UNIV 213 Science & Engineering of Music & Sound Spring 2026

Homework Assignment #6 – due via Moodle at 8:00 pm on Tuesday, Apr. 14, 2026
[one graded problem added 4/12/26]

***Instructions, notes, and hints*:**

Provide the details of all solutions, including important intermediate steps. You will not receive credit if you do not show your work. You may make reasonable assumptions and approximations to compensate for missing information, if any.

The first set of problems will be graded and the rest will not be graded. Only the graded problems must be submitted by the deadline above. Do not submit the ungraded problems. Determine the musical intervals between the strings of an electric bass.

***Graded Problems*:**

1. Find the number of semitones between each adjacent pair of strings in the standard electric bass guitar. See the last paragraph in Section 10.15 of the textbook (Rossing, et al., 3rd. ed.) for the tunings. Also specify the name of the musical interval (such as "perfect fifth") corresponding to each interval. Assume that the strings are tuned to the standard frequencies in the scale of equal temperament.

2. A capo is a clamp that guitar players can attach to the fretboard that effectively shortens all of the strings so that they vibrate only between the bridge and the capo, thereby increasing the pitch of each string. A capo can be thought of as a moveable nut. A quick internet search will show you what a capo looks like and how they attach. You might have seen a guitar player use one. The length of a guitar string is normally 65 cm. Suppose that a capo is attached to the guitar neck 51.6 cm away from the bridge. Find the new resulting pitches of the first two strings (originally tuned to E_2 and A_2), and find the musical interval between them. Without a capo, the interval E_2 and A_2 is five semitones (a perfect fourth).

3. Suppose that the E_4 string of a guitar is plucked exactly 1/4 of the way between the bridge and the nut. The string is open when it is plucked; that is, the player is not pressing on the string anywhere. List the fundamental frequency and the first five overtones that a listener would hear. Briefly explain how you arrived at your answer.

4. The length of a trombone in first position (see Fig. 11.11) is 275 cm. Find the distance that the slide must be moved out to lower the pitch by one semitone in the scale of equal temperament. Note that the increase in the length of the tubing is twice the distance traveled by the slide.

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5. **[added 4/12/26]** The three valves of a trumpet or tuba (or first three values if the tuba has additional valves) insert additional lengths of tubing that lower the tone by a whole tone (first valve), a semitone (second valve), or three semitones (third valve). Assuming that the length of the tubing in a trumpet is 140 cm with the valves open (i.e., no tubing added by the valves), find the length of tubing (in cm) added by each valve. Find the total "round-trip" length from one end of the tubing to the other end.

***Ungraded Problems*:**

The following problems will not be graded, but you should attempt to solve them on your own and then check the solutions. Do not give up too quickly if you struggle with one or more of them. Move on to a different problem and then return to the difficult one after a few hours.

1. Briefly explain why an electric guitar with magnetic pickups must use steel strings and not nylon strings to operate properly.

2. Briefly explain why a string played on an electric guitar is likely to vibrate for a longer period of time (has more "sustain") than the same string played on an acoustic guitar.

3. As shown in Fig. 11.11, a trombone slide is usually moved to one of seven positions, which are each separated by a semitone. Thus, the seven positions correspond to seven consecutive notes in the chromatic scale. How can a trombone play a full chromatic scale (12 semitones) with only seven slide positions?