

**Chapter 29 Reflection and Refraction**

**Exercises**

**29.1 Reflection (page 579)**

1. What usually happens when a wave reaches a boundary between two media?

\_\_\_\_\_

\_\_\_\_\_

2. The return of a wave back to its original medium is called \_\_\_\_\_.

3. Explain what happens when a spring is attached to a wall and you send a pulse along the spring's length.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4. Is the following sentence true or false? Shiny metals, such as aluminum and silver, reflect almost all the frequencies of visible light.

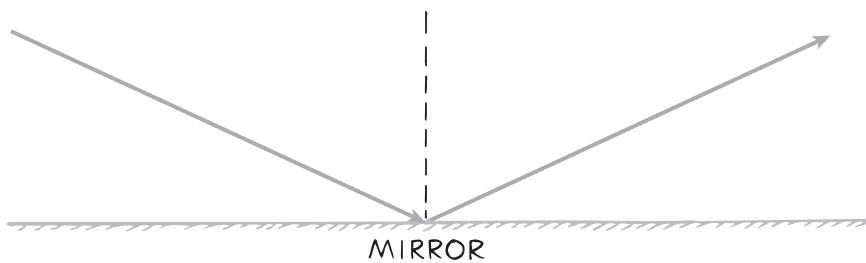
\_\_\_\_\_

5. When light strikes glass perpendicularly, much of its energy is \_\_\_\_\_.

\_\_\_\_\_

**29.2 The Law of Reflection (page 580)**

6. On the diagram below, label the following: *normal*, *incident ray*, *angle of incidence*, *reflected ray*, and *angle of reflection*.



Match each phrase with the correct term or terms.

Phrase	Terms
_____ 7. a line perpendicular to a surface	a. angle of reflection
_____ 8. the angle between the incident ray and the normal	b. angle of incidence
_____ 9. the angle between the reflected ray and the normal	c. law of reflection
_____ 10. the relationship between the angle of incidence and angle of reflection	d. normal

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**29.3 Mirrors (pages 580–581)**

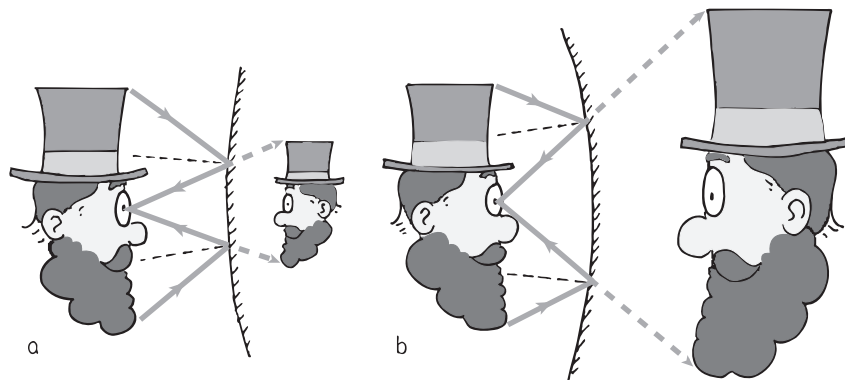
11. A \_\_\_\_\_ is an image that appears to be in a location where light does not really reach.
12. Can your eye tell the difference between an object and its virtual image? Explain.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

13. The virtual image formed by a \_\_\_\_\_ mirror (a mirror that curves outward) is \_\_\_\_\_ and \_\_\_\_\_ to the mirror than the object is.
14. When an object is close to a \_\_\_\_\_ mirror (a mirror that curves inward), the virtual image is \_\_\_\_\_ and \_\_\_\_\_ than the object is.
15. Identify which mirror is concave and which mirror is convex.



a. \_\_\_\_\_ b. \_\_\_\_\_

**29.4 Diffuse Reflection (pages 582–583)**

16. What is diffuse reflection? \_\_\_\_\_
17. Explain why light is reflected in many directions when striking a rough surface.

\_\_\_\_\_

\_\_\_\_\_

18. Is the following sentence true or false? If the differences in elevations in a surface are small (less than about one-eighth the wavelength of the light that falls on it), the surface is considered polished. \_\_\_\_\_
19. An open-mesh parabolic dish acts like a \_\_\_\_\_ reflector for visible light waves but like a \_\_\_\_\_ reflector for long-wavelength radio waves.
20. What determines whether a surface is a diffuse reflector or a polished reflector?

\_\_\_\_\_

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**29.5 Reflection of Sound (pages 583–584)**

21. Is the following sentence true or false? The fraction of sound energy reflected from a surface is less when the surface is rigid and smooth, and more when the surface is soft and irregular. \_\_\_\_\_
22. Sound energy not reflected is \_\_\_\_\_ or \_\_\_\_\_.
23. \_\_\_\_\_ is the study of reflective properties of surfaces and sound.
24. Define reverberations.  
 \_\_\_\_\_  
 \_\_\_\_\_
25. What properties of sound must be considered when designing an auditorium or concert hall?  
 \_\_\_\_\_  
 \_\_\_\_\_
26. Explain why being able to see a reflection of a musical instrument means, you will also be able to hear it.  
 \_\_\_\_\_  
 \_\_\_\_\_

**29.6 Refraction (pages 584–585)**

27. What is refraction?  
 \_\_\_\_\_  
 \_\_\_\_\_
28. Circle the letter of each statement that is true about refraction.
- a. When a wave that is traveling at an angle changes its speed upon crossing a boundary between two media, it continues in a straight line.
  - b. Water waves bend, or refract, when one part of each wave is made to travel slower (or faster) than another part.
  - c. Refraction is the same as reflection.
  - d. Water waves are refracted as they move from deep water into shallow water.
29. On a wave diagram, it is convenient to draw lines, called \_\_\_\_\_, which represent the positions of different crests.
30. Is the following sentence true or false? At each point along a wave front, the wave is moving parallel to the wave front. \_\_\_\_\_

**29.7 Refraction of Sound (page 586)**

31. Sound waves are refracted when parts of a wave front travel at \_\_\_\_\_.

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32. How does a sound wave become refracted?

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33. How does a layer of warm air on top of a layer of colder air near the ground affect sound waves?

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### 29.8 Refraction of Light (pages 587–588)

34. Changes in the speed of light as it passes from one medium to another, or variations in the temperatures and densities of the same medium, cause \_\_\_\_\_.

35. Is the following sentence true or false? The wave fronts of light from the sun look like straight lines because the source of light is so far away.

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36. When light rays enter a medium in which their speed decreases, the rays bend toward the \_\_\_\_\_.

37. Circle the letter of each statement that is true.

- a. If a laser beam enters a container of water at the left and exits at the right, the path would be the same as if the light entered from the right and exited at the left.
- b. Light paths are reversible for reflection but not refraction.
- c. The apparent depth of a glass block is less than the real depth because of refraction.
- d. A full glass mug appears to hold more colored liquid than it actually does because of reflection.

### 29.9 Atmospheric Refraction (pages 588–590)

38. What is a mirage?

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39. Since molecules in hot air are farther apart, light travels \_\_\_\_\_ through it than through the cooler air above, resulting in a \_\_\_\_\_ of the light rays.

40. Is the following sentence true or false? Because of refraction, we see the sun for several minutes after the sunset. \_\_\_\_\_

### 29.10 Dispersion in a Prism (page 590)

41. Light of frequencies closer to the natural frequency of the electron oscillators in a medium travels more \_\_\_\_\_ in the medium.

42. Why is the statement in Question 41 true?

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43. Is the following sentence true or false? Since the natural frequency of most transparent materials is in the ultraviolet part of the spectrum, visible light of higher frequencies travels more slowly than light of lower frequencies. \_\_\_\_\_

44. What is dispersion?

\_\_\_\_\_

\_\_\_\_\_

**29.11 The Rainbow (pages 591–593)**

45. What needs to happen in order for a person to see a rainbow?

\_\_\_\_\_

\_\_\_\_\_

46. Why aren't rainbows completely round?

\_\_\_\_\_

\_\_\_\_\_

47. Explain why, if each drop of water disperses a full spectrum of colors, an observer can only see a single color from any one drop.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

48. How does a secondary rainbow form?

\_\_\_\_\_

**29.12 Total Internal Reflection (pages 593–595)**

Match each phrase with the correct term or number.

Phrase	Terms and Numbers
_____ 49. the angle of incidence that results in light being refracted at an angle of $90^\circ$ with respect to the normal	a. $24.6^\circ$
_____ 50. the complete reflection of light back into its original medium	b. critical angle
_____ 51. critical angle for glass	c. $43^\circ$
_____ 52. critical angle for diamond	d. total internal reflection

53. What are optical fibers?

\_\_\_\_\_

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54. What are two applications for optical fibers?

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