Full name: _____ Student ID: _____

21M.380 · Music and Technology
Recording Techniques & Audio Production

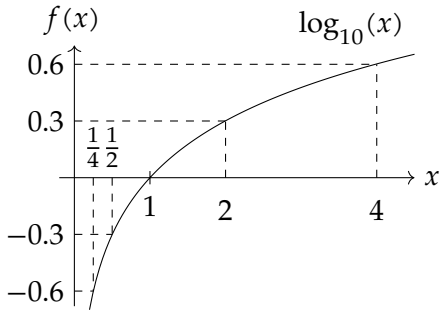
First quiz (qz1)
Physics & perception of sound, microphones

Monday, September 26, 2016
25 minutes, 5% of total grade

1 Physics of sound

1.1 Inverse square and inverse distance law (15%)

Clearly show how you derive the answers the following two questions. In both cases, assume free-field conditions (no reflective surfaces) and a sound source that emits sound spherically in all directions.



1. By how many decibels (dB_{SPL}) does the sound pressure level p drop when you move from a distance of 8 feet from a sound source to a distance of 32 feet?

2. By how many decibels (dB_{SIL}) does the sound intensity level I rise when you move from a distance of 8 feet from a sound source to a distance of 4 feet?

1.2 Speed of sound and harmonic sounds (15%)

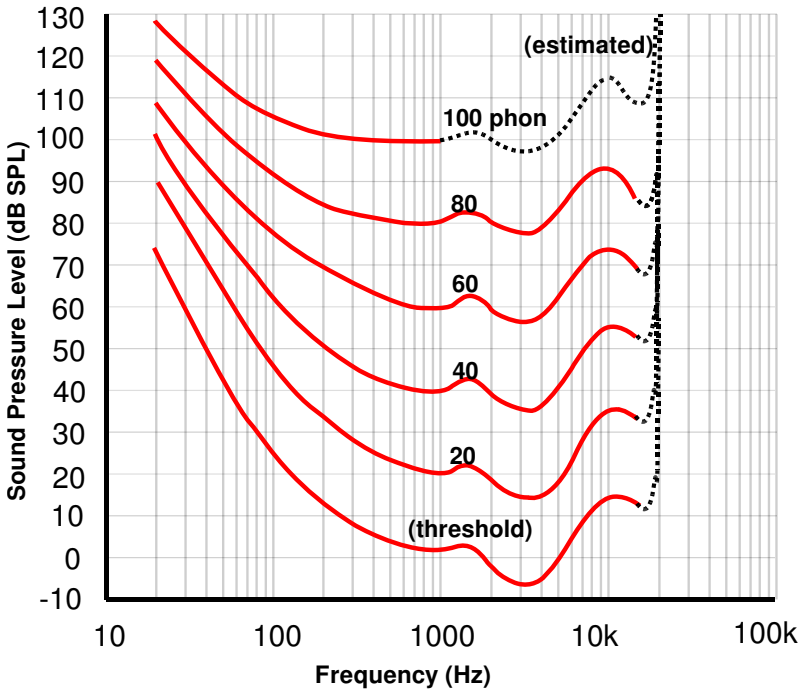
1. For which sound source direction(s) with respect to the listener does the *interaural time difference* reach a maximum? Describe any such direction(s) unambiguously, either in writing, or through a diagram, or through a combination of both.

2. Quantify the maximum interaural time difference in a suitable physical unit, assuming an entirely transparent head with a diameter of 17 cm and a convenient constant for the speed of sound in air. Show how you derive your result.

3. At which frequency will the third harmonic of a sound appear, the wavelength of whose fundamental fits exactly between the two ears of the head assumed above? Show how you derive your result.

2 Perception of sound

2.1 Loudness perception (10%)



(🄯 Public domain image. With edits. Source: https://en.wikipedia.org/wiki/File:Lindos1.svg)

1. What is the name of the above diagram?

   _____

2. At how many dB_{SPL} would a 50 Hz tone need to be played in order to be perceived as equally loud as a 1 kHz tone played at 60 dB_{SPL}?

   _____

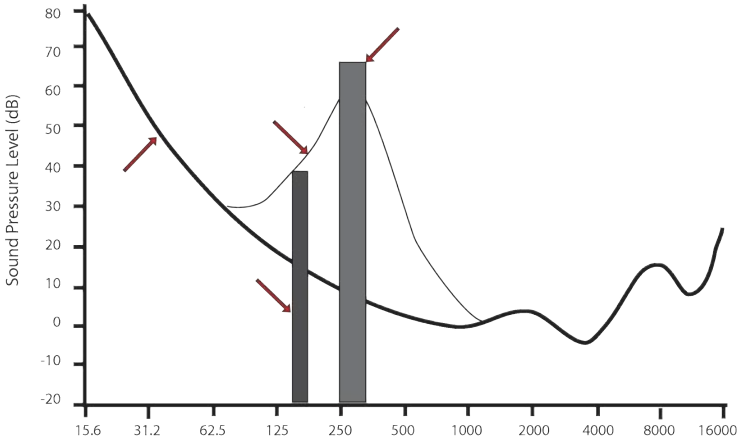
3. Mark the points that were relevant to answer the last question in the above diagram.

4. What's the difference in dB_{SPL} between two tones that are just audible, one at 8 kHz, the other at 40 Hz?

   _____

5. Mark the points that were relevant to answer the last question in the above diagram.

2.2 Psychoacoustic phenomena (15%)



(© Public domain image. Source: https://en.wikipedia.org/wiki/File:Audio_Mask_Graph.png)

1. Which psychoacoustic phenomenon does the figure above illustrate?

   ❍ Missing fundamental
   ❍ Cone of confusion
   ❍ Masking in the time domain
   ❍ Masking in the frequency domain
   ❍ Difference tone

2. In a few words, describe the effect this phenomenon has on the perception of concurrent sounds that are close to each other in frequency.

3. Label the x axis as well as the four arrows in the above figure to support your description. Use the professional terms that we have learned in class.

3 Microphones

3.1 Polar patterns (15%)

1. Which polar pattern does the microphone capsule on the right have?
   ❍ Omni ❍ Cardioid ❍ Figure-eight

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2. What is the purpose of the little red dot on this side of the capsule?

3. Is the microphone capsule on the right affected by the proximity effect, i.e., does it emphasize low frequencies when positioned close to the sound source? Explain how you can tell.

4. Describe a specific recording situation for which a capsule with this polar pattern would be particularly useful.

3.2 Electroacoustic transducer principles (8%)

1. What is the name of the physical phenomenon that allows a ribbon microphone to function? _____

2. Describe how this phenomenon works in *general* terms (not limited to microphones). What happens under which physical circumstances?

3. How is this general principle applied to microphones? What happens when one records sound with a ribbon mic?

4. Does a ribbon microphone generally require phantom power? Explain why or why not.

3.3 Check all statements that are true (7%)

- ❑ A pure pressure transducer is omnidirectional.
- ❑ Condenser microphones tend to achieve a better sound quality than dynamic microphones.
- ❑ Large-diaphragm condensers tend to have a more frequency-neutral polar pattern than small-diaphragm condensers.
- ❑ Tube condensers do not require phantom power from the mixer when they come with a separate power supply.
- ❑ A pure pressure transducer must by definition always be a condenser microphone.
- ❑ Electret condensers achieve better sound quality than any other type of microphone.
- ❑ Dynamic microphones can handle larger sound pressure levels than condenser microphones.

3.4 Identify these microphones (15%)

Manufacturer:	_____	_____	_____
Model number:	_____	_____	_____
Transducer type:	_____	_____	_____
Polar pattern:	_____	_____	_____
Phantom-powered?	_____	_____	_____

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