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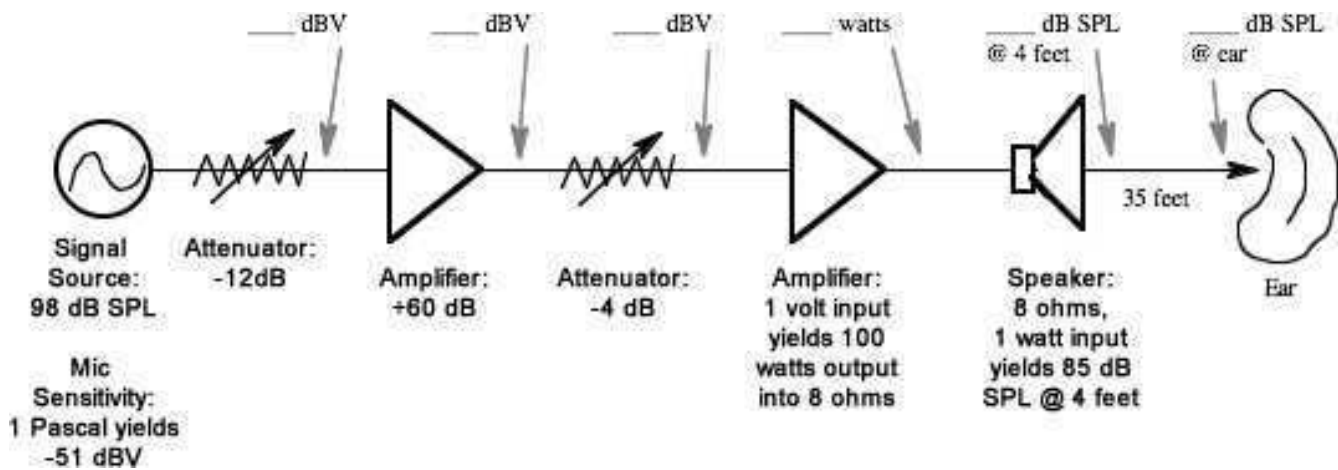
Final Assignment: Midterm Exam

Your final assignment this week is to take the Midterm Exam.

Answer each question to the best of your ability. You may use a calculator and/or any reference materials. **Please show all work - partial credit may be awarded.** Answer all questions using specified units when applicable.

Midterm Exam

- Study the gain structure below and show the signal level at each stage. Show all calculations.

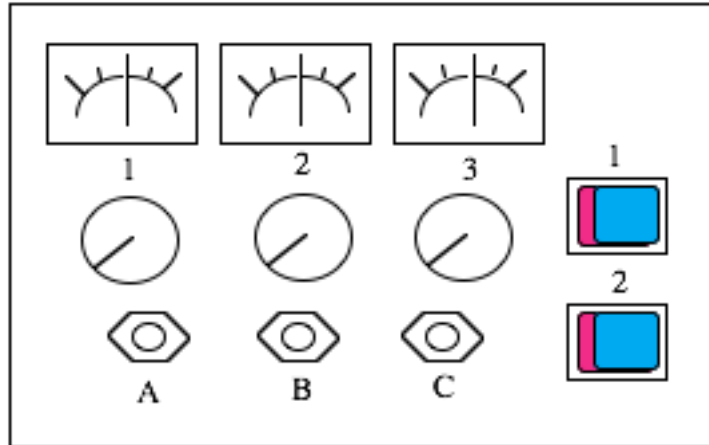


- Signal A has an amplitude four times greater than signal B. Using the formula given, express the ratio of signal A to signal B in decibels.

_____ dB

$$\text{Level}_{\text{dB}} = 20 \log (v_1 / v_2)$$

3. Black Box



An audio device has three variable controls, three audio signal level meters, two switches, and three jacks. The device exhibits the following behaviors:

- The level of a signal inserted to jack A is modified by controls 1 and 3, and is observed at jack C and meters 1 and 3 when switch 1 is activated.
- The level of a signal inserted to jack B is modified by controls 2 and 3, and is observed at jack C and meters 2 and 3 when switch 2 is activated.
- When switch 1 is not activated, the signal from jack A is no longer present at jack C or meter 3.
- When switch 2 is not activated, the signal from jack B is no longer present at jack C or meter 3.
- When signals are inserted at both jacks A and B, a combination of these signals is observed at meter 3 and jack C in accordance with conditions a-d.

Draw a flow chart (block diagram) of this device. Indicate the function of each component. What is the most likely function of this device?

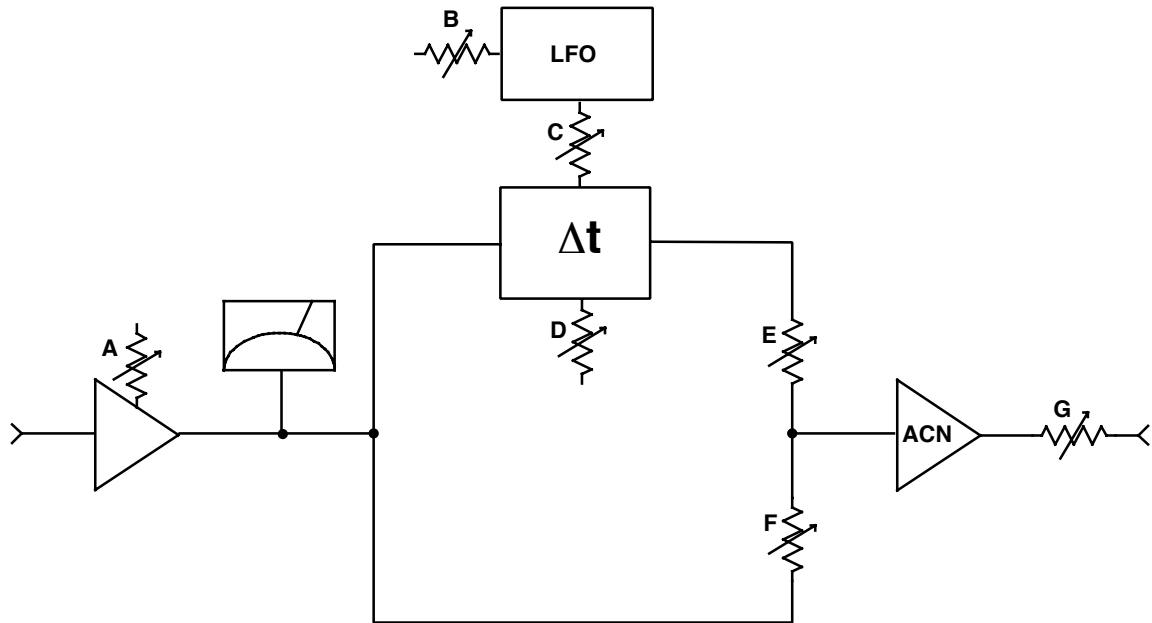
Jack A _____ Jack B _____ Jack C _____

Control 1 _____ Control 2 _____ Control 3 _____

Meter 1 _____ Meter 2 _____ Meter 3 _____

Switch 1 _____ Switch 2 _____

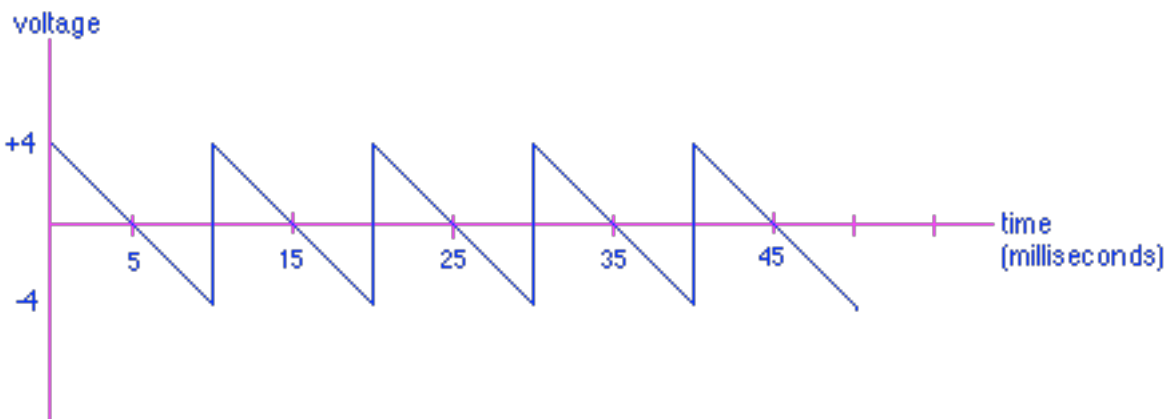
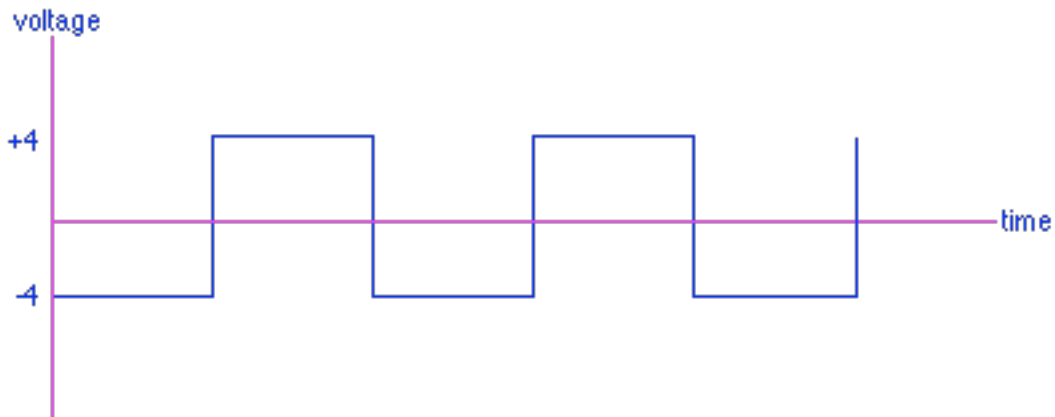
4. The block diagram below describes the signal flow within a digital delay device. The user operates the device via seven rotary controls, labeled A through G. Delay is provided by the module labeled Δt . The LFO is a low frequency oscillator that generates a sine wave, which can be used to continuously increase and decrease the delay time.



- Which level control should be used to adjust the output level from the device? Explain.
- How would you adjust the balance between the delayed signal and the non-delayed signal? Explain.
- Which controls affect the audio signal level? Explain.
- Which control should you adjust to set a fixed (nonvarying) delay time? Explain.
- Which control adjusts the frequency of the LFO? Explain.

5. Express the following measurements in a single graph:
1. An audio signal with a frequency of 1 kHz has a certain reference level.
 2. An audio signal with a frequency of 5 kHz has a level 4 units greater than the level at 1 kHz.
 3. An audio signal with a frequency of 10 kHz has a level 2 units greater than the level at 1 kHz.
 4. An audio signal with a frequency of 15 kHz has a level $3 \frac{1}{2}$ units less than the level at 1 kHz.
 5. An audio signal with a frequency of 50 Hz has a level 12 units less than the level at 1 kHz.
 6. An audio signal with a frequency of 100 Hz has a level 1 unit greater than the level at 1 kHz.
 7. An audio signal with a frequency of 500 Hz has a level 2 units less than the level at 1 kHz.

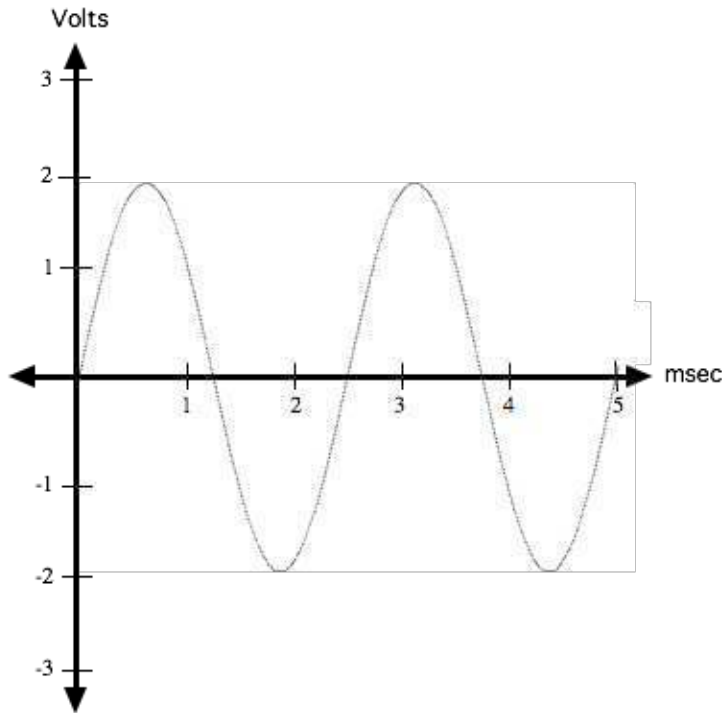
6. The waveforms below are examples of standard square and sawtooth waves.



- What is the frequency of the sawtooth wave?
- The frequency of the square wave is exactly twice the frequency of the sawtooth wave. Label the appropriate units on the time axis above.
- Is the RMS value of the square waveform greater than, equal to, or less than the RMS value of the sawtooth wave? Explain.

Extra Credit: Draw a composite waveform equal to the sum of the two.

7. Fill in the blanks relating to the graph below. (*Reminder: Show your work!*)



The height of the wave along the “Volts” axis is called the _____, and for the waveform pictured above is a total of _____ volts, or _____ volts peak-to-peak, or _____ volts RMS (hint: review relationship between peak and RMS voltage for a sine wave). This parameter is musically perceived as the _____ of the note.

The *time* length of one repetition or cycle of a repeating waveform along the time axis is called the _____. This is mathematically related to the _____, which is expressed in “cycles per second” or _____. That relationship is the following:_____.

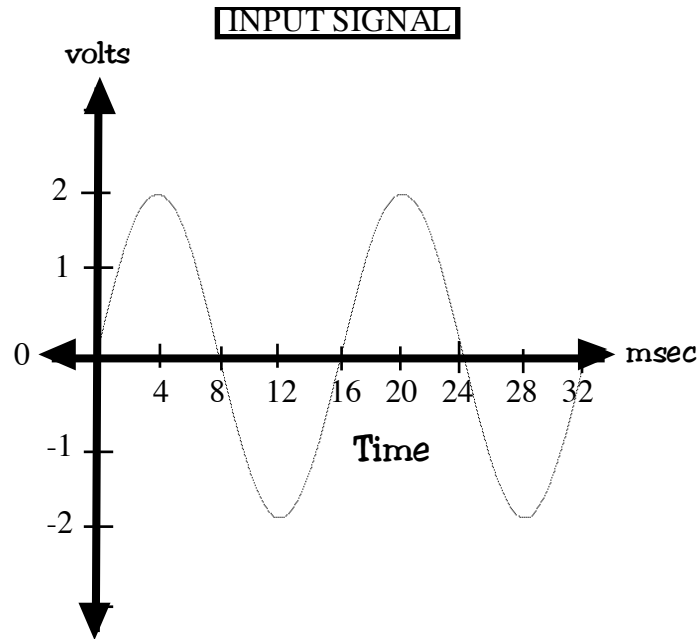
The “cycles per second” of the waveform pictured above is _____. This parameter is musically perceived as the _____ of the note.

The *distance* length of one cycle is called the _____. This is mathematically related to the _____ as follows: _____. For the wave pictured above, this distance is _____ (*assume speed of sound = 1100 ft/sec*).

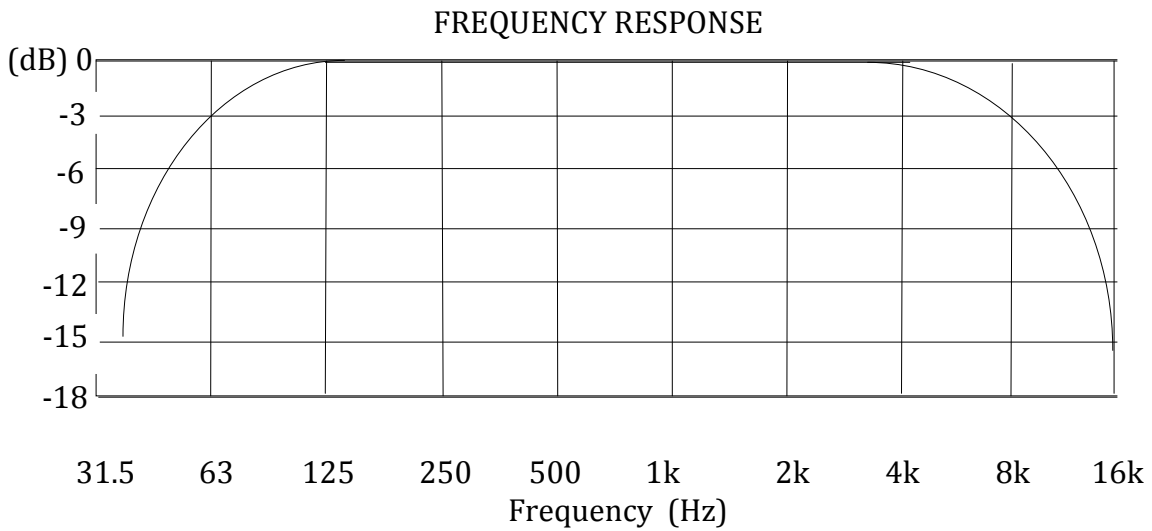
The shape of a waveform is determined by the _____ content. Musically, this is perceived as _____. The shape of the waveform pictured above is a _____ wave, which is made up of _____.

Any signal or waveform whose cycles repeat exactly can be called _____, which means we will perceive it as having a _____.

8.



- a. What is the frequency of this waveform?
- b. The above input signal is sent through an audio device whose frequency response is given below. What would be the resulting RMS level of the signal at the OUTPUT of the device, expressed in dBu.





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