can determine its frequency because
a. all wavelengths travel at the same speed.
b. the speed of light varies for each form.
c. wavelength and frequency are equal.
d. the speed of light increases as wavelength increases.

____ 10. The relationship between frequency, wavelength, and speed holds for light waves because
a. light travels slower in a vacuum than in air.
b. all forms of electromagnetic radiation travel at a single speed in a vacuum.
c. light travels in straight lines.
d. different forms of electromagnetic radiation travel at different speeds.

____ 11. The farther light is from a source,
a. the more spread out light becomes.
b. the more condensed light becomes.
c. the more bright light becomes.
d. the more light is available per unit area.

____ 12. If you are reading a book and you move twice as far away from the light source, how does the brightness at the new distance compare with that at the old distance? It is

a. one-eighth as bright.
b. one-fourth as bright.
c. one-half as bright.
d. twice as bright.

____ 13. Snow reflects almost all of the light incident upon it. However, a single beam of light is not reflected in the form of parallel rays. This is an example of ____ reflection off a ____ surface.

a. regular, rough
b. regular, specular
c. diffuse, specular
d. diffuse, rough

____ 14. A highly polished finish on a new car provides a ____ surface for ____ reflection.

a. rough, diffused
b. specular, diffused
c. rough, regular
d. smooth, specular

____ 15. When incoming rays of light strike a flat mirror at an angle close to the surface of the mirror, the reflected rays are

a. inclined high above the mirror's surface.
b. parallel to the mirror's surface.
c. perpendicular to the mirror's surface.
d. close to the mirror's surface.

____ 16. When a straight line is drawn perpendicular to a flat mirror at the point where an incoming ray strikes the mirror's surface, the angles of incidence and reflection are measured from the normal and

a. the angles of incidence and reflection are equal.
b. the angle of incidence is greater than the angle of reflection.
c. the angle of incidence is less than the angle of reflection.
d. the angle of incidence can be greater than or less than the angle of reflection.

____ 17. If a light ray strikes a flat mirror at an angle of 27° from the normal, the reflected ray will be

a. 27° from the mirror's surface.
b. 27° from the normal.
c. 90° from the mirror's surface.
d. 63° from the normal.

____ 18. If a light ray strikes a flat mirror at an angle of 14° from the normal, the reflected ray will be

a. 14° from the mirror's surface.
b. 76° from the normal.
c. 90° from the mirror's surface.
d. 14° from the normal.

____ 19. If a light ray strikes a flat mirror at an angle of 29° from the normal, the reflected ray will be

a. 29° from the normal.
b. 27° from the normal.
c. 29° from the mirror's surface.
d. 61° from the normal.

____ 20. If a light ray strikes a flat mirror at an angle of 30° from the normal, the ray will be reflected at an angle of

a. 30° from the mirror's surface.
b. 60° from the mirror's surface.
c. 60° from the normal.
d. 90° from the normal.

____ 21. The image of an object in a flat mirror is always

a. larger than the object.
b. smaller than the object.
c. independent of the size of the object.
d. the same size as the object.

____ 22. When two parallel mirrors are placed so that their reflective sides face each other, ____ images form. This is because the image in one mirror becomes the ____ for the other mirror.

a. multiple, object
b. reduced, virtual image
c. inverted, center of curvature
d. enlarged, focal point

____ 23. If you stand 3.0 m in front of a flat mirror, how far away from you would your image be in the mirror?

a. 1.5 m
b. 3.0 m
c. 6.0 m
d. 12.0 m

____ 24. Which of the following best describes the image produced by a flat mirror?
a. virtual, inverted, and magnification greater than one
b. real, inverted, and magnification less than one
c. virtual, upright, and magnification equal to one
d. real, upright, and magnification equal to one

____ 25. When the reflection of an object is seen in a flat mirror, the distance from the mirror to the image depends on
a. the wavelength of light used for viewing.
b. the distance from the object to the mirror.
c. the distance of both the observer and the object to the mirror.
d. the size of the object.

____ 26. What type of mirror is used whenever a magnified image of an object is needed?
a. flat mirror
b. concave mirror
c. convex mirror
d. two-way mirror

____ 27. For a spherical mirror, the focal length is equal to ____ the radius of curvature of the mirror.
a. one-fourth
b. one-third
c. one-half
d. the square of

____ 28. A concave mirror with a focal length of 10.0 cm creates a real image 30.0 cm away on its principal axis. How far from the mirror is the corresponding object?
a. 20 cm
b. 15 cm
c. 7.5 cm
d. 5.0 cm

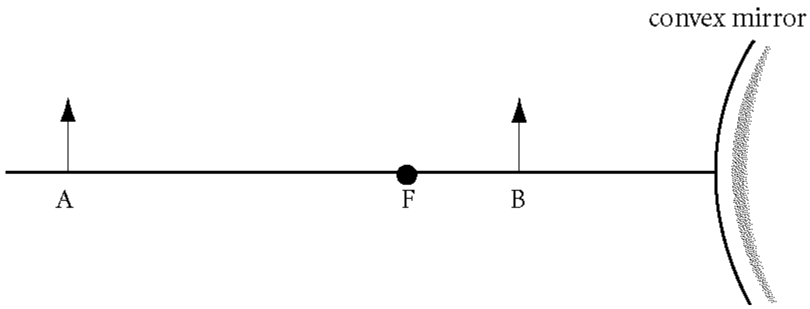
____ 29. A concave mirror forms a real image at 25.0 cm from the mirror surface along the principal axis. If the corresponding object is at a 10.0 cm distance, what is the mirror's focal length?
a. 1.40 cm
b. 7.14 cm
c. 12.0 cm
d. 17.0 cm

____ 30. An object is 29 cm away from a concave mirror's surface along the principal axis. If the mirror's focal length is 9.50 cm, how far away is the corresponding image?
a. 12 cm
b. 14 cm
c. 29 cm
d. 36 cm

____ 31. If a virtual image is formed 10.0 cm along the principal axis from a convex mirror with a focal length of –15.0 cm, what is the object's distance from the mirror?
a. 30 cm
b. 12 cm
c. 6.0 cm
d. 3.0 cm

____ 32. A convex mirror with a focal length of –20.0 cm has an object 30.0 cm in front of the mirror. What is the value of q for the corresponding image?
a. −60 cm
b. −12 cm
c. 12 cm
d. 60 cm

____ 33. A mirror has an object located on its principal axis 40.0 cm from the mirror's surface. A virtual image is formed 15.0 cm behind the mirror. What is the mirror's focal length?
a. −24.0 cm
b. −10.9 cm
c. 2.38 cm
d. 13 cm



____ 34. In the diagram shown above, the image of object *B* would be
a. real, reduced, and upright.
b. virtual, enlarged, and upright.
c. virtual, reduced, and inverted.
d. virtual, reduced, and upright.

____ 35. Which best describes the image of a concave mirror when the object is located somewhere between the focal point and twice the focal-point distance from the mirror?
a. virtual, upright, and magnification greater than one
b. real, inverted, and magnification less than one
c. virtual, upright, and magnification less than one
d. real, inverted, and magnification greater than one

____ 36. Which best describes the image of a concave mirror when the object is at a distance greater than twice the focal-point distance from the mirror?
a. virtual, upright, and magnification greater than one
b. real, inverted, and magnification less than one
c. virtual, upright, and magnification less than one
d. real, inverted, and magnification greater than one

____ 37. Which best describes the image of a concave mirror when the object's distance from the mirror is less than the focal-point distance?
a. virtual, upright, and magnification greater than one
b. real, inverted, and magnification less than one
c. virtual, upright, and magnification less than one
d. real, inverted, and magnification greater than one

____ 38. A parabolic mirror, instead of a spherical mirror, can be used to reduce the occurrence of which effect?
a. spherical aberration
b. mirages
c. chromatic aberration
d. light scattering

____ 39. When parallel rays that are also parallel to the principal axis strike a spherical mirror, rays that strike the mirror ____ the principal axis are focused at the focal point. Those rays that strike the mirror ____ the principal axis are focused at points between the mirror and the focal point.
a. perpendicular to, far from
b. close to, perpendicular to
c. close to, far from
d. far from, close to

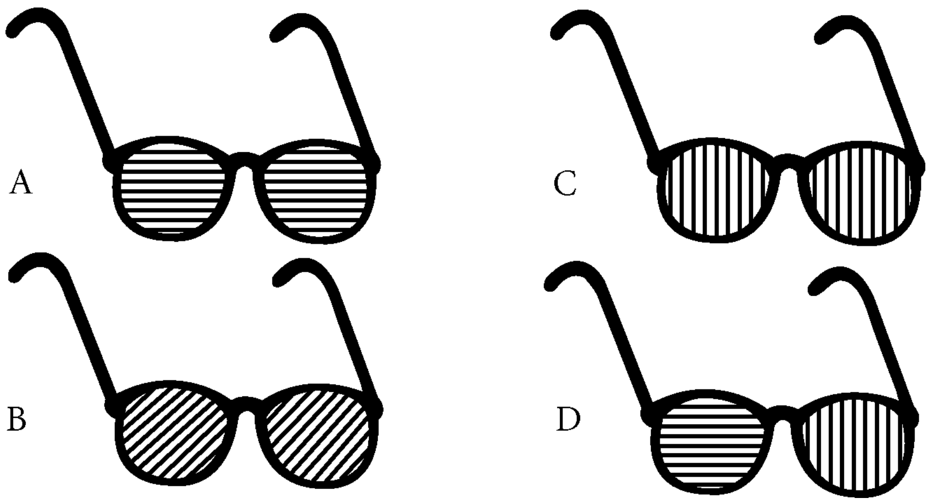
____ 40. When red light and green light shine on the same place on a piece of white paper, the spot appears to be
a. yellow.
b. brown.
c. white.
d. black.

____ 41. Which of the following is *not* an additive primary color?
a. yellow
b. blue
c. red
d. green

____ 42. Which of the following is *not* a primary subtractive color?
a. yellow
b. cyan
c. magenta
d. blue

____ 43. As the angle between the electric-field waves and the transmission axis increases,

a. the component of light that passes through the polarizer decreases and the brightness of the light decreases.
b. the component of light that passes through the polarizer decreases and the brightness of the light increases.
c. the component of light that passes through the polarizer increases and the brightness of the light decreases.
d. the component of light that passes through the polarizer increases and the brightness of the light increases.



____ 44. Which pair of glasses shown above is best suited for automobile drivers? The transmission axes are shown by straight lines on the lenses. (Hint: The light reflects off the hood of the car.)

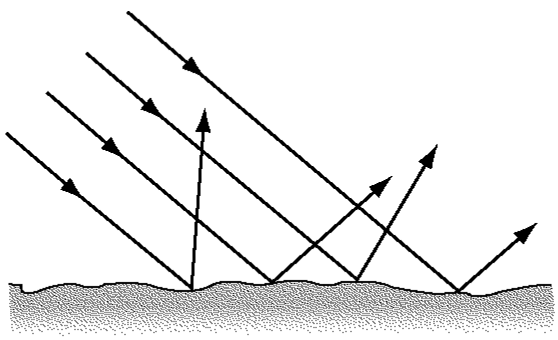
a. A
b. B
c. C
d. D

____ 45. If you looked at a light through the lenses from two polarizing sunglasses that were overlapped at right angles to each other,

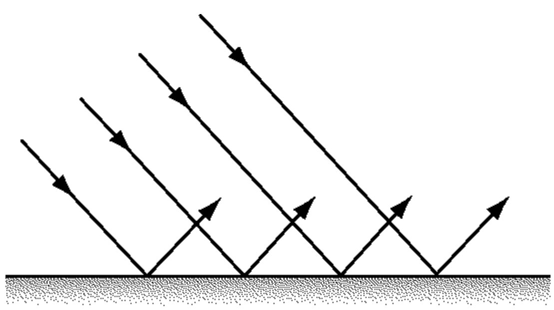
a. all of the light would pass through.
b. most of the light would pass through.
c. little of the light would pass through.
d. none of the light would pass through.

Short Answer

1. Which portion of the electromagnetic spectrum is used for aircraft navigation?
2. Why did early experimental attempts to measure the speed of light fail?
3. How are the terms *luminous flux* and *illuminance* related to each other?
4. How is the brightness of a light source affected by distance?



5. What type of reflection is illustrated in the figure shown above?



6. What type of reflection is illustrated in the figure shown above?
7. If a light ray strikes a flat mirror at an angle of 61° above the mirror's surface, what is the angle of reflection in relation to the normal?
8. Translate into words the following mathematical relationships that are observed with flat mirror reflection: $p = q$ and $h = h'$.
9. When drawing a ray diagram of a flat mirror, why are the reflected rays traced back to a point behind the mirror?
10. If a lowercase "b" and "d" were placed on a table in front of a flat mirror, what would the image of these two letters look like in the mirror?
11. If an object or image height is negative, where is the object or image located in relation to the principal axis?
12. An object's distance is 15.0 cm, and its image distance is 25.0 cm behind the mirror. If the height of the object is 10.0 cm, what is the height of the image? Is the image upright or inverted? Is the image real or inverted?
13. A line parallel to the principal axis is drawn from the object to a spherical mirror. How should the reflected ray be drawn?

14. A line is drawn from the object to a spherical mirror and passes through the center of curvature (C). How should the reflected ray be drawn?
15. A line is drawn from an object to a spherical mirror and passes through the focal point (F). How should the reflected ray be drawn?
16. What type of image do flat mirrors always form?
17. What is the chief difference between real and virtual images?
18. Spherical aberration may be avoided by employing a(n) ____________________ mirror or by making sure that the diameter of a spherical mirror is sufficiently ____________________.
19. Why are some primary colors called additive?
20. What occurs when light passed through a red filter is combined with light passed through a green filter?
21. What occurs when subtractive primary colors are combined?
22. What color results when yellow and blue pigment are combined?
23. What color does yellow pigment subtract from white light?
24. What percentage of light passes through a polarizing filter when the transmission axis is perpendicular to the plane of polarization for light?
25. Are light rays reflected from rough, textured surfaces polarized or unpolarized?

Problem

1. Yellow light has a wavelength of 595 nm. What is its frequency?
2. The frequency of an gamma ray is 6.54×10^{18} Hz. What is the gamma ray's wavelength?
3. A portion of infrared light in the electromagnetic spectrum has a wavelength of $727\ \mu m$. What is the frequency of this portion of infrared light?
4. A concave mirror forms a real image at 17.9 cm from the mirror surface along the principal axis. If the corresponding object is at a distance of 35.3 cm, what is the mirror's focal length?
5. A concave mirror with a focal length of 19.9 cm forms a real image at 29.5 cm from the mirror's surface along the principal axis. How far is the corresponding object located from the mirror's surface?
6. A pencil is located 17.6 cm in front of a convex mirror whose focal length is 14.7 cm. In relation to the mirror's surface, where and how far away is the corresponding image located?
7. A candle 15 cm high is placed in front of a concave mirror at the focal point. The radius of curvature is 60 cm. Draw a ray diagram to determine the position and magnification of the image.
8. An object that is 2.00 cm high is placed 10.0 cm in front of a concave mirror with a radius of curvature of 40.0 cm. Find the magnification and location of the corresponding image in relation to the mirror's surface. Draw a ray diagram to confirm the position and magnification of the image.
9. A concave spherical mirror has a radius of curvature of 10.0 cm. A candle that is 5.0 cm tall is placed 15.0 cm in front of the mirror. Draw a ray diagram to find the image distance and height. Confirm the results of your diagram with the mirror equation and the equation for magnification.
10. A 1.5 cm high image of a candle is formed by a convex mirror. The virtual image is 3.00 cm from the mirror's surface. The image's magnification is +0.25. Draw a ray diagram to determine the position and height of the corresponding object. Use the equation for magnification to confirm the results of your diagram.

Q3W1-Light and Reflection-Qs Bank
Answer Section

MULTIPLE CHOICE

1. ANS: C PTS: 1 DIF: I OBJ: 13-1.1
2. ANS: C PTS: 1 DIF: I OBJ: 13-1.1
3. ANS: A PTS: 1 DIF: I OBJ: 13-1.1
4. ANS: D

   Given

   $\lambda = 1.0 \times 10^{-4}$ m

   $c = 3.00 \times 10^{8}$ m/s

   Solution

   Rearrange the wave speed equation, $c = f\lambda$, to isolate f, and calculate.

   $$f = \frac{c}{\lambda} = \frac{(3.00 \times 10^{8}\ \text{m/s})}{(1.0 \times 10^{-4}\ \text{m})} = 3.0 \times 10^{12}\ \text{s}^{-1} = 3.0 \times 10^{12}\ \text{Hz}$$

   PTS: 1 DIF: IIIA OBJ: 13-1.2
5. ANS: B

   Given

   $\lambda = 1.0 \times 10^{5}$ m

   $c = 3.00 \times 10^{8}$ m/s

   Solution

   Rearrange the wave speed equation, $c = f\lambda$, to isolate f, and calculate.

   $$f = \frac{c}{\lambda} = \frac{(3.00 \times 10^{8}\ \text{m/s})}{(1.0 \times 10^{5}\ \text{m})} = 3.0 \times 10^{3}\ \text{s}^{-1} = 3.0 \times 10^{3}\ \text{Hz}$$

   PTS: 1 DIF: IIIA OBJ: 13-1.2
6. ANS: C

Given

$f = 4.2 \times 10^{14}$ Hz $= 4.2 \times 10^{14}$ s^{-1}

$c = 3.00 \times 10^{8}$ m/s

Solution

Rearrange the wave speed equation, $c = f\lambda$, to isolate λ, and calculate.

$$\lambda = \frac{c}{f} = \frac{\left(3.00 \times 10^{8}\ \text{m/s}\right)}{\left(4.2 \times 10^{14}\ \text{s}^{-1}\right)} = 7.1 \times 10^{-7}\ \text{m}$$

PTS: 1 DIF: IIIA OBJ: 13-1.2

7.	ANS: A	PTS: 1	DIF: I	OBJ: 13-1.3
8.	ANS: C	PTS: 1	DIF: II	OBJ: 13-1.3
9.	ANS: A	PTS: 1	DIF: I	OBJ: 13-1.3
10.	ANS: B	PTS: 1	DIF: II	OBJ: 13-1.3
11.	ANS: A	PTS: 1	DIF: I	OBJ: 13-1.4
12.	ANS: B	PTS: 1	DIF: II	OBJ: 13-1.4
13.	ANS: D	PTS: 1	DIF: II	OBJ: 13-2.1
14.	ANS: D	PTS: 1	DIF: I	OBJ: 13-2.1
15.	ANS: D	PTS: 1	DIF: II	OBJ: 13-2.2
16.	ANS: A	PTS: 1	DIF: I	OBJ: 13-2.2
17.	ANS: B	PTS: 1	DIF: II	OBJ: 13-2.2
18.	ANS: D	PTS: 1	DIF: II	OBJ: 13-2.2
19.	ANS: A	PTS: 1	DIF: II	OBJ: 13-2.2

20. ANS: B

Given

$\theta = 30°$

Solution

According to the law of reflection, $\theta = \theta'$, therefore $\theta' = 30°$. The angle between the reflected ray and the surface is $90° - \theta'$, which equals $60°$. Therefore, the correct response is "B," since the reflected ray forms an angle of $60°$ with the mirror's surface.

PTS: 1 DIF: IIIA OBJ: 13-2.2

21.	ANS: D	PTS: 1	DIF: I	OBJ: 13-2.3
22.	ANS: A	PTS: 1	DIF: II	OBJ: 13-2.3

23. ANS: C

Given

$p = 3.0$ m

Solution

For a flat mirror, a virtual image forms behind the mirror and thus $p = q$.

Therefore, the total distance from the observer is $p + q = (3.0\ \text{m}) + (3.0\ \text{m}) = 6.0$ m.

PTS: 1 DIF: IIIA OBJ: 13-2.3

24. ANS: C PTS: 1 DIF: I OBJ: 13-2.3
25. ANS: B PTS: 1 DIF: I OBJ: 13-2.3
26. ANS: C PTS: 1 DIF: I OBJ: 13-3.1
27. ANS: C PTS: 1 DIF: I OBJ: 13-3.1
28. ANS: B

Given

$f = 10.0$ cm

$q = 30.0$ cm

Solution

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for p.

$$\frac{1}{p} = \frac{1}{f} - \frac{1}{q} = \frac{1}{10.0\text{ cm}} - \frac{1}{30.0\text{ cm}} = \frac{3}{30.0\text{ cm}} - \frac{1}{30.0\text{ cm}} = \frac{2}{30.0\text{ cm}}$$

$p = 15$ cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

29. ANS: B

Given

$p = 10.0$ cm

$q = 25.0$ cm

Solution

Use the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for f.

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q} = \frac{1}{10.0\text{ cm}} + \frac{1}{25.0\text{ cm}} = \frac{2.5}{25.0\text{ cm}} + \frac{1}{25.0\text{ cm}} = \frac{3.5}{25.0\text{ cm}}$$

$f = 7.14$ cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

30. ANS: B

Given

$p = 29$ cm

$f = 9.50$ cm

Solution

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for q.

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{9.50\text{ cm}} - \frac{1}{29\text{ cm}} = \frac{3.05}{29\text{ cm}} - \frac{1}{29\text{ cm}} = \frac{2.05}{29\text{ cm}}$$

$p = 14$ cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

31. ANS: A

Given

$f = -15.0$ cm

$q = -10.0$ cm

Solution

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for p.

$$\frac{1}{p} = \frac{1}{f} - \frac{1}{q} = \frac{1}{-15.0\text{ cm}} - \frac{1}{-10.0\text{ cm}} = -\frac{1}{15.0\text{ cm}} + \frac{1.5}{15.0\text{ cm}} = \frac{0.5}{15.0\text{ cm}}$$

$p = 30$ cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

32. ANS: B

Given

$f = -20.0$ cm

$p = 30.0$ cm

Solution

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for q.

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{-20.0\text{ cm}} - \frac{1}{30.0\text{ cm}} = -\frac{1.5}{30.0\text{ cm}} - \frac{1}{30.0\text{ cm}} = -\frac{2.5}{30.0\text{ cm}}$$

$q = -12$ cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

33. ANS: A

Given

$p = 40.0$ cm

$q = -15.0$ cm

Solution

Use the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for f.

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q} = \frac{1}{40.0\text{ cm}} + \frac{1}{-15.0\text{ cm}} = \frac{3.00}{120.\text{ cm}} - \frac{8.00}{120.\text{ cm}} = -\frac{5.00}{120.\text{ cm}}$$

$f = -24.0$ cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

34. ANS: D PTS: 1 DIF: II OBJ: 13-3.3

35.	ANS:	D	PTS:	1	DIF:	II	OBJ:	13-3.3
36.	ANS:	B	PTS:	1	DIF:	II	OBJ:	13-3.3
37.	ANS:	A	PTS:	1	DIF:	II	OBJ:	13-3.3
38.	ANS:	A	PTS:	1	DIF:	I	OBJ:	13-3.4
39.	ANS:	C	PTS:	1	DIF:	II	OBJ:	13-3.4
40.	ANS:	A	PTS:	1	DIF:	I	OBJ:	13-4.1
41.	ANS:	A	PTS:	1	DIF:	I	OBJ:	13-4.1
42.	ANS:	D	PTS:	1	DIF:	I	OBJ:	13-4.2
43.	ANS:	A	PTS:	1	DIF:	II	OBJ:	13-4.3
44.	ANS:	C	PTS:	1	DIF:	II	OBJ:	13-4.3
45.	ANS:	D	PTS:	1	DIF:	II	OBJ:	13-4.3

SHORT ANSWER

1. ANS:
microwaves

PTS: 1 DIF: I OBJ: 13-1.1

2. ANS:
The speed of light is so great that it could not be measured given the limitations of early measuring instruments.

PTS: 1 DIF: I OBJ: 13-1.3

3. ANS:
Luminous flux is a measure of the amount of light emitted from a light source. It is measured in lumens. *Illuminance* is a derived unit that indicates the relationship between luminous flux and the distance from the light source squared. Illuminance is the ratio of lumens/m^2.

PTS: 1 DIF: II OBJ: 13-1.4

4. ANS:
Brightness decreases by the square of the distance from the source.

PTS: 1 DIF: I OBJ: 13-1.4

5. ANS:
diffuse

PTS: 1 DIF: I OBJ: 13-2.1

6. ANS:
specular

PTS: 1 DIF: I OBJ: 13-2.1

7. ANS:
29° from the normal

Given

$\theta_{mirror's\ surface} = 61°$

Solution

Rearrange the equation, $\theta_{mirror's\ surface} = 90° - \theta$, solve for θ, and substitute values.

$\theta = 90° - \theta_{mirror's\ surface} = 90° - 61° = 29°$.

According to the law of reflection, the angle of incidence (θ) is equal to the angle of reflection(θ').

Therefore, $\theta' = \theta = 29°$ from the normal.

PTS: 1 DIF: IIIA OBJ: 13-2.2

8. ANS:
Object distance (p) is equal to image distance (q) and object height (h) is equal to image height (h').

PTS: 1 DIF: II OBJ: 13-2.3

9. ANS:
Flat mirrors always form a virtual image that appears to originate behind the mirror.

PTS: 1 DIF: II OBJ: 13-2.3

10. ANS:
The “b” would look like a “d” and the “d” would look like a “b.”

PTS: 1 DIF: II OBJ: 13-2.3

11. ANS:
below the principal axis

PTS: 1 DIF: I OBJ: 13-3.1

12. ANS:
Given

$p = 15.0$ cm

$q = -25.0$ cm

$h = 10.0$ cm

Solution

Use the equation for magnification, $M = \frac{h'}{h} = -\frac{q}{p}$, and solve for h'.

$$h' = -\frac{qh}{p} = -\frac{(-25.0\text{ cm})(10.0\text{ cm})}{(15.0\text{ cm})} = 16.7\text{ cm}$$

Since M is positive, the image is upright and virtual.

PTS: 1 DIF: IIIA OBJ: 13-3.1

13. ANS:
through the focal point (F)

PTS: 1 DIF: I OBJ: 13-3.2

14. ANS:
back along itself through *C*

PTS: 1 DIF: I OBJ: 13-3.2

15. ANS:
parallel to the principal axis

PTS: 1 DIF: I OBJ: 13-3.2

16. ANS:
virtual

PTS: 1 DIF: I OBJ: 13-3.3

17. ANS:
Real images can be displayed on a surface; virtual ones cannot.

PTS: 1 DIF: I OBJ: 13-3.3

18. ANS:
parabolic, small

PTS: 1 DIF: I OBJ: 13-3.4

19. ANS:
When they are added in varying proportions, they can form all of the colors of the spectrum.

PTS: 1 DIF: I OBJ: 13-4.1

20. ANS:
Yellow light appears.

PTS: 1 DIF: I OBJ: 13-4.1

21. ANS:
When combined in the proper proportions, they filter out all light.

PTS: 1 DIF: I OBJ: 13-4.2

22. ANS:
green

PTS: 1 DIF: I OBJ: 13-4.2

23. ANS:
blue

PTS: 1 DIF: I OBJ: 13-4.2

24. ANS:
0%

PTS: 1 DIF: I OBJ: 13-4.3

25. ANS:
unpolarized

PTS: 1 DIF: I OBJ: 13-4.3

PROBLEM

1. ANS:
5.04×10^{14} Hz

Given

$\lambda = 595 \text{ nm} = 595 \times 10^{-9} \text{ m} = 5.95 \times 10^{-7} \text{ m}$

$c = 3.00 \times 10^{8} \text{ m/s}$

Solution

Rearrange the wave speed equation, $c = f\lambda$, to isolate f, and calculate.

$$f = \frac{c}{\lambda} = \frac{\left(3.00 \times 10^{8} \text{ m/s}\right)}{\left(5.95 \times 10^{-7} \text{ m}\right)} = 5.04 \times 10^{14} \text{ s}^{-1} = 5.04 \times 10^{14} \text{ Hz}$$

PTS: 1 DIF: IIIA OBJ: 13-1.2

2. ANS:
4.59×10^{-11} m

Given

$f = 6.54 \times 10^{18} \text{ Hz} = 6.54 \times 10^{18} \text{ s}^{-1}$

$c = 3.00 \times 10^{8} \text{ m/s}$

Solution

Rearrange the wave speed equation, $c = f\lambda$, to isolate λ, and calculate.

$$\lambda = \frac{c}{f} = \frac{\left(3.00 \times 10^{8} \text{ m/s}\right)}{\left(6.54 \times 10^{18} \text{ s}^{-1}\right)} = 4.59 \times 10^{-11} \text{ m}$$

PTS: 1 DIF: IIIA OBJ: 13-1.2

3. ANS:
4.13×10^{11} Hz

Given

$\lambda = 727 \ \mu\text{m} = 727 \times 10^{-6} \text{ m} = 7.27 \times 10^{-4} \text{ m}$

$c = 3.00 \times 10^{8} \text{ m/s}$

Solution

Rearrange the wave speed equation, $c = f\lambda$, to isolate f, and calculate.

$$f = \frac{c}{\lambda} = \frac{(3.00 \times 10^8 \text{ m/s})}{(7.27 \times 10^{-4} \text{ m})} = 4.13 \times 10^{11} \text{ s}^{-1} = 4.13 \times 10^{11} \text{ Hz}$$

PTS: 1 DIF: IIIA OBJ: 13-1.2

4. ANS:

11.9 cm

Given

p = 35.3 cm

q = 17.9 cm

Solution

Use the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for f.

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q} = \frac{1}{35.3 \text{ cm}} + \frac{1}{17.9 \text{ cm}} = \frac{0.0283}{1 \text{ cm}} + \frac{0.0559}{1 \text{ cm}} = \frac{0.0842}{1 \text{ cm}}$$

f = 11.9 cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

5. ANS:

61.0 cm

Given

f = 19.9 cm

q = 29.5 cm

Solution

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for p.

$$\frac{1}{p} = \frac{1}{f} - \frac{1}{q} = \frac{1}{19.9 \text{ cm}} - \frac{1}{29.5 \text{ cm}} = \frac{0.0503}{1 \text{ cm}} - \frac{0.0339}{1 \text{ cm}} = \frac{0.0164}{1 \text{ cm}}$$

p = 61.0 cm

PTS: 1 DIF: IIIB OBJ: 13-3.1

6. ANS:

-8.013 cm

Given

$f = -14.7$ cm

$p = 17.6$ cm

Solution

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for q.

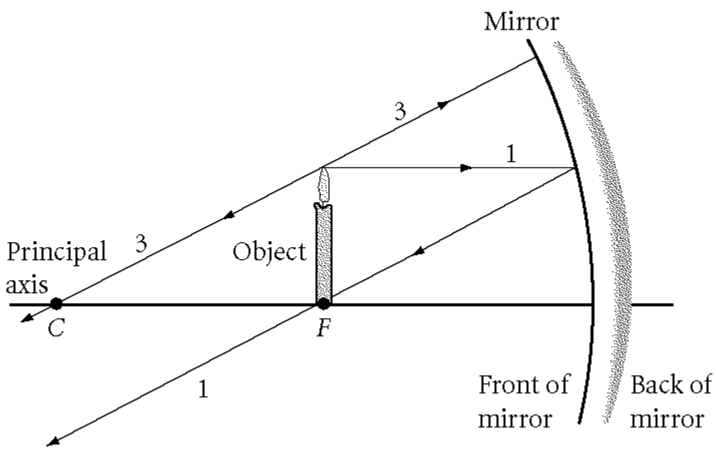
$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{-14.7\text{ cm}} - \frac{1}{17.6\text{ cm}} = -\frac{0.0680}{1\text{ cm}} - \frac{0.0568}{1\text{ cm}} = -\frac{0.1248}{1\text{ cm}}$$

$q = -8.013$ cm

Since q is negative, the image is located 8.013 cm behind the mirror.

PTS: 1 DIF: IIIB OBJ: 13-3.1

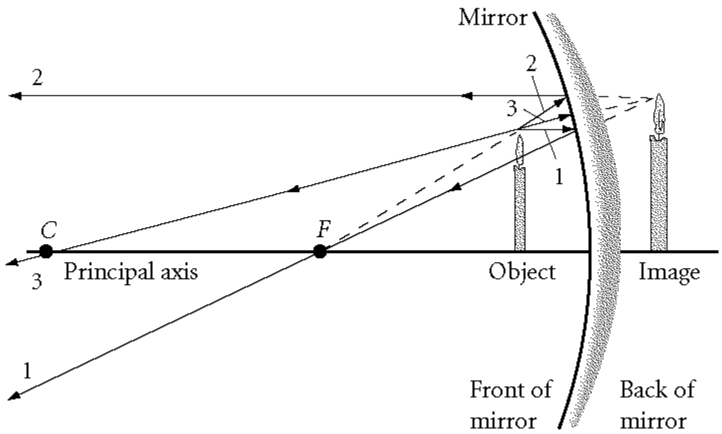
7. ANS:
When the candle is at the focal point, the image is infinitely far to the left and therefore is not seen, as shown in the answer diagram.



PTS: 1 DIF: IIIB OBJ: 13-3.2

8. ANS:
$q = -20.0$ cm

$M = +2.00$



Given

$h = 2.00$ cm

$R = 40.0$ cm

$p = 10.0$ cm

Solution

Since $R = 40.0$ cm, $f = 20.0$ cm.

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for q.

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{20.0\text{ cm}} - \frac{1}{10.0\text{ cm}} = \frac{1}{20.0\text{ cm}} - \frac{2}{20.0\text{ cm}} = -\frac{1}{20.0\text{ cm}}$$

$q = -20.0$ cm

Since q is negative, the image is located 20.0 cm behind the mirror.

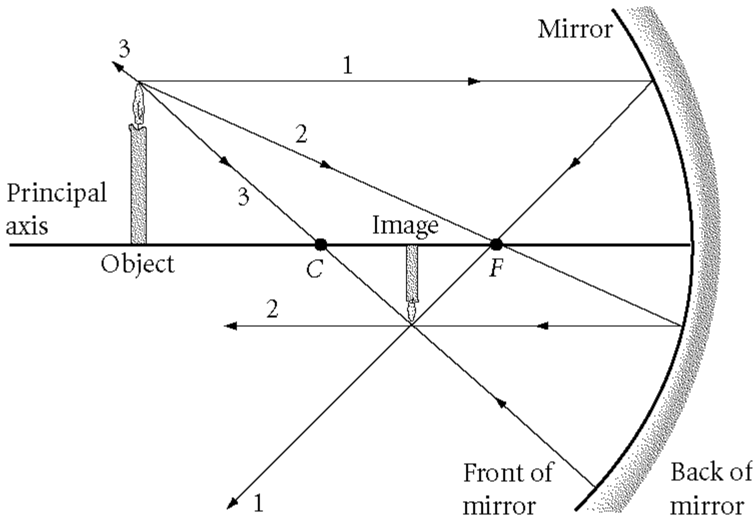
$$M = -\frac{q}{p} = -\frac{(-20.0\text{ cm})}{10.0\text{ cm}} = +2.00$$

PTS: 1 DIF: IIIC OBJ: 13-3.1

9. ANS:

$q = 7.50$ cm

$h' = -2.5$ cm



Given

$h = 5.0$ cm

$R = 10.0$ cm

$p = 15.0$ cm

Solution

Since $R = 10.0$ cm, $f = 5.00$ cm.

Rearrange the mirror equation, $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$, and solve for q.

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{5.00 \text{ cm}} - \frac{1}{15.0 \text{ cm}} = \frac{3}{15.0 \text{ cm}} - \frac{1}{15.0 \text{ cm}} = \frac{2}{15.0 \text{ cm}}$$

$q = 7.50$ cm

Since q is positive, the image is located 7.50 cm in front of the mirror.

Solve the equation for magnification, $M = \frac{h'}{h} = -\frac{q}{p}$, for h'.

$$h' = -\frac{qh}{p} = -\frac{(7.50 \text{ cm})(5.0 \text{ cm})}{(15.0 \text{ cm})} = -2.5 \text{ cm}$$

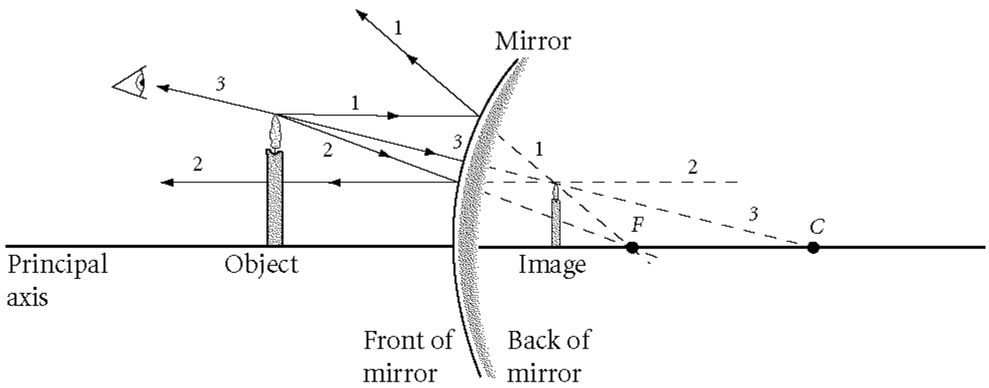
Since h' is negative, the image is located below the principal axis.

PTS: 1 DIF: IIIC OBJ: 13-3.2

10. ANS:

$p = 12$ cm

$h = 6.0$ cm



Given

$h' = 1.5$ cm

$M = +0.25$

$q = -3.00$ cm

Solution

Use the equation for magnification, $M = \frac{h'}{h}$, and solve for h.

$$h = \frac{h'}{M} = \frac{(1.5\ \text{cm})}{(+0.25)} = 6.0\ \text{cm}$$

Since h is positive, the object is located above the principal axis.

Use the equation for magnification, $M = -\frac{q}{p}$, and solve for p.

$$p = -\frac{q}{M} = -\frac{(-3.00\ \text{cm})}{(0.25)} = 12\ \text{cm}$$

Since q is positive, the object is located 12 cm in front of the mirror.

PTS: 1 DIF: IIIC OBJ: 13-3.2