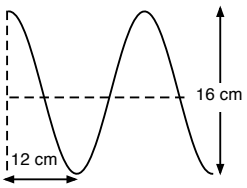
Waves Review Sheet

MULTIPLE CHOICE: Circle the best answer. (Assume the speed of sound is 345 m/s when needed).

Questions 1-4

A wave traveling horizontally with a frequency of 20 Hz is shown.



1 The amplitude of the wave is
(A) 6 cm (C)16 cm
(B) 8 cm (D)24 cm

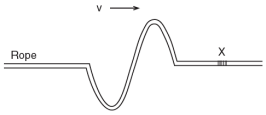
2 The wavelength of the wave is
(A) 6 cm (C) 16 cm
(B) 8 cm (D) 24 cm

3 The period of the wave is
(A) 12 s (C) 0.05 s
(B) 0.12 s (D) 20 s

4 The speed of the wave is
(A) 40 m/s (C) 24 m/s
(B) 480 m/s (D) 4.80 m/s

5 Which of the following do sound waves and light waves have in common?
(A) both are transverse waves
(B) both are mechanical waves
(C) both travel at 345 m/s
(D) both can transfer energy

6 A transverse wave is moving with velocity *v* along a rope.

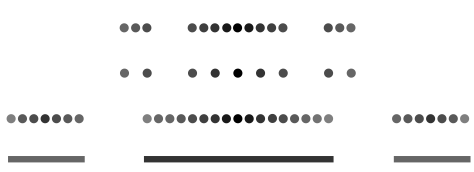


In which direction will segment X move as the wave passes through it?
(A) down, only (C) down, then up, then down
(B) up, only (D) up, then down, then up

7 The diagram below shows the interference pattern of a 2-slit diffraction grating:

Which diagram shows another 2-slit pattern with the same slit width, *a*, but a larger slit separation, *d*?

(A)
(B)
(C)
(D)



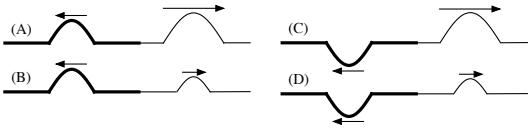
8 Referring to the previous question, which diagram shows a 2-slit pattern with a larger slit width (*a*), but the same slit separation (*d*) as the original diagram?

9 Which of the following must be different for a trumpet and a banjo when notes are being played by both at the same fundamental frequency?
(A) wavelength of the first harmonic
(B) intensity of the harmonic frequencies
(C) number of harmonics present
(D) speed of sound in air

10 A sound with level of 100 dB is how many times more intense than a sound of level 20 dB?
(A) 5 (C) 10^8
(B) 80 (D) 1000

11 The diagram shows a thick rope connected to a thin rope with a wave pulse moving right.

Which diagram shows what occurs after the wave pulse encounters the boundary between the thick rope and thin rope?

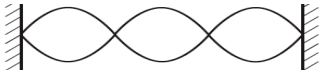


12 What will happen to the fundamental frequency of an organ pipe open at both ends if a cap is placed over one end sealing it? The frequency will
(A) be quadrupled (C) be doubled
(B) remain the same (D) be halved

13 Yellow light has a wavelength of 580 nanometers. Its frequency is
(A) 5.17×10^{14} Hz (C) 5.17 Hz
(B) 5.17×10^{5} Hz (D) 0.595 Hz

14 Which of the following wave properties does not change when a sound wave enters a new medium?
(A) amplitude (C) speed
(B) frequency (D) wavelength

15 A standing wave is set up on a 1.2-meter string. The wave speed on the string is 60 m/s. What is the frequency of the harmonic shown?

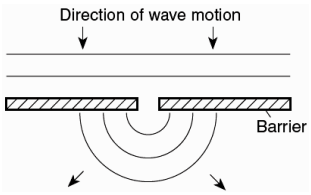


(A) 25 Hz (C) 75 Hz
(B) 37.5 Hz (D) 100 Hz

16 Constructive interference occurs when the path length difference between a point on an interference pattern and two waves sources (in phase) is the sequence ____ and destructive interference occurs when the path length difference between a point on an interference pattern and two waves sources (in phase) is the sequence ____
(A) $1\lambda, 3\lambda, 5\lambda, \ldots$ (C) $\frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda, \ldots$
(B) $1\lambda, 2\lambda, 3\lambda, \ldots$ (D) $\frac{1}{2}\lambda, 1\lambda, \frac{3}{2}\lambda, \ldots$

17 In a vacuum, all electromagnetic waves have the same
(A) wavelength (C) speed
(B) frequency (D) amplitude

18 The diagram shows wave fronts spreading into the region behind a barrier. Which wave phenomenon is represented?



(A) diffraction (C) refraction
(B) interference (D) reflection

19 The driver of a car hears the siren of an ambulance. The siren generates a frequency of 2,000 hertz. The frequency heard by the driver will be higher *only if*:

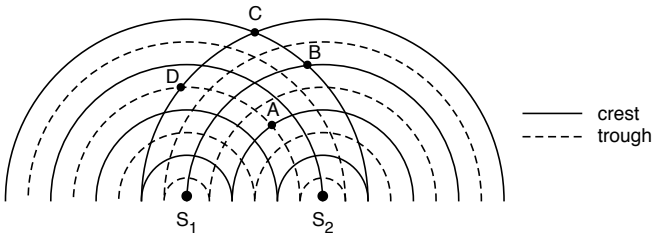
(A) the car and ambulance are chasing each other
(B) the car and ambulance are heading towards each other
(C) the car and ambulance are getting closer to each other
(D) the car and ambulance are heading away each other

20 If the displacement of particles in a medium is parallel to the direction of travel of the wave, the wave is classified as

(A) electromagnetic (C) transverse
(B) torsional (D) longitudinal

21 The diagram below shows waves created by two sources, S_1 and S_2. At which two points is constructive interference occurring?

(A) A and B (C) B and C
(B) A and C (D) A and D



22 In the previous question, how much longer is the path length from S_1 to B than the path length from S_2 to B?

(A) 1λ (B) 1.5λ (C) 2λ (D) 4λ

Questions 23-27: Honors Physics only

23 Which phenomenon *cannot* be exhibited by longitudinal waves?

(A) reflection (C) diffraction
(B) refraction (D) polarization

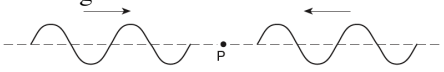
24 In a demonstration, a vibrating tuning fork causes a nearby second tuning fork to begin to vibrate with the same frequency. This is called?

(A) the Doppler effect (C) resonance
(B) nodes (D) interference

25 If light waves are coherent

(A) they shift over time (D) they remain in phase
(B) their intensity is less than non-coherent light
(C) they have less than three different wavelengths

26 The diagram below shows two waves of equal amplitude and frequency approaching point P as they move through the same medium.



As the two waves pass through each other, the medium at point P will vibrate

(A) up & down (C) into & out of page
(B) left and right (D) remain stationary

27 The width of the central maximum for a single slit interference pattern does not depends on the

(A) wave frequency (C) wavelength
(B) wave amplitude (D) slit width

PROBLEM SOLVING: on separate paper, include the general equation, substitutions, final calculation, and appropriate units.

28 You are driving north on a highway at 20 m/s and an ambulance approaches you from behind at 40 m/s. The ambulance siren has a frequency of 6000 Hz. What frequency shift is heard as the ambulance passes you?

29 You are traveling west toward a train that sounds a 7500 Hz whistle. The train is moving east toward you at 45 m/s. The frequency you hear is 9000 Hz. At what speed are you traveling?

30 Light is directed through a diffraction grating with 100 lines per centimeter. At a distance of 0.40 m from the grating, third order bright lines are seen 12.6 mm apart. What is the wavelength of the light? Hint: conversions to meters first!

31 A flute, open at both ends, resonates at a first harmonic of 300 Hz. a) What is the flute's length? b) If a clarinet, closed at one end, is the same length as the flute, what is its first harmonic? c) And the next harmonic frequency for each?

32 A third harmonic standing wave resonates in a tube of length 2.6 meters that is closed at one end and open at the other. a) What is the frequency of the harmonic? b) What is the frequency of the next harmonic?

33 A double-slit interference pattern with blue light of wavelength 486 nanometers, has a 5^{th}-order maximum at 4.60° from the central maximum. a) How far apart are the double slits? b) At what angle is a 3^{rd} order minimum?

34 Draw the first four harmonics for: a) stringed instrument b) open wind instrument c) closed wind instrument.

Questions 35-38: Honors Physics only

35 A piece of steel piano wire is held fixed at both ends under tension of 100 newtons. The total wire length is 1.20 meters and it has a mass of 2.5 grams. What is the wave speed on the wire? What is the third harmonic frequency?

36 A source emits waves with an acoustic power of 6.0 W. How far away is a sound level meter placed if it reads 95 dB?

37 Light incident on a screen containing two narrow slits 0.020 mm apart casts a pattern on paper 2.0 m away. What is the distance separating the violet light (400 nm) in the 1^{st} order band from the red light (600 nm) in the 2^{nd} order band?

38 A narrow single slit is illuminated by infrared light at 1150 nanometers. At an angle of 6.2° from the central maximum, the middle of the fifth-order dark band is seen. a) Determine the width of the slit. b) The same slit is now illuminated with visible light, and the ninth-order dark band is seen at 6.2°. What is the wavelength, in nanometers, of this light?

1. B **2.** D **3.** C **4.** D **5.** D **6.** D **7.** C **8.** B **9.** B **10.** C **11.** A **12.** D **13.** A **14.** B **15.** C **16.** B/C **17.** C **18.** A **19.** C **20.** D **21.** C **22.** A **23.** D **24.** C **25.** D **26.** D **27.** B **28.** 705 Hz **29.** 15 m/s **30.** $5.25E^{-7}$ m **31a.** 0.575 m **31b.** 150 Hz **31c.** 600/450Hz **32a.** 99.5 Hz **32b** 166 Hz **33a.** $3.03E^{-5}$ m **33b.** 3.22° **35a.** 219 m/s **35b** 274 Hz **36.** 12.3 m **37.** 0.08 m **38.** 639 nm