

Name: \_\_\_\_\_

Other group members: \_\_\_\_\_

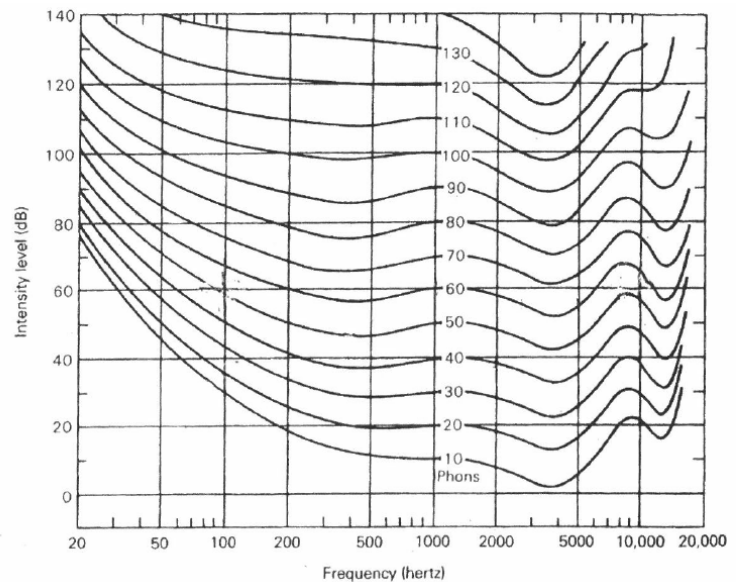
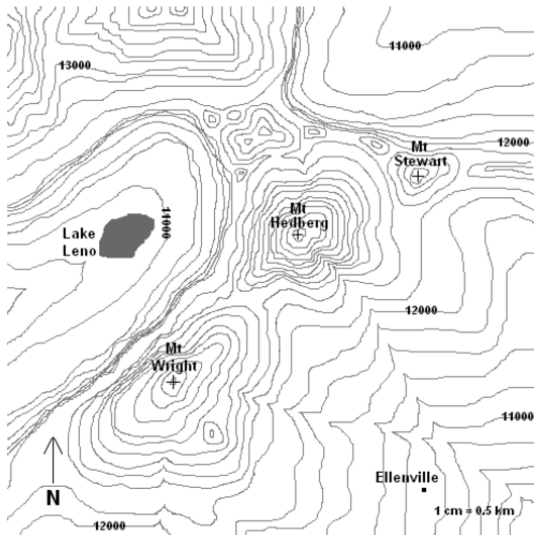
# Tutorial #3

PHYS 1240: Sound and Music

Tuesday, July 16, 2019

*Instructions:* Work in groups of 3 or 4 to answer the following questions. Write your solutions on this copy of the tutorial—each person should have their own copy, but make sure you agree on everything as a group. When you're finished, keep this copy of your tutorial for reference—no need to turn it in (grades are based on participation, not accuracy).

1. To the left is a topographic map. Longitude specifies the east-west position and latitude specifies the north-south position.



Compare these two contour plots and draw lines connecting the quantities that are the most similar. In addition, write in the units for each of the quantities on the right.

**Altitude**  
**Longitude**  
**Latitude**

**Frequency**  
**Loudness**  
**SIL**

2. How loud (in phons) is a 9 kHz pure tone at 40 dB?
  
  
  
  
  
  
  
  
  
  
3. If two pure tones have sound intensity levels of 20 dB and 30 dB, at what frequencies must they be played so that you hear both of them with the same 20-phon loudness?
  
  
  
  
  
  
  
  
  
  
4. Two tones  $A$  and  $B$ , both with frequencies of 3,000 Hz, have pressure amplitudes of  $0.5 \text{ N/m}^2$  and  $2 \text{ N/m}^2$ , respectively. Tone  $A$  is found to have an intensity of  $1 \text{ mW/m}^2$  (milliwatt per square meter).
  - a) What is the intensity of tone  $B$ , in  $\text{W/m}^2$ ?
  
  
  
  
  
  
  
  
  
  
  - b) What is the sound intensity level of tone  $B$ , in dB?
  
  
  
  
  
  
  
  
  
  
  - c) What is the loudness level of tone  $B$ , in phons?

5. Old stereo systems are designed to have audio amplifiers that increase the SIL of all frequencies exactly the same as the volume is increased. Newer high-fidelity systems have more complicated effects when adjusting the volume to account to different frequencies, but older systems simply have a “Loudness” switch that can be turned on and off. Turning the “loudness” on boosts the low frequency (bass) range. Why and when would this be used? Let’s do an example.



- a) If you hear two pure tones with frequencies 50 Hz and 10 kHz, both at the same loudness level of 70 phons, what is the SIL (dB) of these two tones?
- b) Now, decrease the SIL of both these tones by 40 dB. What is the loudness level (in phons) of these two tones now? Which tone is quieter?
- c) Discuss with your colleagues why loudness control is needed. Check with the instructor or TA to make sure everyone in the group is on the same page.

6. Make a sketch of the auditory pathway that a sound pressure wave takes from the outer ear into the brain. Include and label the following structures, and check with your instructor or TA once you are finished:

