1. An oscillation, or vibration
   C) is not random at all. If you are going to use that fly as an example, then you have to look at its wings. The wings move up and down, over and over (and really fast), but they stay attached to the fly. The wings are oscillating.

2. A wave is
   C) an oscillation in time propagated through space.

3. As a wave propagates,
   C) the molecules of the medium vibrate, but do not propagate forward with the wave.

4. Compare a longitudinal and a transverse wave.
   A) Longitudinal waves vibrate parallel to the direction of propagation, transverse perpendicular.

5. Compare sound and light waves.
   D) Sound waves are longitudinal, light waves are transverse.

6. Sound waves
   A) are exclusively longitudinal.

7. Light waves
   B) are exclusively transverse.

8. Seismic waves
   D) have longitudinal and transverse components.

9. A seismograph is used to record earthquake tremors. The same earthquake can be recorded on different seismographs located in different places. This data can then be used to locate the epicenter of the earthquake. Geologists have labeled seismic waves as S-waves or P-waves.
   B) S- and P-waves are two different types of seismic waves. The S-waves are transverse, and the P-waves are longitudinal.

10. Pushing and pulling an accordion parallel to its axis, making the bellows expand and contract
    B) causes a longitudinal wave.

11. A transverse wave
    A) occurs when the direction of oscillation is perpendicular to the direction of travel.

12. The rarefactions of a longitudinal wave
    A) are analogous to the troughs of a transverse wave.

13. The compressions of a longitudinal wave
    A) are analogous to the crests of a transverse wave.

14. The troughs of a transverse wave
    B) are analogous to the rarefactions of a longitudinal wave.

15. An alarm clock vibrates with a frequency of 68 Hz. The speed of the resulting sound wave through the air is 340 m/s. What is its wavelength?
    A) 1 m   B) 2 m   C) 3 m   D) 4 m   E) 5 m

16. Gusts of wind make the Sears Tower sway back and forth, completing a cycle every 10 seconds.
    A) Its frequency = 1/10 Hz, and its period is 10 seconds.

17. Two sound waves travel through dry air at 20°C. The second wave has twice the frequency of the first.
    B) Its wavelength is half the wavelength of the original wave.

18. If the temperature of the air increased suddenly to 30°C,
    A) the wave speed would increase as well.

19. How is refraction different from reflection?
    A) Reflection occurs when a wave strikes a boundary that it cannot cross, so it bounces.
    Refraction occurs when the wave strikes a boundary, but can continue to travel through the new medium.
20. An echo
   C) results when a sound wave is reflected off a surface. The reflected wave has the same
   wavelength and frequency as the original pulse.

21. What is the approximate distance of a thunderstorm when you note a 5–s delay between the flash of
    lightning and the sound of thunder? (Use 340 m/s for the speed of sound.)
   A) 68 m                B) 340 m                 C) 1360 m              D) 1700 m

22. What is the approximate distance of a thunderstorm when you note a 3 second delay between the
    flash of lightning and the sound of thunder? (Use 340 m/s for the speed of sound.)
   A) 1360 m               B) 1020 m              C) 340 m                D) 113 m

23. A depth-sounding vessel surveys the ocean bottom by sending out an ultrasonic pulse. The vessel
    receives the echo after 4 seconds. If the pulse has a speed of 1530 m/s, how deep is the ocean floor?
   A) 382 m                B) 765 m                 C) 3060 m               D) 6120 m

24. The intensity of a sound is exactly 16 W/m\(^2\) at a distance of 4m. At 1m, the intensity will be
   A) 4 W/m\(^2\)               B) 32 W/m\(^2\)            C) 64 W/m\(^2\)           D) 128 W/m\(^2\)           E) 256 W/m\(^2\)

25. Should you be wearing ear protection?
   D) Are you kidding me? Put the ear muffs on, but it won't really help. This is so far beyond the
      threshold of pain that it would probably shatter your teeth. You go ahead and get closer, but
      I am moving farther away—at least 16 meters away.

26. What intensity level would be comfortable without ear protection? Like a normal conversation.
   B) In the neighborhood of 30–40 dB.

27. What is the difference between sound intensity and intensity level?
   E) Intensity is absolute: power/area. This can be measured. Intensity level is relative: it
      compares any sound to the softest sound a person can hear.

28. Your cousin is visiting from Tulsa, and she brought her 3 month old baby. Cute, but colicky. You just
    got back from Radio Shack, where you bought a cool new sound meter. Coincidence? I don’t think so.
    C) Screaming baby could hit as high as 90dB.

29. For a sound to be audible, it must have
   A) frequency between 20Hz and 20,000Hz. It must also have an intensity greater than 10\(^{-12}\) W/m\(^2\).

30. An infrasonic pulse has a frequency
   A) less than 20Hz.

31. An ultrasonic pulse
   E) has a frequency too high to be heard by the human ear.

32. When bats use echolocation to hunt for food, they emit
   E) an ultrasonic pulse. The frequency is too high for human ears to hear.

33. In space, no one can hear you scream.
   C) True; sound cannot travel through space because there is no medium to propagate the wave.

34. In defense of the Intergalactic Zambonian Empire, your starship, Ice Princess, fires a photon torpedo at
    an invading destroyer. As the enemy ship explodes into millions of pieces, you hear
    B) absolutely nothing other than the noise within your own ship.

35. Sound travels best through a medium that is
   D) highly elastic, like steel.

36. The speed of sound in water
   A) is greater than the speed of sound through air.

37. The speed of sound in steel
   A) is greater than the speed of sound through air.

38. Why does styrofoam or cork make a good sound insulator?
   B) Amorphous structure and many air pockets make it very difficult to pass the sound energy along.
39. Why does sound travel faster in warm air than cold?
   C) Warm air molecules move faster than cold air molecules, so sound travels faster.

40. Sound waves traveling through air of uneven temperatures
   A) are bent from warm air toward cool air.

41. The superposition principle is based on the idea that
   C) two waves can occupy the same space at the same time: they superimpose to result in a new
   wave having the combined amplitude: \( A = A_1 + A_2 \).

42. Two transverse waves have the same amplitude, frequency, and wavelength. If they are in phase,
   A) the resulting superposition will be a wave with twice the amplitude.

43. Two transverse waves have the same amplitude, frequency, and wavelength. If they are out of phase,
   B) they will interfere destructively and cancel each other.

44. Constructive interference occurs when two waves are
   A) in phase: crest\(_1\) matches crest\(_2\), and the resulting wave has an amplitude \( A = A_1 + A_2 \).

45. What happens when two waves meet that are not perfectly in phase or perfectly out of phase?
   D) The waves do not cancel completely or reinforce; you must use the superposition principle
   to determine the amplitude of the new wave at each point. The new wave may have an odd
   shape.

46. A standing wave will be formed when a guitar string is plucked.
   A) The string is fixed at both ends: this means that each end must be a node.

47. For an especially dangerous and exciting APO mission, Marshall equips Sydney with a device capable
   B) Slightly exaggerated, but possible; the device is designed to emit a wave with the same
   amplitude and frequency as the sound wave, but out of phase. The resulting destructive
   interference will cause complete cancellation of the wave. Pilots already use similar devices.

48. What is the Doppler effect?
   B) The change in the apparent frequency of a wave because the source of the wave either
   approaches toward or recedes away from the receiver.

49. As you are standing on the sidewalk, a firetruck zooms past with its siren wailing. The siren's
   C) frequency
   decreases as the truck recedes away from you.

50. You wait at the railroad crossing for the train to pass. As it approaches you, the sound of its whistle
   A) increases in pitch, then decreases as the train passes and moves away from you.

51. For an especially dangerous and exciting APO mission, Syd finds herself concealed in the trunk of a
   moving vehicle, while Vaughan drives at dangerous speeds in pursuit of Sark. Sark's car has a homing
   device, and Syd is listening to the signal it emits. How does she know if they are gaining on Sark?
   A) The signal frequency received will increase if they are approaching Sark's car.

52. A tuning fork is struck with a rubber mallet. The frequency of the resulting vibration
   B) depends on the natural frequency of fork, and will be the same each time the fork is struck.