For each question, select the best answer from the four alternatives.

1. Which of the following statements is true of waves passing through media? (8.1) K/U
   (a) Energy is transferred and lost as a wave passes through a material.
   (b) Sound waves travel faster in air than in water.
   (c) The speed of sound waves through a gas is affected by the temperature of the gas.
   (d) Waves travelling through a less rigid material travel faster and farther than through a rigid material.

2. Which three wave characteristics depend on one another? (8.3) K/U
   (a) amplitude, speed, phase
   (b) speed, wavelength, frequency
   (c) amplitude, direction, frequency
   (d) amplitude, waveform, speed

3. A vuvuzela supports a wave with a frequency of 235 Hz. If the wave travels at 335 m/s, what is its wavelength? (8.4) K/U
   (a) 0.7 m
   (b) 1.4 m
   (c) 14 cm
   (d) 100 m

4. If you know the linear density of a violin string, and want to calculate the speed of a wave on the violin string, which additional information is needed? (8.4) K/U
   (a) tension on the string
   (b) temperature of the string
   (c) time to complete a cycle
   (d) density of the violin's sounding board

5. A hypersonic test glider achieved a speed of Mach 20 before crashing. This means that the glider travelled
   (a) at 20 times the speed of sound
   (b) at 20 m/s
   (c) at 2 times the speed of sound
   (d) at $\dfrac{1}{20}$ the speed of sound (8.5) K/U

6. When two waves meet, one with amplitude 4 cm and the other with amplitude 2 cm, what are the possible maximum and minimum amplitudes of the resulting wave? (9.1) K/U
   (a) maximum 6 cm, minimum 2 cm
   (b) maximum 4 cm, minimum 2 cm
   (c) maximum 8 cm, minimum 0.5 cm
   (d) maximum 6 cm, minimum 6 cm

7. A didgeridoo (Australian indigenous wind instrument) produces a fundamental frequency of 60 Hz. How long is the didgeridoo? (Use 343 m/s as the speed of sound.) (9.2) T/I
   (a) 70 cm
   (b) 5.72 m
   (c) 1.59 cm
   (d) 1.43 m

8. Which of the following statements is true of amplitude? (9.4) T/I
   (a) When the difference between the frequency of a wave and its natural frequency increases, the amplitude of a wave increases.
   (b) A decrease in wave energy decreases a wave's amplitude.
   (c) When damping is increased, the amplitude of a wave increases.
   (d) When a system vibrates close to a harmonic, resonance occurs and the amplitude of the observed vibration decreases.

9. A truck is travelling at 30 m/s toward a stationary observer. If the truck sounds its horn at a frequency of 700 Hz, what frequency does the observer detect? (Use 340 m/s as the speed of sound.) (9.5) T/I
   (a) 638 Hz
   (b) 643 Hz
   (c) 762 Hz
   (d) 767 Hz

10. Which of the following statements correctly describes an aspect of hearing? (10.1) K/U
    (a) Vibrations of the pinna cause hairs to vibrate, thus determining the loudness of a sound.
    (b) The outer ear funnels sound into the cochlea.
    (c) When a sound wave enters the auditory canal, the eardrum vibrates at twice the frequency of the sound wave.
    (d) In the cochlea, vibrations are transformed into electrical impulses, which are then sent to the brain.

11. A 33 cm long violin string vibrates with a fundamental frequency of 196 Hz. If the violinist presses against the fingerboard 4 cm from the end of the string, what is the new fundamental frequency? (10.2) T/I
    (a) 172 Hz
    (b) 192 Hz
    (c) 196 Hz
    (d) 223 Hz

12. Which of the following is the wavelength of the third harmonic of a 33 cm long violin string? (10.2) T/I
    (a) 11 cm
    (b) 16.5 cm
    (c) 22 cm
    (d) 33 cm

13. Which of the following statements is true? (10.5) K/U
    (a) Sound waves produced by a function generator travel through Earth and reflect off the various layers.
    (b) S-waves can move through both solid and liquid material.
    (c) Earthquakes cause different types of waves that move through Earth and across the surface.
    (d) Geophysical exploration using seismic waves has never provided scientists with useful information about Earth's interior.

14. A bat sent out a pulse with a frequency of 80 kHz and a wavelength of 0.4 cm to locate its prey. If the bat received an echo after 0.2 s, how far away was the prey? (10.7) T/I
    (a) 16 m
    (b) 32 m
    (c) 64 m
    (d) 320 m

Indicate whether each statement is true or false. If you think the statement is false, rewrite it to make it true.

15. The "wave" at a sports stadium models a transverse wave. (8.2) K/U

16. Sound waves are created in air through a series of alternating compressions and rarefactions. (8.2) K/U

17. The amplitude of a wave is the distance between a wave's crest and trough. (8.3) K/U

18. The distance between the peaks of two adjacent waves is an example of wavelength. (8.3) K/U

19. Identical waves with a phase shift of 0.5 would match up crest to trough and trough to crest. (8.3) K/U

20. If you halve the frequency of a wave, you double the speed. (8.4) K/U

21. To prevent hearing damage, exposure to a sound level of 100 dB should be less than 15 min. (8.5) K/U

22. The frequency of audible sound waves ranges from 20 Hz to 20 000 Hz. (8.5) K/U

23. As the distance a sound travels increases, the energy of the wave decreases. (8.5) K/U

24. Noise pollution from a variety of sources can lead to damaged hearing. (8.7) K/U

25. If two similar waves are perfectly out of phase when they meet, constructive interference occurs and the sum of the amplitudes is doubled. (9.1) K/U

26. A standing wave occurs when the reflected wave interferes with the incident wave. (9.2) K/U

27. Free-end reflections result in waves with the opposite orientation to the original. (9.2) K/U

28. When a wave crosses between two different media, the wave will break into two waves, one of which will be partly transmitted and the other partly reflected. (9.2) K/U

29. When two waves with nearly identical frequencies interfere, the resultant interference pattern produces a rhythmic beat. (9.3) K/U

30. Engineers must design structures so that winds do not produce resonance resulting in wide vibrations. (9.4) K/U

31. As a moving sound source approaches a stationary observer, the observed frequency increases and the speed of the sound source is taken to be positive. (9.5) K/U

32. A strong current moving in the direction opposite to the direction of strong winds and waves can cause waves to combine to form a tsunami. (9.6) K/U

33. Typical hearing aids amplify sound and then send the sound into the auditory canal. (10.1) K/U

34. Music is characterized by waves of variable frequencies and amplitudes. (10.2) K/U

35. Sound quality in a concert hall is maximized when reverberation time is no more than a second or two. (10.3) K/U

36. Aeroelastic flutter can cause objects to vibrate at high frequencies. (10.4) K/U

37. Sympathetic vibration occurs when an object is vibrating and the input energy is greater than the energy lost to damping. (10.4) K/U

38. Aeroelastic flutter in an aircraft seems to arise from the aircraft itself rather than from air turbulence. (10.6) K/U

39. Elephants hear ultrasonic sounds with their trunk, feet, and ears. (10.7) K/U

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