

## Conceptual Physics Review (Chapters 25, 26, 27 & 28)

### Chapter 25

- Describe the period of a pendulum.
- Describe the characteristics and properties of waves.
- Describe wave motion.
- Describe factors that affect the speed of a wave.
- Distinguish between transverse and longitudinal waves, and be able to give an example of each.
- Distinguish between constructive and destructive interference.
- Describe how a standing wave occurs.
- Describe the Doppler effect for sound.
- Describe bow waves.
- Describe sonic booms.
- Be able to define all vocabulary words in bold from the chapter.

### Chapter 26

- Describe the relationship between a sound wave's frequency and pitch.
- Describe the movement of sound through air.
- Compare the transmission of sound through air with that through solids, liquids, and a vacuum.
- Describe factors that affect the speed of sound.
- Describe loudness and sound intensity.
- Determine the relative intensities of two sounds from their respective decibel levels.
- Describe natural frequency.
- Describe resonance.
- Describe beats.
- Be able to define all vocabulary words in bold from the chapter.

### Chapter 27

- Describe the dual nature of light.
- What produces light (electromagnetic waves)?
- Define photons and identify which theory of light they provide evidence for.
- Explain why it is difficult to measure the speed of light.
- Explain Roemer's method of measuring the speed of light.
- Explain Michelson's method of measuring the speed of light.
- Know the different portions of the electromagnetic spectrum and how they each relate to each other in terms of wavelength and frequency.
- Describe opaque materials.
- Describe solar and lunar eclipses.
- Distinguish between umbra and penumbra.
- Describe polarization and how Polaroid filters work.
- Know the speed of light in meters per second and kilometers per second.
- Explain why sound waves move faster through steel than through air, while light waves travel more slowly in any medium than through a vacuum.

## **Chapter 28**

- Explain why white and black are not true colors.
- Describe what factors affect the color of an object.
- Describe what determined whether a material reflects, transmits, or absorbs light of a certain color, in terms of the frequency of that color of light.
- Identify the three primary colors of light, and what secondary colors are formed by combining any two of them in equal proportions.
- Describe white light.
- Define complementary colors.
- Identify the three primary pigments by name, and identify which of the primary colors of light each pigments absorbs and reflects.
- Describe the difference between color mixing by addition and color mixing by subtraction.
- Explain why the sky is blue.
- Explain why sunsets are red.
- Explain why water is greenish-blue.
- Explain what is meant by atomic spectra.

### **Labs**

- Review the Pendulum Lab.
- Review the Mechanical Waves Lab.
- Review the Speed of Sound Lab.

### **Homework Assignments**

- Review all written assignments out of your textbook.
- Review all reading quizzes.
- Review all worksheets.
- Review all class notes and challenge problems worked during class.

## Sample Calculations

1. What is the frequency, in hertz, that corresponds to each of the following periods?

a) 0.10 sec

b) 5 secs

c)  $\frac{1}{60}$  sec

d) 24 hours

e) 12 mins

2. What is the period, in seconds, that corresponds to each of the following frequencies?

a) 10 Hz

b) 0.2 Hz

c) 60 Hz

d)  $1.1574 \times 10^{-5}$  Hz

e) 2.3 MHz

3. A metronome is set so that it makes ten complete vibrations in 12 seconds. Find the frequency of the metronome.

4. While sitting on a pier, Carlos notices that incoming waves are 2.0 m between crests. If the waves lap against the pier every 5.0 s, find the

a) frequency of the waves

b) speed of the waves

5. Light travels at a speed of  $3 \times 10^8$  m/s in a vacuum, and for practical purposes, through air as well. The wavelength of a shade of yellow light is  $5.80 \times 10^{-11}$  m. Find the frequency of this light.

6. A gamma ray is high-frequency light. Find the wavelength of a gamma ray with a frequency of  $10^{22}$  Hz.
7. If the speed of a longitudinal sound wave is 340 m/s, and the frequency is 1000 Hz, what is the wavelength of the wave?
8. The Sears Building in Chicago sways back and forth at a frequency of about 0.1 Hz. What is its period of vibration?
9. If a train of freight cars, each 10 m long, rolls by you at the rate of 2 cars each second, what is the speed of the train?
10. If a wave with wavelength 10 m has a frequency of 2 Hz, what is the wave speed?
11. If a water wave vibrates up and down two times each second and the distance between wave crests is 1.5 meters, find each of the following:
- a) the frequency of the wave
  - b) the wavelength of the wave
  - c) the speed of the wave
12. Is it possible for one wave to cancel another wave so that the combined amplitude is zero? Explain your answer.
13. Is the Doppler effect an apparent change in speed or frequency of a wave, due to the motion of the source relative to the receiver?

14. Find the frequency of a sound wave that has a wavelength of 1.5 meters. Could you hear this sound?
15. Your teacher says “Hello” to you from across the gym, 34 m away. How long does it take the sound to reach you?
16. Imagine a hiker camping in the mountains. Just before going to sleep he yells “WAKE UP”, and the sound echoes off the nearest mountain, returning 8 hours later. How far away is that mountain?
17. Suppose that you put your left ear down against a railroad track, and your friend one kilometer away strikes the track with a hammer. How much sooner will the sound get to your left ear than to your right ear? The speed of sound is about 5950 m/s in steel and 340 m/s in air.
18. Radio station WKLB in Boston broadcasts at a frequency of 99.5 MHz. What is the wavelength of the radio waves emitted by WKLB?
19. A pendulum’s natural frequency is one full back-and-forth swing every 2 seconds. For maximum amplitude, how often should the pendulum bob be pushed? Express your answer in terms of time and also as a frequency, in Hz.
- a) Would the pendulum continue to swing at this natural frequency if it were pushed only half as frequently?
- b) What about if it were pushed with twice the frequency?

20. In order to create beats, should two sound waves be of the same frequency or of different frequencies? Why?

21. Two notes of frequencies of 110 Hz and 140 Hz are sounded together. What is the resulting beat frequency? Would you be able to hear the beats? If not, why not? If so, what would they sound like?

22. If you owe me \$50, and you only pay me \$45, by how much money were you short? What percentage is this of the amount you owed me? This percentage is equivalent to a percent error.

23. Assume that the actual speed of sound at a given temperature is 340 m/s and that you do an experiment to calculate the speed of sound using echo reflection. If your experimentally determined speed of sound is 335 m/s, what is your percent error in the experiment? Show your work!!!

24. For each of the following pairs, identify which has the longer wavelength and identify which has the higher frequency:

a. radio waves vs. gamma rays

b. ultraviolet radiation vs. microwaves

c. microwaves vs. X-rays

d. visible light waves vs. infrared radiation

e. gamma rays vs. visible light waves

f. X-rays vs. radio waves

25. How long does it take for light from the sun to reach Earth if the sun is  $1.50 \times 10^{11}$  m away? Show your calculation!!

26. When you look at a distant star or planet, you are looking back in time. How far back in time are you looking when you observe Pluto through the telescope from a distance of  $5.91 \times 10^{12}$  m?

27. If a person could travel at the speed of light, it would still take 4.3 years to reach the nearest star, Proxima Centauri. How far away, in meters, is Proxima Centauri? (Ignore any relativistic effects.)

28. The wavelength of green light is about 500 nm. What is the frequency of this light?

29. When electromagnetic waves travel through a medium such as glass, what happens to the speed of the waves? What happens to the frequency? What happens to the wavelength?

30. Draw a sketch (not necessarily to scale) of the sun, moon, and Earth in their relative positions for a solar eclipse. Then draw a sketch with the relative positions for a lunar eclipse. Throughout your life, which type of eclipse would you probably be able to see more often? Explain why.

31. I have a bright red umbrella. What do I actually mean when I say the umbrella is red? Explain in terms of frequencies of light that are reflected or absorbed by the umbrella.

32. What color does my “red” umbrella appear when it is illuminated with white light? With yellow light? With magenta light? With cyan light?

33. My raincoat is bright yellow when illuminated with white light. What color does it appear when illuminated with red light? With green light? With blue light?

34. When a piece of green glass is held in front of a white light source, what color is the light that is transmitted through the glass? What color light is transmitted through a piece of blue glass held in front of a white light source? What color light is transmitted through the two pieces of glass (blue and green) when they are held one against the other in front of the white light source?

35. Microwave ovens emit waves of about 2450 MHz. What is the wavelength of this radiation? Show your work!!

36. When red light shines on a red rose, why do the leaves become warmer than the petals?

37. What are the three primary colors of light? For each pair of primary colors, list the color that is produced by mixing that pair of colors of light. Then, note what color is produced by mixing all three primary colors of light in equal proportions.

38. What are complementary colors? Give three examples of pairs of complementary colors, and describe what happens when light of the two colors in each pair is mixed, and also explain what happens when pigment of the two colors in each pair is mixed.

39. If molecules in the sky scattered low-frequency light more than high frequency light, what color would the sky appear during the majority of the day? What color would it appear at sunrise and sunset?

40. You are working in a theater and have three lights available to shine on the actors on stage: red, blue, and green. If the actor is wearing a yellow jumpsuit, what color does the jumpsuit appear when you shine the red light on the actor? What color does the jumpsuit appear when you shine the blue light on the actor? What about when you shine the green light on the actor? What if you shine all three lights simultaneously on the actor?