Name: _____ Unit VIII
Mr. Willis Electromagnetic Spectrum & Light
Conceptual Physics: _____ Need extra help?
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**VIII**

## Unit VIII Study Guide

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

____ 1. In 1926, Michelson was able to measure the speed of light using
a. lanterns.
b. stars.
c. mirrors.
d. sunlight.

____ 2. Electromagnetic waves vary in
a. the speed they travel in a vacuum.
b. wavelength and frequency.
c. the way they reflect.
d. the orientation of their electric and magnetic fields.

____ 3. To calculate the frequency of an electromagnetic wave, you need to know the speed of the wave and its
a. wavelength.
b. intensity.
c. refraction.
d. amplitude.

____ 4. An electromagnetic wave in a vacuum has a wavelength of 0.07 m. What is its frequency?
a. $f = 3.0 \times 10^8 \text{ m/s}$
b. $f = 4.3 \times 10^9 \text{ Hz}$
c. $f = 3.0 \times 10^9 \text{ Hz}$
d. $f = 4.3 \times 10^8 \text{ m/s}$

____ 5. Light acts like
a. a wave.
b. a particle.
c. both a wave and a particle.
d. neither a wave nor a particle.

____ 6. Because light travels in a straight line and casts a shadow, Isaac Newton hypothesized that light is
a. radiation.
b. a stream of particles.
c. a wave.
d. heat.

____ 7. Photons travel outward from a light bulb in
a. a single straight line.
b. increasing intensity.
c. a small, dense area.
d. all directions.

____ 8. Which of the following occurs as light travels farther from its source?
a. Far from the source, photons come together in a small area.
b. The intensity of light increases as photons move away from the source.
c. The source gives off less light as photons move away from it.
d. Far from the source, photons spread over a larger area.

____ 9. Infrared rays have a shorter wavelength than
a. ultraviolet rays.
c. radar waves.

b. X-rays.
d. gamma rays.

____ 10. The full range of frequencies of electromagnetic radiation is called
a. visible light.
b. radio waves.
c. the electromagnetic spectrum.
d. invisible radiation.

____ 11. The waves with the longest wavelengths in the electromagnetic spectrum are
a. Infrared rays.
b. radio waves.
c. gamma rays.
d. X-rays.

____ 12. The visible light spectrum ranges between
a. radar waves and X-rays.
b. television waves and infrared rays.
c. Infrared rays and ultraviolet rays.
d. ultraviolet rays and gamma rays.

____ 13. Cellular telephones utilize
a. radar waves.
b. very high frequency waves.
c. very low frequency waves.
d. microwaves.

____ 14. X-ray photographs show softer tissue
a. as invisible.
b. as dark, highly exposed areas.
c. the same as dense bones.
d. as bright white areas.

____ 15. A translucent material
a. scatters some light.
b. transmits all light.
c. absorbs all light.
d. reflects all light.

____ 16. In order of increasing light-transmitting capabilities of materials, which is the correct sequence?
a. transparent, opaque, translucent
b. opaque, transparent, translucent
c. opaque, translucent, transparent
d. translucent, transparent, opaque

____ 17. Which of the following occurs as a light wave bends when it passes from one medium into another?
a. constructive interference
b. refraction
c. destructive interference
d. reflection

____ 18. Polarized sunglasses work by
a. blocking light waves that vibrate in one plane.
b. gradually refracting light as it passes through the lenses.
c. bending light as it passes from air into the lenses.
d. reflecting most of the light that strikes the sunglasses.

____ 19. Newton's prism experiments showed that white sunlight is made up of
a. the full electromagnetic spectrum.
b. only blue light.
c. all the colors of the visible spectrum.
d. only the longest wavelengths.

____ 20. When droplets of water in the atmosphere act like prisms, the colors in sunlight undergo
a. interference.
b. absorption.
c. polarization.
d. dispersion.

____ 21. What an object is made of and the color of light that strikes it determine the
a. apparent color of the object.
b. transparency of the object.
c. opacity of the object.
d. translucence of the object.

____ 22. Blue light and yellow light combine to produce white light because
a. they absorb each other's wavelengths.
b. blue, yellow, and white are primary colors.
c. they are complementary colors of light.
d. they are both primary colors of light.

____ 23. The primary colors of light are
a. green, blue, and black.
b. cyan, magenta, and yellow.
c. red, yellow, and blue.
d. blue, green, and red.

____ 24. The primary colors of pigments
a. are cyan, yellow, and magenta.
b. are the same as the secondary colors of light.
c. combine in equal amounts to produce black.
d. all of the above

____ 25. An incandescent light bulb produces light when electrons flow through the
a. air.
b. glass.
c. filament.
d. vacuum.

____ 26. Which of the following is NOT true regarding neon lights?
a. Light is emitted as electrons move through a gas in a tube.
b. All neon lights are colored by the color of the tubing.
c. Neon lights may contain other gases, such as helium or krypton.
d. Each kind of gas produces its own distinctive color.

____ 27. Many streets and parking lots are illuminated with
a. laser lights.
b. tungsten-halogen lights.
c. sodium-vapor lights.
d. fluorescent lights.

____ 28. Light whose waves all have the same wavelength, direction, and coincidental peaks is called
a. coherent light.
b. incandescent light.
c. fluorescent light.
d. neon light.

____ 29. A fluorescent light tube usually contains
a. a vacuum.
b. Oxygen.
c. mercury vapor.
d. light-emitting diodes.

____ 30. Which kind of light is used to carry information through optical fibers?
a. incandescent
b. fluorescent
c. sodium-vapor light
d. laser

**Completion**
*Complete each sentence or statement.*

31. Electromagnetic waves are _____ waves consisting of changing electric and magnetic fields.

32. Warm objects give off more _____ radiation than cool objects give off.

33. The speed of light in a vacuum is _____ m/s.

34. The farther away you are from a light source, the _____ intense it appears.

35. Objects that scatter some of the light that is transmitted through them are _____.

36. When viewed in yellow light, an object that reflects all the colors of light will appear _____.

37. Combining equal amounts of the three primary pigments produces _____.

38. Electromagnetic waves can travel through a(an) _____.

39. Light is produced when _____ change energy levels in an atom.

40. Microwaves have a higher _____ than radio waves have.

41. A transparent object _____ almost all of the light that strikes it.

42. The electromagnetic waves with the shortest wavelengths are _____ rays.

43. An ultraviolet light wave has a wavelength of 200 nm and a frequency of $6.0 \times 10^{14}$ Hz. The ultraviolet light is NOT traveling through a(an) _____.

44. In microwave cooking, heating only occurs near the _____ of the food.

45. A mirage, or distorted image, can be caused by the _____ of light as it moves into layers of hotter and hotter air.

46. White light passing through a prism separates into colors because of the differences in the _____ of each color of light.

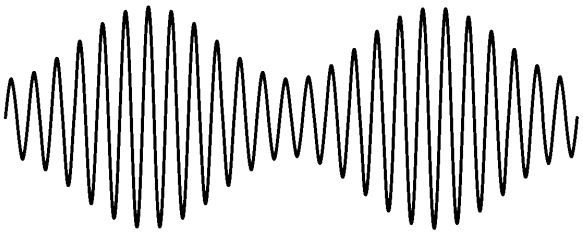

**Figure 18-1**

47. The electromagnetic waves shown in Figure 18-1 are an example of _____ used in certain radio broadcasts.

48. Light amplification by stimulated emission of radiation is known as _____ light.

49. To form white light from the combination of only two colors of light, the colors must be _____.

50. The following electromagnetic waves are arranged in order of increasing frequency: infrared, _____, ultraviolet.

**Short Answer**

51. What is a basic difference between electromagnetic waves and sound waves?

52. In which medium does light travel faster, air or glass?

53. What is the photoelectric effect?

54. Describe what happens to photons as they travel away from a light source.

55. Which type of electromagnetic wave has the longest wavelength and lowest frequency?

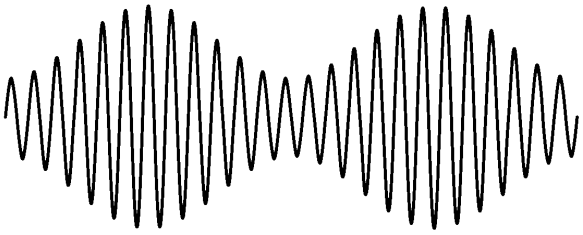

**Figure 18-1**

56. Why is the amplitude of the radio wave in Figure 18-1 varied?

57. Both gamma rays and X-rays are used to see inside the body. Which one is used to make images of bones? How are the other rays used?

58. Which waves have wavelengths longer than those of visible light? Give an example of how each kind of wave is used.

59. How would you describe a translucent material?

60. Use the scattering of light to explain why the sun is red at sunset.

61. What type of light passes through a polarizing filter?

62. What two factors influence the color of an object?

63. Magenta is a secondary color of light. What type of color is magenta when it is a pigment?

64. What is common to all light sources including incandescent, fluorescent, neon, halogen, laser, and sodium-vapor devices?

65. What distinguishes a laser from other common light sources?

**Problem**

66. A communications satellite transmits a radio wave at a frequency of $5.0 \times 10^9$ Hz. What is the signal's wavelength? Assume the wave travels in a vacuum. Show your work.

**Essay**

67. Is light a particle or a wave? Briefly explain your answer and give examples.

68. What is the electromagnetic spectrum? Give examples of each kind of wave and relate each example to its relative position in the spectrum.

69. What is polarized light? What is unpolarized light? Name at least one familiar kind of polarizing filter and explain how it works.

70. Describe the economic advantage of using sodium-vapor lights and a disadvantage of the color it produces.

**Other**

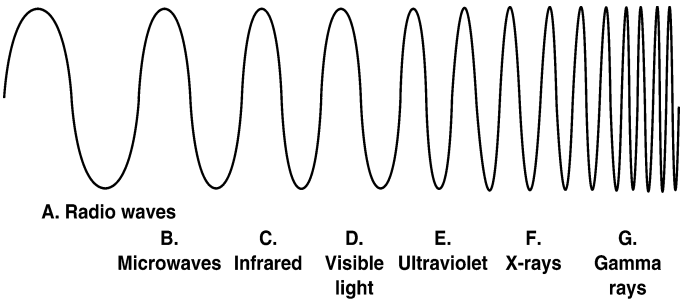


**Figure 18-2**

71. Which waves in Figure 18-2 carry AM and FM signals? How do the frequencies of AM and FM signals compare?

72. Which waves in Figure 18-2 are used to expose heat-sensitive film? Where are these waves located in the electromagnetic spectrum?

73. Look at Figure 18-2. Without referring to the specific frequencies and wavelengths of the colors of the visible spectrum, at which end of the visible spectrum would you place red? At which end would you place violet? *Hint:* Use the names of the waves outside the visible spectrum to help you.

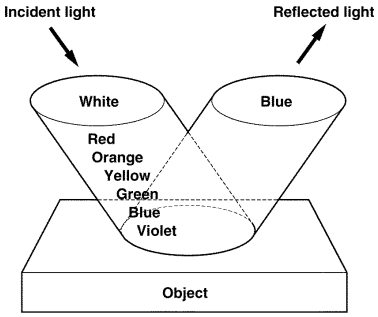


**Figure 18-3**

**Figure 18-4**

74. Examine Figure 18-4, which represents a pencil in a glass container of a liquid. Is the liquid transparent, translucent, or opaque to visible light? Explain.

75. Explain why the pencil in Figure 18-4 appears to be broken.

76. What color is the object in Figure 18-3? Explain your answer.

77. Suppose the light striking the object in Figure 18-3 was a combination of red and green. What color would the object be when viewed in this light? Explain your answer.