Instructions and Tips

- Assume the speed of sound in air (c_{air}) is 340 m/s at room temperature (21°C).
- Assume the speed of sound in water (c_{water}) is approximately $4 \cdot c_{air}$.
- The speed of sound in air changes with temperature by: $c_{air} = 331.4 + 0.607 \cdot T$, where T is °C.
- A calculator is not necessary (nor is one allowed) to answer these questions.
- For each question, choose the **best, most specific answer** from those given.

1. (1 pt) Which is a psychological attribute of sound?

   a) loudness
   b) peak-to-peak amplitude
   c) duration
   d) instantaneous phase
   e) particle velocity

2. (1 pt) Assume 100 people have their hearing tested and the mean threshold for detecting a 3 kHz tone is 20 μPa. If one person's threshold is 10 μPa, what is their threshold relative to the group?

   a) -50 dB HL
   b) -20 dB HL
   c) -6 dB HL
   d) 0 dB HL
   e) 0 dB SPL

3. (1 pt) If a 0.33747 kHz sound wave traveling through early morning air and has a wavelength of 1.0 m, what is the approximate temperature of the air in degrees Celsius (ºC)?

   a) 55 °C
   b) 15 °C
   c) 10 °C
   d) -10 °C
   e) -15 °C

4. (1 pt) If the sound pressure level (SPL) measured @ 10 m in front of an outdoor concert stage is 130 dB SPL, then how much further away should a person walk to reach a position that is 100 dB SPL?

   a) 20 m
   b) 120 m
   c) 240 m
   d) 310 m
   e) 500 m

5. (1 pt) Two types of wave disturbance rates for airborne sounds are the:

   a) molecular inertia rate and the speed of sound.
   b) transverse vibration rate and the radial vibration rate.
   c) radial vibration rate and the molecular vibration rate.
   d) longitudinal air particle collision rate and the transverse air particle collision rate.
   e) air particle vibration rate and the speed of sound.

6. (1 pt) If the peak amplitude of a sound wave is 142 ⌠Pa, then what is the root mean square (rms) sound pressure?

   a) 141.4 μPa
   b) 100 μPa
   c) √2 μPa
   d) 1 Pa
   e) 0.707 Pa

7. (1 pt) A 4 dB change in sound intensity corresponds to a _____ dB change in sound power.

   a) 16
   b) 4
   c) √4
   d) √2
   e) 1

8. (1 pt) A tuning fork produces a simple tone when struck against a hard surface. Generally speaking, the amount force does not change the frequency of the emitted signal. A tuning fork's natural or resonant frequency is the frequency at which the:

   a) magnitude of the mass reactance equals the magnitude of the compliant reactance.
   b) magnitude of the mass reactance is greater than the magnitude of the compliant reactance.
   c) magnitude of the mass reactance is less than the magnitude of the compliant reactance.
   d) resistance of the tuning fork is zero .
   e) complex impedance of the tuning fork is zero.

9. (1 pt) A phase angle of 900° corresponds to how many radians?

   a) $1/5 \cdot \pi$
   b) $1/4 \cdot \pi$
   c) π
   d) $2 \cdot \pi$
   e) $5 \cdot \pi$

10. (1 pt) In airborne sound propagation, when air particle displacement is at a _____ the air particle velocity is at a _____.

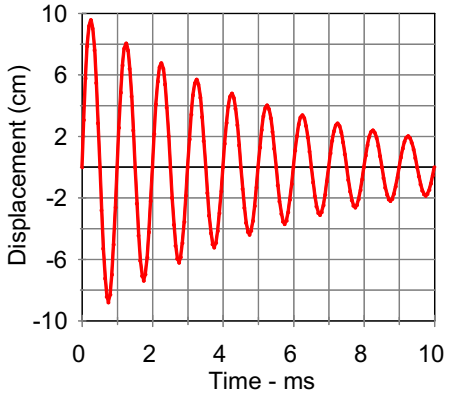
   a) minimum, minimum
   b) maximum, maximum
   c) maximum, minimum
   d) a and b are correct
   e) all of the above are correct

11. (1 pt) What causes the pressure in a filled balloon to be higher than that of an empty balloon?

   a) the air molecules in a filled balloon exert less force on the balloon's surface
   b) the density of air molecules is higher in a filled balloon
   c) the static pressure in the filled balloon is lower than in an empty balloon
   d) the velocity of air particles is slower in a filled balloon
   e) the mass of each air molecule is higher in the filled balloon

12. (1 pt) What is frequency of the waveform in the figure to the right?

   a) 1 Hz
   b) 10 Hz
   c) 100 Hz
   d) 500 Hz
   e) 1000 Hz



13. (1 pt) Which statement is **not** correct?

    a) Mr. Jones perceived the pitch of the violin in the orchestra.
    b) The sound meter indicated that the car produced a high frequency.
    c) A noise meter indicated that the airplane had a high altitude.
    d) The wind noise decreased in amplitude during the nightfall.
    e) When a single key is played on a piano, a tone is produced.

14. (1 pt) How is air pressure related to hearing?

    a) Air pressure provides a force on the eardrum.
    b) Due to gravity, air molecules are more compressed closer to earth.
    c) The static air pressure is normally audible to humans.
    d) Only vibrating air molecules can produce airborne sound.
    e) Sound generation requires air particles to be produced.

15. (1 pt) If a filter introduces a 1.0 s delay to a 1 Hz tone, then what is the phase shift in degrees?

    a) 1°
    b) 45°
    c) 90°
    d) 180°
    e) 360°

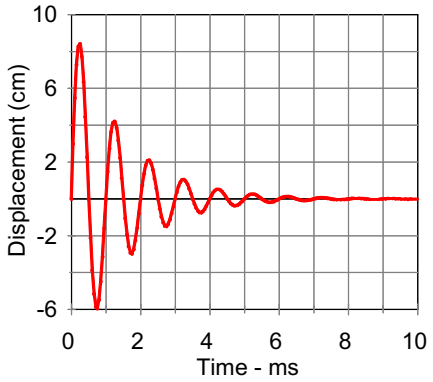
16. (1 pt) A value of 46 dB SPL corresponds to what pressure ratio?

    a) (10 / 20) ⌈Pa
    b) 46 ⌈Pa
    c) 100
    d) (200 / 20) ⌈Pa
    e) 200

Use the figure to the right to answer Questions 17-19.

17. (1 pt) What is the magnitude of the damping factor?

    a) ln (8)
    b) ln (4)
    c) ln (2)
    d) ln (1)
    e) ln (0)



18. (1 pt) What is the period of the waveform?

    a) 0.5 ms
    b) 1 ms
    c) 2 ms
    d) 10 ms
    e) cannot be determined

19. (1 pt) What is the approximate duration of the waveform?

    a) 1 ms
    b) 2 ms
    c) 4 ms
    d) 8 ms
    e) >10 ms

20. (1 pt) What is the peak-to-peak amplitude ($A_{peak\text{-}to\text{-}peak}$) of a sine wave with a root mean square amplitude (A_{rms}) of 20 Volts (V)?

    a) 14 V
    b) 28 V
    c) 40 V
    d) 56 V
    e) 100 V

21. (1 pt) What is the reference pressure for a 40 dB sound with an absolute pressure of $200 \times 10^5\,\mu$Pa?

    a) $1 \times 10^5\,\mu$Pa
    b) $2 \times 10^5\,\mu$Pa
    c) $4 \times 10^5\,\mu$Pa
    d) $8 \times 10^5\,\mu$Pa
    e) $10 \times 10^5\,\mu$Pa

22. (1 pt) What is the absolute pressure of a 20 dB SPL sound?

    a) 20 μPa
    b) 40 μPa
    c) 200 μPa
    d) 400 μPa
    e) 800 μPa

23. (1 pt) If 100 Hz pure tone with a starting phase of 0˚ is listened to for 1.5 s, then how many times has the signal reached an instantaneous phase of 90˚?

    a) 50
    b) 100
    c) 150
    d) 200
    e) 250

24. (1 pt) How long would it take a 100 Hz pure tone with a starting phase of 0˚ to achieve an instantaneous phase 180˚?

    a) 5 ms
    b) 10 ms
    c) 20 ms
    d) 100 ms
    e) 1000 ms

25. (1 pt) If the resonant frequency of an object increases from 200 Hz to 800 Hz and its mass remains unchanged, then by how much as has the object's stiffness changed?

    a) 1/4
    b) 1/16
    c) 2
    d) 4
    e) 16

26. (1 pt) A pressure ratio of 0.01 corresponds to how many decibels (dB)?

    a) -2 dB
    b) -4 dB
    c) -20 dB
    d) -30 dB

e) -40 dB

27. (1 pt) Three loudspeakers are equidistant from a microphone. If each speaker begins to broadcast a pure tone at exactly the same time (speaker A = 20 Hz; speaker B = 40 Hz; speaker C = 80 Hz), which signal will arrive at the microphone first?

a) 20 Hz
b) 40 Hz
c) 80 Hz
d) the three signals will arrive at the same time
e) none of the above are correct

28. (1 pt) What is the frequency of oscillation for an object that complete four cycles of rotation in 20 ms?

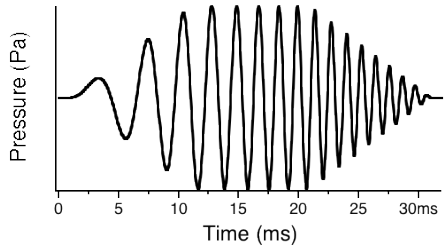
a) 50 Hz
b) 100 Hz
c) 150 Hz
d) 200 Hz
e) 250 Hz

29. (1 pt) What is the reference intensity for a 10 dB sound with an absolute intensity of $2x10^{-11}$ W/m^2?

a) 1×10^{-12} W/m^2
b) 2×10^{-12} W/m^2
c) 4×10^{-12} W/m^2
d) 8×10^{-12} W/m^2
e) 10×10^{-12} W/m^2

30. (1 pt) The waveform in the figure to the right is an example of a(n):

a) FM stimulus.
b) square wave stimulus.
c) pure tone stimulus.
d) white noise stimulus.
e) none of the above



31. (1 pt) What is the 3rd harmonic frequency (f_3) of a 3.4 m organ pipe open at one end and closed at the other end?

a) 25 Hz
b) 50 Hz
c) 75 Hz
d) 100 Hz
e) none of the above

32. (1 pt) Which would influence the time domain appearance of a complex waveform?

a) the number of harmonic components in the waveform
b) the peak-to-peak amplitude of each frequency component
c) the starting phase of each frequency component
d) a and b are correct
e) a, b, and c are correct