Reviewing for Test 1

Here are some review problems for the test. In addition to these problems, I recommend that you review your quizzes, homework, handouts, and class notes. Bring your calculator, a 3” x 5” note card, some pencils, and a good eraser to the test.

1. Given the graph of a sound wave, you should be able to
   (a) Determine whether or not the graph is periodic.
   (b) If the graph is periodic, sketch a fundamental cycle, measure the fundamental period, and calculate the frequency.
   (c) Use appropriate units (seconds, minutes, Hz, or BPM) and be able to convert between Hz and BPM.
   (d) Determine whether the frequency is within the range of human hearing.

   **SAMPLE QUESTION:** Here are two sound waves. Identify which is periodic. For the periodic wave, sketch a fundamental cycle, measure the fundamental period, and calculate the frequency in Hz and BPM. Is the frequency within the range of human hearing?

2. Given a mathematical function \( y = f(t) \) expressed as a formula or in a table, you should be able to
   (a) Determine whether or not the function is periodic.
   (b) If the function is periodic, list the smallest four positive numbers \( P \) for which \( f(t) = f(t + P) \), identify the fundamental period, and calculate the frequency, using appropriate units in your answers.
   (c) If the function is a trigonometric function of the form \( y = A \sin(Bt) \), be able to find its amplitude and sketch a fundamental cycle.

   **SAMPLE QUESTION A:** For each function, determine whether or not it is periodic. If it is periodic, list the smallest four positive numbers \( P \) for which \( f(t) = f(t + P) \), identify the fundamental period, and calculate the frequency, using appropriate units in your answers.

   **SAMPLE QUESTION B:** Find the amplitude, fundamental period, and frequency of each sinusoid, and sketch a fundamental cycle: (1) \( y = 3 \sin(1000\pi t) \) (2) \( y = 2 \sin(0.31415t) \).

3. Write the formula for a sine wave with a given amplitude and frequency (or a given amplitude and fundamental period).

   **SAMPLE QUESTION:** Write the formula for a sine wave \( y = A \sin(Bt) \), where \( t \) is measured in seconds, with (1) amplitude = 5 and frequency =3 BPM (2) amplitude = 10 and fundamental period = 0.005 seconds.

4. Be able to predict what the envelope tells us about a sound, and be able to sketch a sound wave with a given envelope.

   **SAMPLE QUESTION:** Suppose a 1000 Hz tone is modulated by the following envelope. Sketch the resulting sound wave (what you would see in Audacity) and describe in words what you would hear.
5. Understand how sounds of two different—but close—frequencies combine to produce beats, and be able to predict the resulting sound. Alternately, given a tone with a chosen frequency that has beats of another frequency, describe which two sounds combine to produce that sound.

**SAMPLE QUESTION A:** Suppose a 1000 Hz tone and a 1008 Hz tone are played simultaneously. Describe what you would hear, and make a sketch of the first second of the resulting sound file.

**SAMPLE QUESTION B:** Describe how the phenomenon of beats can be used to produce an 1000 Hz tone that pulses at a rate of 120 BPM.

6. Be able to predict the frequencies of the harmonics of a wind or stringed instrument and sketch the standing waves corresponding to those harmonics. For a wind instrument, know how the state of the ends (open or closed) determines the harmonics.

**SAMPLE QUESTION:** Suppose a willow flute has a fundamental frequency of 400 Hz when played with the end open. Calculate the frequencies of the second and third harmonics and sketch the standing waves corresponding to these harmonics. Describe how a 600 Hz tone could be produced on the same flute.

7. Be familiar with the formulas (1) frequency = \( \frac{an}{2L} \) and (2) frequency = \( \frac{an}{4L} \); know when it is appropriate to use which formula and the meaning of \( a, n, \) and \( L \).

**SAMPLE QUESTION:** Suppose that when a slide whistle has an inside length of 6 inches, its first harmonic has frequency 800 Hz. If the length is decreased to 5 inches, what is the frequency of the first harmonic that results? What length would produce a sound that is an octave above the original frequency?

8. Know the difference between a harmonic and inharmonic spectrum, be able to give examples of instruments with each type of spectrum, be able to distinguish between pictures of harmonic and inharmonic spectra, and know what is measured on the horizontal and vertical axis of a spectral graph.

**SAMPLE QUESTION:** Which picture represents a harmonic spectrum? Label the units on the axes. If one picture is the spectrum of a drum and the other is the spectrum of a violin, which is which?

9. Be able to interpret a spectrogram. Know what is measured on the horizontal and vertical axis, and be able to predict the sound that will be heard.

**SAMPLE QUESTION:** This picture is a spectrogram. Label the units on the axes, and describe the sound that will be heard.

10. Know the definition of a musical interval and be able to produce frequencies that form a given interval. For the test, the intervals you need to know are an octave and a perfect fifth. Explain why these intervals sound “good” when played on an instrument with a spectrum containing frequencies \( f_0, 2f_0, 3f_0, 4f_0 \), etc.

**SAMPLE QUESTION:** Find the following frequencies: (1) an octave above 600 Hz (2) an octave below 600 Hz (3) a perfect fifth above 600 Hz (4) a perfect fifth below 600 Hz. Explain why two flutes playing 400 Hz and 800 Hz sound better than flutes playing 400 Hz and 820 Hz.