Light PT

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

____ 1. The color of an object we see is determined by the
a. colors of light reflected by the object.
b. frequencies of light absorbed by the object.
c. colors of light shining on the object.
d. frequencies of light reflected by the object.
e. all of the above

____ 2. Sunlight contains all colors of light, but much of it is
a. orange.
b. blue.
c. violet.
d. yellow.
e. red.

____ 3. Humans are most sensitive to light that is
a. red.
b. white.
c. black.
d. yellow-green.
e. green-blue.

____ 4. The three paint colors that are useful for color subtraction are
a. magenta, cyan, and red.
b. red, blue, and yellow.
c. magenta, green, and yellow.
d. red, green, and blue.
e. magenta, cyan, and yellow.

____ 5. Magenta light is really a mixture of
a. red and yellow light.
b. red and cyan light.
c. yellow and green light.
d. red and blue light.
e. none of the above

____ 6. The color of an opaque object is determined by the light that is
a. absorbed.
b. reflected.
c. transmitted.
d. all of the above
e. none of the above

____ 7. If molecules in the sky scattered orange light instead of blue light, sunsets would be colored
a. yellow.
b. blue.
c. green.
d. orange.

e. none of the above

____ 8. Sunsets are red because
a. the longest path of sunlight through the atmosphere is at sunset or sunrise.
b. a lot of high-frequency light is scattered by the atmosphere.
c. blue light from the sun is scattered by Earth's atmosphere.
d. all of the above
e. none of the above

____ 9. When a sample of an element is heated until it glows, the color it gives off is
a. a continuous band of color.
b. a composite of many frequencies of light.
c. a single frequency of light.

____ 10. If you're looking for an instrument that tells what stars are made of, look for a
a. stethoscope.
b. spectroscope.
c. telescope.
d. stellar microscope.

____ 11. A photograph of your favorite person's yellow sweater shows as what color on the negative?
a. Green
b. Orange
c. Red
d. Blue
e. Yellow

____ 12. When a wave passes through an opening, some of the wave is bent. This phenomenon is called
a. polarization.
b. reflection.
c. diffraction.
d. refraction.
e. interference.

____ 13. Colors seen when gasoline forms a thin film on water are a demonstration of
a. refraction.
b. diffraction.
c. dispersion.
d. interference.
e. polarization.

____ 14. Constructive interference occurs when
a. the crest of one wave meets the trough of another wave.
b. two waves of the same color overlap.
c. the crests of two waves overlap.
d. all of the above
e. none of the above

____ 15. When monochromatic light shines through two closely spaced narrow slits and onto a screen some distance away, the pattern on the screen has
a. no light in it.
b. two large bright spots.
c. alternating dark and light bands.

d. one large bright spot.
e. none of the above

____ 16. A diffraction grating consists of
a. many closely spaced parallel slits.
b. a criss-cross of narrow slits.
c. two closely spaced parallel slits.
d. a single narrow slit.
e. none of the above

____ 17. When gasoline drips on a wet street, you can see a beautiful spectrum of colors. This phenomenon is called
a. iridescence.
b. refraction.
c. diffraction.
d. construction.
e. incoherence.

____ 18. A thin film appears blue when illuminated with white light. The color being canceled by destructive interference is
a. green.
b. red.
c. blue.
d. white.
e. none of the above

____ 19. Coherent light is many different rays of light all having the same
a. frequency.
b. wavelength.
c. phase.
d. direction.
e. all of the above

____ 20. Light emitted by a laser is
a. incoherent.
b. coherent.

____ 21. A hologram is most similar to a
a. diffraction grating.
b. prism.
c. 3-D photograph.
d. compound lens.

____ 22. A magnifying glass is a
a. diverging lens.
b. combination of diverging and converging lenses.
c. converging lens.

____ 23. Ray diagrams are used to
a. figure out where an image will be located.
b. find the focal point of a lens.
c. draw pretty pictures.
d. figure out what kind of lens is being used.
e. all of the above

____ 24. In drawing a ray diagram, rays can be drawn
a. from the tip of the object arrow.
b. through the focal point in front of the lens.
c. parallel to the principal axis of the lens.
d. through the center of the lens.
e. all of the above

____ 25. A simple astronomical telescope consists of
a. condenser lenses, prisms, and a projection lens.
b. a pair of converging lenses.
c. several sets of lenses that focus an image on the eye.
d. a single lens that focuses an image on a piece of film.
e. none of the above

____ 26. The eyepiece of a compound microscope forms a
a. virtual image.
b. real image.

____ 27. The image your eye receives is
a. upside down.
b. right-side up.

____ 28. On a bright day, the iris of the eye changes so the pupil
a. stays the same as always.
b. becomes larger.
c. becomes smaller.

____ 29. The eyes of nearsighted people focus light
a. behind the retina.
b. in front of the retina.
c. at the retina.

____ 30. Spherical aberration occurs when light passes through
a. the center part of a lens.
b. a round lens.
c. diverging lenses.
d. the edges of a lens.
e. none of the above

____ 31. A magnifying glass under water will magnify
a. less.
b. the same.
c. more.

____ 32. Electromagnetic waves are
a. transverse waves.
b. longitudinal waves.

____ 33. Compared to the velocity of radio waves, the velocity of visible light waves is
a. slower.
b. faster.
c. the same.

____ 34. The main difference between a radio wave and a light wave is its
a. speed.
b. wavelength.
c. both A and B
d. none of the above.

____ 35. Which of the following is NOT an electromagnetic wave?
a. Sound
b. Radio
c. Light
d. Infrared
e. X-ray

____ 36. Solar eclipses are seen less commonly than lunar eclipses because
a. the sun is so much larger than the moon.
b. the sun is farther from Earth than is the moon.
c. solar eclipses don't happen as often as lunar eclipses.
d. Earth's shadow on the moon is larger than the moon's shadow on Earth.
e. none of the above

____ 37. If an electron vibrates up and down 1000 times each second, it generates an electromagnetic wave having a
a. frequency of 1000 Hz.
b. speed of 1000 m/s.
c. period of 1000 s.
d. wavelength of 1000 m.

____ 38. You are designing hand-held stereo viewers for a children's book. To produce the perception of 3-D objects in the eyes of your readers, you must ensure that polarized filters allow that

a. the right eye sees only the left view and the left eye sees only the right view.
b. the left eye sees only the left view and the right eye sees only the right view.
c. the left eye and the right eye see both views simultaneously.
d. the left eye is covered and the right eye sees both views simultaneously.

____ 39. When a virtual image is created in a plane mirror
a. the image is upright.
b. the image is located behind the mirror.
c. reflected rays diverge.
d. all of the above
e. none of the above

____ 40. The reason we can read print from any direction is that
a. the white part of a page reflects light in all directions.
b. letters emit black light in all directions.
c. letters absorb black light from all directions.
d. all of the above
e. none of the above

____ 41. It is difficult to see the roadway from a car on a rainy night because the road surface
a. is obscured by the rain itself.
b. that is normally a diffuse reflector when dry becomes a mirror surface when wet.
c. absorbs the light more when wet.
d. scatters light in all directions.

____ 42. Refraction occurs
   a. when a wave changes speed.
   b. only at a wave front.
   c. at any unpredictable time.
   d. only with light waves.
   e. all of the above

____ 43. A penny lies in the bottom of a tea cup filled with water. As you look down on the penny, compared to its actual depth, it looks
   a. closer.
   b. farther away.
   c. at the same depth.

____ 44. When you see a "wet spot" mirage on the road in front of you, you are most likely seeing
   a. water.
   b. hot air.
   c. a figment of your imagination.
   d. sky.
   e. none of the above

____ 45. The critical angle for a light from the bottom of a swimming pool shining upward toward the pool's surface is the angle
   a. where light is refracted so it just skims the pool surface.
   b. 43 degrees.
   c. at which all light is refracted out of the pool.
   d. 42 degrees.
   e. at which some light is reflected from the surface.

____ 46. The explanation for a filled root beer mug looking fuller than it is involves
   a. refraction.
   b. reflection.
   c. both
   d. neither

____ 47. The shortest plane mirror in which you can see your entire image
   a. is half your height.
   b. is twice your height.
   c. is equal to your height.
   d. cannot be determined.
   e. depends on how far the mirror is from you.

____ 48. A rainbow nicely illustrates an example of light
   a. internal reflection.
   b. refraction.
   c. both A and B
   d. neither A nor B

____ 49. A secondary rainbow is dimmer than a primary rainbow because
   a. only large drops produce secondary rainbows.
   b. sunlight reaching it is less intense.
   c. there is an extra reflection inside the water drops.
   d. it is a reflection of the primary rainbow.

e. none of the above

____ 50. Ninety percent of light incident on a certain piece of glass passes through it. How much light passes through two pieces of this glass?
a. 81%
b. 85%
c. 89%
d. 90%
e. 80%

True/False
Indicate whether the statement is true or false.

____ 51. Two colors of light that add together to form black light are called complementary colors.

____ 52. The sky is blue because air molecules absorb blue light.

____ 53. A spectroscope is an instrument that analyzes the colors in a light beam.

____ 54. Tennis balls are yellow-green because our eyes are most sensitive to that color.

____ 55. When light falls on the edge of an object, diffraction occurs.

____ 56. Interference patterns are produced when two sources of waves are placed side by side.

____ 57. If you look through a hologram toward a light bulb, normally all you will see is a series of light and dark interference fringes.

____ 58. A real image can be projected onto a screen.

____ 59. A telescope is a collection of lenses that allows us to look at very distant objects.

____ 60. A projector is the part of a camera that focuses light on the film.

____ 61. The point on the principal axis at which parallel rays of light cross after passing through a converging lens is the focal point.

____ 62. A nearsighted person needs to wear glasses that have converging lenses in them.

____ 63. According to Einstein, light consists of massless bundles of electromagnetic energy called photons.

____ 64. A total shadow is called an umbra.

____ 65. Mirages occur because of the reflection of light on a hot day.

____ 66. The separation of light into colors arranged according to their frequency is dispersion.

____ 67. Total internal reflection occurs when a light ray hits a surface at an angle greater than the critical angle.

____ 68. A line that represents the position of a wave crest is called a wave front.

____ 69. The angle of incidence is always slightly smaller than the angle of reflection.

____ 70. When the walls of a concert hall are too reflective, there is an absence of reverberations.

Essay

71. Write a short paragraph on why objects look a certain color and why colored glass transmits a certain color of light. (For example, why is a blue quilt blue and why does red light pass through a red piece of glass?)

72. What are the three primary colors for light addition? What colors appear when lights of any two primary colors are shone on a white object? How would you guess a TV set makes purple?

73. What is color subtraction? When do we use it? What color do you get when you mix blue paint with yellow paint? Explain.

74. Explain why the sky is blue.

75. What is the true color of water? Explain.

76. What is a line spectrum? How is it observed? What is it used for?

77. Write a short paragraph on Huygens' principle and how it applies to a straight wave passing through an opening in a ripple tank.

78. What is diffraction? When does it occur? Which waves will diffract more when passing through an opening?

79. What is interference? What are the two types of interference? When does each occur? Give evidence of interference.

80. Explain why soap bubbles display many different colors.

81. What is coherent light? Briefly, how is it produced in a laser?

82. What is a hologram? What does it look like? How must you use it? What kind of image do you see?

83. Draw a ray diagram showing how a compound microscope works. Explain what each lens does.

84. Write a short paragraph on how the human eye works.

85. Where do nearsighted people's eyes focus light? What kind of glasses do these people need? Explain.

86. Where do farsighted people's eyes focus light? What kind of glasses do these people need? Explain.

87. Write a short paragraph on spherical aberration and chromatic aberration. When does each occur?

88. Explain why a pinhole camera works. Where is the "lens"? Where is the image located? What is its orientation?

89. Write a short paragraph on early measurements of the speed of light.

90. Which waves are part of the electromagnetic spectrum? What are their approximate frequencies? Give examples of where you can find each kind of wave.

91. Explain how light is transmitted through glass. Why is ultraviolet radiation not transmitted through glass?

92. Write a short paragraph on polarization. Explain what it is and how we use polarizers. Explain why sunglasses polarize light vertically.

93. Using the law of reflection and geometry, prove that image distance equals object distance for a plane mirror. (Draw horizontal rays from the flame and base of a candle. Draw a ray from the flame that meets the mirror at the axis.)

94. Explain why you can hear better in an auditorium that has grooves in the walls than in one with flat walls.

95. What is refraction? Why does it occur? Give examples of sound refraction and light refraction.

96. What is a mirage? When are mirages formed? Give an example of a mirage you have seen.

97. Why does the sun stay in the sky a little longer than expected at sunset? What shape is the sun then? Why? What would you expect to happen at sunrise?

98. What is a rainbow? How is it formed? Be specific.

99. What is total internal reflection? When does it happen? Why do diamonds sparkle so much?

100. On a warm day, you are carrying grocery bags through a parking lot. Explain why you observe that sound waves do not seem to carry very well over the asphalt.

Light PT
Answer Section

MULTIPLE CHOICE

1. ANS: E PTS: 1 DIF: L2 OBJ: 28.2 Color by Reflection
   KEY: color | reflect | light BLM: comprehension
2. ANS: D PTS: 1 DIF: L1 OBJ: 28.4 Sunlight
   KEY: sun | light BLM: knowledge
3. ANS: D PTS: 1 DIF: L1 OBJ: 28.8 Why the Sky Is Blue
   KEY: humans | light BLM: knowledge
4. ANS: E PTS: 1 DIF: L1 OBJ: 28.7 Mixing Colored Pigments
   KEY: subtract | color BLM: knowledge
5. ANS: D PTS: 1 DIF: L1 OBJ: 28.5 Mixing Colored Light
   KEY: magenta | red | blue BLM: knowledge
6. ANS: B PTS: 1 DIF: L1 OBJ: 28.2 Color by Reflection
   KEY: opaque | color BLM: knowledge
7. ANS: B PTS: 1 DIF: L3 OBJ: 28.9 Why Sunsets Are Red
   KEY: scatter | sky BLM: synthesis
8. ANS: D PTS: 1 DIF: L2 OBJ: 28.9 Why Sunsets Are Red
   KEY: sunset | red BLM: comprehension
9. ANS: B PTS: 1 DIF: L2
   OBJ: 28.11 The Atomic Color Code-Atomic Spectra KEY: heat | metal
   BLM: comprehension
10. ANS: B PTS: 1 DIF: L2
    OBJ: 28.11 The Atomic Color Code-Atomic Spectra KEY: spectroscope | star
    BLM: comprehension
11. ANS: D PTS: 1 DIF: L2 OBJ: 28.7 Mixing Colored Pigments
    KEY: complement | photo BLM: comprehension
12. ANS: C PTS: 1 DIF: L1 OBJ: 31.2 Diffraction
    STA: Ph.V.1.b KEY: wave | opening | bent | diffraction BLM: knowledge
13. ANS: D PTS: 1 DIF: L2 OBJ: 31.5 Interference from Thin Films
    KEY: color | interference BLM: comprehension
14. ANS: C PTS: 1 DIF: L1 OBJ: 31.3 Interference
    KEY: constructive | interference BLM: knowledge
15. ANS: C PTS: 1 DIF: L2
    OBJ: 31.4 Young's Interference Experiment KEY: monochromatic | slit | pattern
    BLM: comprehension
16. ANS: A PTS: 1 DIF: L1
    OBJ: 31.4 Young's Interference Experiment KEY: diffraction | slit
    BLM: knowledge
17. ANS: A PTS: 1 DIF: L1 OBJ: 31.5 Interference from Thin Films
    KEY: spectrum | iridescence BLM: knowledge
18. ANS: E PTS: 1 DIF: L2 OBJ: 31.5 Interference from Thin Films
    KEY: destructive | interference BLM: comprehension
19. ANS: E PTS: 1 DIF: L1 OBJ: 31.6 Laser Light
    KEY: coherent | wavelength BLM: knowledge

20. ANS: B PTS: 1 DIF: L1 OBJ: 31.6 Laser Light
KEY: light | laser BLM: knowledge
21. ANS: A PTS: 1 DIF: L2 OBJ: 31.7 The Hologram
KEY: hologram BLM: comprehension
22. ANS: C PTS: 1 DIF: L2 OBJ: 30.2 Image Formation by a Lens
KEY: magnifying | lens BLM: comprehension
23. ANS: A PTS: 1 DIF: L1
OBJ: 30.3 Constructing Images Through Ray Diagrams KEY: ray diagram | image
BLM: knowledge
24. ANS: E PTS: 1 DIF: L2
OBJ: 30.3 Constructing Images Through Ray Diagrams KEY: ray diagram | image
BLM: comprehension
25. ANS: B PTS: 1 DIF: L1
OBJ: 30.5 Some Common Optical Instruments KEY: telescope | converging
BLM: knowledge
26. ANS: A PTS: 1 DIF: L1
OBJ: 30.5 Some Common Optical Instruments KEY: microscope | virtual
BLM: knowledge
27. ANS: A PTS: 1 DIF: L1 OBJ: 30.6 The Eye
KEY: image | eye BLM: knowledge
28. ANS: C PTS: 1 DIF: L1 OBJ: 30.6 The Eye
KEY: iris | light | eye BLM: knowledge
29. ANS: B PTS: 1 DIF: L2 OBJ: 30.7 Some Defects in Vision
KEY: eye | nearsight BLM: comprehension
30. ANS: D PTS: 1 DIF: L1 OBJ: 30.8 Some Defects of Lenses
KEY: aberration | edge BLM: knowledge
31. ANS: A PTS: 1 DIF: L2 OBJ: 30.2 Image Formation by a Lens
KEY: magnifying | lens BLM: analysis
32. ANS: A PTS: 1 DIF: L1 OBJ: 27.7 Polarization
KEY: electromagnetic waves BLM: knowledge
33. ANS: C PTS: 1 DIF: L2 OBJ: 27.3 Electromagnetic Waves
STA: Ph.V.2.b KEY: velocity BLM: comprehension
34. ANS: B PTS: 1 DIF: L2 OBJ: 27.3 Electromagnetic Waves
STA: Ph.V.2.b KEY: radio | light BLM: comprehension
35. ANS: A PTS: 1 DIF: L1 OBJ: 27.3 Electromagnetic Waves
STA: Ph.V.2.b KEY: sound | electromagnetic BLM: knowledge
36. ANS: D PTS: 1 DIF: L2 OBJ: 27.6 Shadows
KEY: eclipse | shadow BLM: comprehension
37. ANS: A PTS: 1 DIF: L2
OBJ: 27.4 Light And Transparent Materials KEY: vibrate | frequency
BLM: comprehension
38. ANS: B PTS: 1 DIF: L2
OBJ: 27.8 Polarized Light And 3-D Viewing KEY: polarized light | 3-D viewing
BLM: application
39. ANS: D PTS: 1 DIF: L2 OBJ: 29.3 Mirrors
KEY: virtual | mirror | image BLM: comprehension
40. ANS: A PTS: 1 DIF: L1 OBJ: 29.4 Diffuse Reflection
STA: Ph.V.1.b KEY: light | white | black BLM: knowledge
41. ANS: B PTS: 1 DIF: L2 OBJ: 29.4 Diffuse Reflection

STA: Ph.V.1.b KEY: mirror | reflect | wet BLM: analysis

42. ANS: A PTS: 1 DIF: L1 OBJ: 29.6 Refraction
KEY: refract | speed | wave BLM: knowledge

43. ANS: A PTS: 1 DIF: L2 OBJ: 29.8 Refraction of Light
STA: Ph.V.1.b KEY: refract | water BLM: application

44. ANS: D PTS: 1 DIF: L2 OBJ: 29.9 Atmospheric Refraction
KEY: mirage | wet | sky BLM: comprehension

45. ANS: A PTS: 1 DIF: L2 OBJ: 29.12 Total Internal Reflection
STA: Ph.V.1.b KEY: critical angle | light BLM: comprehension

46. ANS: A PTS: 1 DIF: L2 OBJ: 29.8 Refraction of Light
STA: Ph.V.1.b KEY: mug | glass | refraction BLM: comprehension

47. ANS: A PTS: 1 DIF: L2 OBJ: 29.3 Mirrors
KEY: plane | mirror | size BLM: analysis

48. ANS: C PTS: 1 DIF: L2 OBJ: 29.11 The Rainbow
STA: Ph.V.1.b KEY: rainbow | refraction | reflection BLM: comprehension

49. ANS: C PTS: 1 DIF: L2 OBJ: 29.11 The Rainbow
STA: Ph.V.1.b KEY: secondary | primary | rainbow BLM: analysis

50. ANS: A PTS: 1 DIF: L2 OBJ: 29.8 Refraction of Light
STA: Ph.V.1.b KEY: glass | incident | refraction BLM: application

TRUE/FALSE

51. ANS: F PTS: 1 DIF: L1 OBJ: 28.6 Complementary Colors
KEY: black | light BLM: knowledge

52. ANS: F PTS: 1 DIF: L2 OBJ: 28.8 Why the Sky Is Blue
KEY: sky | blue | absorb BLM: comprehension

53. ANS: T PTS: 1 DIF: L1
OBJ: 28.11 The Atomic Color Code-Atomic Spectra KEY: spectroscope | light
BLM: knowledge

54. ANS: T PTS: 1 DIF: L1 OBJ: 28.4 Sunlight
KEY: yellow-green | visibility BLM: knowledge

55. ANS: T PTS: 1 DIF: L1 OBJ: 31.2 Diffraction
STA: Ph.V.1.b KEY: light | diffraction BLM: knowledge

56. ANS: T PTS: 1 DIF: L2 OBJ: 31.3 Interference
KEY: interference | source BLM: comprehension

57. ANS: T PTS: 1 DIF: L2
OBJ: 31.4 Young's Interference Experiment KEY: hologram
BLM: comprehension

58. ANS: T PTS: 1 DIF: L1 OBJ: 30.2 Image Formation by a Lens
KEY: real | image | project BLM: knowledge

59. ANS: T PTS: 1 DIF: L1
OBJ: 30.5 Some Common Optical Instruments KEY: telescope | lens
BLM: knowledge

60. ANS: F PTS: 1 DIF: L1
OBJ: 30.5 Some Common Optical Instruments KEY: projector | camera
BLM: knowledge

61. ANS: T PTS: 1 DIF: L1
OBJ: 30.1 Converging and Diverging Lenses KEY: axis | rays

BLM: knowledge

62. ANS: F PTS: 1 DIF: L2 OBJ: 30.7 Some Defects in Vision
KEY: nearsighted | converging BLM: comprehension

63. ANS: T PTS: 1 DIF: L1 OBJ: 27.1 Early Concepts Of Light
STA: Ph.V.2 KEY: Einstein | photons BLM: knowledge

64. ANS: T PTS: 1 DIF: L1 OBJ: 27.6 Shadows
KEY: umbra | shadow BLM: knowledge

65. ANS: F PTS: 1 DIF: L1 OBJ: 29.9 Atmospheric Refraction
KEY: mirage | heat | air BLM: knowledge

66. ANS: T PTS: 1 DIF: L1 OBJ: 29.10 Dispersion in a Prism
KEY: light | color | dispersion BLM: knowledge

67. ANS: T PTS: 1 DIF: L1 OBJ: 29.12 Total Internal Reflection
STA: Ph.V.1.b KEY: total | internal | light BLM: knowledge

68. ANS: T PTS: 1 DIF: L1 OBJ: 29.6 Refraction
KEY: front | crest BLM: knowledge

69. ANS: F PTS: 1 DIF: L2 OBJ: 29.2 The Law of Reflection
KEY: angle of incidence | angle of reflection | law of reflection BLM: knowledge

70. ANS: F PTS: 1 DIF: L2 OBJ: 29.5 Reflection of Sound
STA: Ph.V.1.b KEY: reflection | sound | reverberations BLM: knowledge

ESSAY

71. ANS:
Objects look the color of the light they reflect. If a quilt looks blue, it absorbs all colors of light except blue. Transparent objects transmit only colors of light they don't absorb. For example, a piece of red glass absorbs all colors of light except red.

PTS: 1 DIF: L2 OBJ: 28.2 Color by Reflection | 28.3 Color by Transmission
KEY: color | glass | transmit BLM: comprehension

72. ANS:
The three primary colors of light for additive color mixing are red, green, and blue. When any two primary-color lights shine on a white object, the object appears to be the complementary color of the third primary color. For example, red and green light add to yellow, which is the complementary color of blue. A TV set makes purple by using red and blue light.

PTS: 1 DIF: L2 OBJ: 28.5 Mixing Colored Light
KEY: primary | addition | TV BLM: application

73. ANS:
Color subtraction occurs when we mix paints. Each paint or pigment reflects certain colors of light and absorbs the others. The colors reflected by a mixture of pigments are those that are not absorbed. This process is called color subtraction. When you mix blue paint with yellow paint the only color that both pigments reflect is green. All other colors incident upon the mixture are absorbed; therefore the result is green paint.

PTS: 1 DIF: L2 OBJ: 28.7 Mixing Colored Pigments
KEY: subtract | color BLM: application

74. ANS:

The sky is blue because nitrogen and oxygen molecules scatter the higher frequencies of light much more than they scatter the lower frequencies of light. Therefore, violet and blue light are scattered the most by atmospheric molecules. Although violet light is scattered more than blue light, our eyes are much more sensitive to blue light, so we see a blue sky.

PTS: 1 DIF: L2 OBJ: 28.8 Why the Sky Is Blue
KEY: sky | blue | scatter BLM: analysis

75. ANS:
Water is greenish blue. This is because water molecules absorb infrared light and small amounts of red light. When any color is subtracted from incident white light, it is the complementary color that remains. The complementary color of red is cyan (greenish blue); hence, water looks greenish blue.

PTS: 1 DIF: L2 OBJ: 28.1 The Color Spectrum
KEY: water | color BLM: analysis

76. ANS:
A line spectrum is the result of passing a light beam containing many different colors through a prism or a diffraction grating. Each color of light will refract or diffract at a different angle, making it possible to observe the individual colors of light making up the ray. These can be seen with the naked eye through the eyepiece of a spectroscope, or recorded on photographic film in a spectrometer. The line spectrum can be used to identify atomic constituents of matter.

PTS: 1 DIF: L2 OBJ: 28.11 The Atomic Color Code-Atomic Spectra
KEY: line | spectrum BLM: comprehension

77. ANS:
Huygens' principle treats every point on a wave front as a new source of wavelets. If a straight wave passes through an opening in a ripple tank, the shape changes in relation to the size of the opening. A wide opening allows most of the wave to remain straight with "shadow regions" at the edges. As the opening narrows, the waves become more circular, making the wavelets of Huygens' principle more apparent.

PTS: 1 DIF: L2 OBJ: 31.1 Huygens' Principle
STA: Ph.V.1.c KEY: Huygens | ripple BLM: application

78. ANS:
Diffraction is the bending of light by means other than reflection or refraction. Diffraction is seen as the spreading of light when light passes through small openings or around the edges of objects. The smaller the opening, the more pronounced is the spreading.

PTS: 1 DIF: L2 OBJ: 31.2 Diffraction
STA: Ph.V.1.b KEY: diffraction | wave BLM: comprehension

79. ANS:
Interference occurs when two or more waves meet at the same place at the same time. The resulting wave amplitude is the vector sum of the individual wave amplitudes. Basically there is constructive and destructive interference. Constructive interference occurs when two or more waves are in phase with each other; destructive interference occurs when the two waves are 180 degrees out of phase with each other. Sound from two speakers placed a few meters apart from each other in a large open place will interfere—in some places you will hear no sound at all. Coherent light passing through two or more thin slits will interfere and produce a visible interference pattern when projected onto a wall.

PTS: 1 DIF: L2 OBJ: 31.3 Interference
KEY: interference | wave BLM: comprehension

80. ANS:

Soap bubbles appear many-colored because light reflected from the top of the soap film interferes with light reflected from the bottom of the film. The color of light that interferes constructively depends on the thickness of the soap film and the wavelengths of light shining on the bubble. It also depends on the angle at which you view the bubble.

PTS: 1 DIF: L2 OBJ: 31.5 Interference from Thin Films
KEY: soap | bubble | interference BLM: analysis

81. ANS:
Coherent light is light of a single frequency, all waves of which are in phase with each other. Lasers produce coherent light by exciting a group of atoms (so they are on the verge of emitting light). When a photon of a certain frequency passes the atom, it stimulates emission of an atomic photon that is exactly the same frequency as, and in phase with, the passing photon. The emission of this photon stimulates others to be emitted in a cascading process, producing coherent light.

PTS: 1 DIF: L2 OBJ: 31.6 Laser Light
KEY: coherent | laser BLM: comprehension

82. ANS:
A hologram is a piece of photographic film with an interference pattern recorded on it. It is produced by splitting a beam of coherent light in two and recombining the two beams after one of them has been reflected from an object. No object appears on the film, but just a few wavy bands of color. (White-light holograms are an exception.) In order to see the image, you must use laser light. After light passes through the hologram, it diffracts in the reverse way it was made and an image can be seen. The image is extremely realistic, for you can move your head and "see around corners."

PTS: 1 DIF: L2 OBJ: 31.7 The Hologram
KEY: hologram | image BLM: comprehension

83. ANS:
See Fig. 30-16 on page 472.

PTS: 1 DIF: L2 OBJ: 30.5 Some Common Optical Instruments
KEY: ray diagram | microscope BLM: comprehension

84. ANS:
The human eye contains a lens that focuses incoming light onto the retina at the back of the eye. Nerve endings in the retina carry this information to the brain. The iris regulates the amount of light entering the eye.

PTS: 1 DIF: L2 OBJ: 30.6 The Eye
KEY: eye | lens BLM: comprehension

85. ANS:
Nearsighted people's eyes focus light in front of the retina. Nearsighted people need glasses with diverging lenses to lengthen the distance to the point where the rays focus.

PTS: 1 DIF: L2 OBJ: 30.7 Some Defects in Vision
KEY: nearsighted | focus | lens BLM: comprehension

86. ANS:
Farsighted people's eyes focus light behind the retina. Farsighted people need glasses with converging lenses to shorten the image distance.

PTS: 1 DIF: L2 OBJ: 30.7 Some Defects in Vision
KEY: farsighted | focus BLM: comprehension

87. ANS:

Spherical aberration occurs because light passing through the edges of a lens focuses at a slightly different place than light passing through the center of the lens. Chromatic aberration occurs because different colors of light refract at slightly different angles when passing through a lens.

PTS: 1 DIF: L2 OBJ: 30.8 Some Defects of Lenses
KEY: aberration | spherical | chromatic BLM: comprehension

88. ANS:
A pinhole camera works because its tiny aperture admits only a very few light rays from each part of the object. The "lens" of a pinhole camera is actually just an opening in the front of the camera, which doesn't bend the light, so the image is in focus at any distance from the pinhole. The image is viewed on a screen (or recorded on film). Light from the top of the object is seen on the bottom of the viewing screen, and light from the bottom of object is seen at the top of the screen. Thus the image is upside down.

PTS: 1 DIF: L2 OBJ: 30.5 Some Common Optical Instruments
KEY: pinhole | camera | image BLM: comprehension

89. ANS:
Early measurements of the speed of light include Olaus Roemer's timing of the disappearance of one of Jupiter's moons (Io) behind Jupiter for many months in a row. Roemer found that Io disappeared later than expected when Earth was farthest from Jupiter. Roemer figured the discrepancy was due to the time it took light to travel the extra distance. Another measurement of the speed of light was done by Albert Michelson in 1880. He used a system of revolving mirrors to reflect light to a distant mountain and back. Once the rotation rate was adjusted correctly, he could calculate the speed of light quite accurately.

PTS: 1 DIF: L1 OBJ: 27.2 The Speed Of Light
KEY: speed | light | measurement BLM: knowledge

90. ANS:
Radio waves, microwaves, infrared waves, visible light, ultraviolet waves, X-rays, and gamma rays are all part of the electromagnetic spectrum. Their approximate frequencies are 10^3 to 10^6 Hz, 10^7 to 10^{10} Hz, 10^{11} to 10^{14} Hz, 10^{14} Hz, 10^{15} to 10^{16} Hz, 10^{17} Hz, and 10^{18} Hz respectively. Radio waves are emitted at radio broadcast towers, and microwaves in microwave ovens. Microwaves are also used to transmit TV and information signals across Earth and between Earth and satellites. Infrared, visible, and ultraviolet waves are found in sunlight. X-rays are found in medical laboratories and also are emitted from most stars and galaxies. Gamma rays are emitted by nuclear reactions in laboratories and in reactors.

PTS: 1 DIF: L2 OBJ: 27.3 Electromagnetic Waves
STA: Ph.V.2.b KEY: waves | electromagnetic BLM: comprehension

91. ANS:
Visible light is transmitted through glass by molecules that do not easily absorb light photons. A light photon is absorbed for a very short time by a glass molecule, but then it is reemitted in the same direction it was originally traveling and with the same frequency it originally had. This process continues until the photon finally emerges from the other side of the glass. Ultraviolet radiation is in the range of frequencies that resonate with atoms. Glass atoms hold onto UV energy for millions of vibrations, during which time the energy is passed to neighboring atoms by many collisions. The transmitted energy takes the form of heat instead of light. So glass is not transparent to ultraviolet radiation.

PTS: 1 DIF: L2 OBJ: 27.4 Light And Transparent Materials
KEY: glass | transmit BLM: analysis

92. ANS:

Electric field vectors of an electromagnetic wave vibrate in a plane. When many electromagnetic waves are present at once, electric field vectors are vibrating in many different planes. A polarizer is a material that absorbs electromagnetic radiation and passes only radiation that is vibrating in a certain plane. We decrease the amount of light entering our eyes by using sunglasses that allow only vertically polarized light to pass. A large fraction of reflected light is horizontally polarized, so sunglasses help reduce glare from reflected light.

PTS: 1 DIF: L2 OBJ: 27.7 Polarization
KEY: polarization | sunglasses BLM: analysis

93. ANS:
Draw an object (customarily an arrow, or a candle, as shown in Fig. 29-4) in front of a mirror. Draw a ray from the top of the object to the mirror. This ray should be perpendicular to the mirror's surface. Draw another ray from the top of the object to the bottom of the mirror. Using the law of reflection, draw the reflected ray for this lower ray. Extend both reflected rays to the backside of the mirror until they meet. You now have two right triangles, one in front of the mirror and the other in back of the mirror, that have equal angles and one common side. Therefore, the triangles are equal and image distance equals object distance.

PTS: 1 DIF: L2 OBJ: 29.3 Mirrors KEY: reflection | image | mirror
BLM: application

94. ANS:
Grooves in a wall reflect sound in many different directions so you hear all parts of an orchestra at once. With flat walls, you hear some parts of the orchestra better than other parts and you depend on other reflections to direct all parts of the orchestral sound to your ears.

PTS: 1 DIF: L2 OBJ: 29.5 Reflection of Sound
STA: Ph.V.1.b KEY: sound | reflection | auditorium BLM: analysis

95. ANS:
Refraction is the bending of light or sound as it passes from one medium to another. Light and sound are refracted because they travel at different speeds in different media. Sound refraction occurs at concerts on hot summer days when it is often difficult to hear the band. It also is responsible for noises traveling better across water at night than in the daytime. Lenses work because of light refraction. A pencil in a glass of water will appear broken because of light refraction.

PTS: 1 DIF: L2 OBJ: 29.6 Refraction
KEY: refraction | light | sound BLM: comprehension

96. ANS:
A mirage is something seen in a different place than it really is. It occurs when light is bent as it passes through different temperature layers in the atmosphere. "Wet pavement" seen on a hot summer day is an example of a mirage.

PTS: 1 DIF: L2 OBJ: 29.9 Atmospheric Refraction
KEY: mirage | refraction BLM: comprehension

97. ANS:
Atmospheric refraction keeps the sun in the sky a little longer than expected at sunset. When the sun is already below the horizon, its light bends as it passes through Earth's atmosphere, making the sun appear as if it were still above the horizon. Light we see from the lower part of the sun has been refracted more than rays we see from the upper part. The net effect is to "raise" the lower part of the sun more than the upper part. Therefore, the sun appears to be shortened vertically, that is, elliptical instead of round. The same things happen at sunrise. We see the sun before it is really above the horizon, and we see it as somewhat squashed.

PTS: 1 DIF: L2 OBJ: 29.9 Atmospheric Refraction

KEY: refraction | sun | atmosphere BLM: analysis

98. ANS:
A rainbow is the result of dispersion of light by water droplets. When light enters a water droplet, it is refracted. Because each color (wavelength) is refracted at a slightly different angle, dispersion occurs. After light is reflected within the droplet and refracted a second time as it leaves the droplet, more dispersion occurs. The result is that we see different colors of light, depending on which droplets we are looking at and at which angle we are viewing a single droplet.

PTS: 1 DIF: L2 OBJ: 29.11 The Rainbow
STA: Ph.V.1.b KEY: rainbow | dispersion | water BLM: comprehension

99. ANS:
Total internal reflection is the complete reflection of light from inside an object. It happens when light strikes the inner surface at an angle greater than the critical angle for the material. Different materials have different critical angles, because the speed of light varies from material to material. Light travels most slowly in a diamond, which has the smallest critical angle known. This small critical angle means that much of the light inside a diamond is totally internally reflected. In a diamond gemstone, total internal reflection occurs at each of the many facets oriented in many directions -- hence the sparkle of a diamond.

PTS: 1 DIF: L2 OBJ: 29.12 Total Internal Reflection
STA: Ph.V.1.b KEY: total | sparkle | reflection BLM: analysis

100. ANS:
Sound waves are refracted when parts of a wave front travel at different speeds. In the parking lot, air near the hot asphalt is warmer than the air above. Since sound travels faster in warmer air, sound waves travel faster near the asphalt and therefore tend to bend away from the ground. Thus, sound waves travel slightly upward and you observe that they do not carry very well.

PTS: 1 DIF: L2 OBJ: 29.7 Refraction of Sound
STA: Ph.V.1.b KEY: refraction | sound BLM: application