1. The waveform of a sound wave is a graph of
   (A) amplitude vs. frequency
   (B) amplitude vs. time
   (C) amplitude vs. position
   (D) amplitude vs. pressure
   (E) none of the above.

2. The quality of a sound that distinguishes it from others of the same pitch and volume is called
   (A) reverberation
   (B) intensity
   (C) frequency
   (D) timbre
   (E) none of the above.

3. Force is defined as
   (A) mass times acceleration
   (B) mass per unit length
   (C) mass per unit area
   (D) mass per unit volume
   (E) none of the above.

4. Motion that repeats over equal time intervals is called
   (A) action
   (B) standing
   (C) periodic
   (D) nodal
   (E) none of the above.

5. Who is credited with inventing the diatonic musical scale?
   (A) Fourier
   (B) Faraday
   (C) Lorentz
   (D) Doppler
   (E) Einstein
   (F) none of the above.
Definitions. 10 points each. For full credit, use proper grammar, spelling and complete sentences. (A complete sentence has both a subject and a predicate.)

6. Define linear restoring force. A linear restoring force is in the opposite direction of the displacement from equilibrium and proportional to the distance from equilibrium.

7. Define limit of frequency discrimination. The limit of frequency discrimination is the smallest frequency difference that can be noticed by the average human when two frequencies are played at the same time.

8. Define absorption coefficient. The absorption coefficient is a measure of how well (or not well) a material absorbs sound waves. The larger the coefficient, the better the material is able to absorb sound waves.

9. Define diffraction. Diffraction is the process by which waves appear to bend around corners.

10. What are Fletcher-Munson Curves? Fletcher-Munson Curves are curves of equal loudness perceived vs. frequency.
Short Answers. 10 points each. For full credit, use proper grammar, spelling and complete sentences. (A complete sentence has both a subject and a predicate.)

11. What is the Nyquist Theorem? The Nyquist Theorem states that the conversion from analog to digital will introduce no error in frequency if the sampling rate is greater than twice the largest input frequency.

12. What is the difference between sound intensity and sound intensity level? Sound intensity is the physical strength of a sound wave. Sound intensity level is how the intensity is perceived by humans.

13. What did you find most interesting about the LaSells Stewart Center? Please be specific.

14. How does temperature affect the speed of sound in air? As the temperature increases, the speed of sound in air increases. Likewise, as the temperature decreases, the speed of sound in air decreases.

15. Compare and contrast sampling rate and resolution. Sampling rate is how often the amplitude is measured when converting from analog to digital while resolution is how accurately the amplitude is determined during the same process.
Numerical Problems. 10 points each. If the temperature is not given, then assume that the speed of sound in air is 345 m/sec. If the answer is incorrect, then partial credit may be awarded.

16. The fundamental frequency of a sound wave on a string is 100 Hz and the tension is 10 N. If the tension is increased to 30 N, then what will the new fundamental frequency be?

\[
\frac{f_2}{f_1} = \frac{(1/2L)\sqrt{F_2/W}}{(1/2L)\sqrt{F_1/W}} \quad f_2 = f_1 \sqrt{\frac{F_2}{F_1}} = 100 \sqrt{\frac{30}{10}} = 173 \text{ Hz}
\]

17. The smallest frequencies produced by a wind instrument are 88 Hz, 176 Hz, 264 Hz, 352 Hz, etc. What is the effective length of this instrument?

\[
f_1 = 88 \text{ Hz} \quad f_2 = 176 \text{ Hz} \quad f_2/f_1 = 176/88 = 2
\]

\[
f_n = \frac{nv}{2L} \quad f_1 = \frac{v}{2L} \quad L = \frac{v}{2f_1} = \frac{345}{2(88)} = 1.96 \text{ meters}
\]

18. The wavelength in base two is 11100011 cm. Convert this wavelength to decimal.

\[
\lambda = 227_{10} \text{ cm}
\]

19. On a warm summer day the air temperature is 77 degrees Fahrenheit. What is the speed of sound in air?

\[
T_C = \frac{5}{9} (T_F - 32^\circ) = \frac{5}{9} (77^\circ - 32^\circ) = \frac{5}{9} (45^\circ) = 25^\circ C
\]

\[v(\text{sound}) = (331 + 0.6 T_C) = (331 + 0.6 (25)) = 346 \text{ m/sec}
\]

20. If the sound intensity level increases by 30 dB, then by what factor does the intensity increase?

\[
\Delta B = 10 \log_{10} \left( \frac{I_2}{I_1} \right) \quad \Delta B / 10 = \log_{10} \left( \frac{I_2}{I_1} \right)
\]

\[
\frac{I_2}{I_1} = 10^{30/10} = 10^3 = 1000
\]

If you have extra time, then check over your answers and make sure that you have printed your name, signed your name and printed your student ID # on the first page. Thanks.

I hope that you all have a good spring break.