

# Homework 3

Math 109 / Music 109A, Spring 2020

Due Monday, February 24.

NOTE: Express all decimal approximations in this assignment rounded off to three digits to the right of the decimal.

- Express each of these intervals as ratio, i.e., as elements of  $\mathbb{R}^+$ , three ways: (1) as a power of 2, (2) as a radical or the reciprocal of a radical, and (3) by a decimal approximation.
  - up 47 cents
  - down 325 cents
  - up a minor sixth
  - the interval from  $G_3$  to  $A_1^\sharp$
- Assuming  $A_4$  is tuned to 440 Hz, find the frequencies for:
  - $C_4$
  - $E_2^\flat$
  - $B_5$
  - $A_3^\flat$
- Suppose middle C is tuned as 256 Hz. (Note: This is not standard practice.) Find the frequencies for:
  - $A_4$
  - $F_5^\flat$
  - $C_1$
  - $G_2^\sharp$
- For each of these chords, voiced within an octave with the root on the bottom, give the pitch of each note in the chord. Assume  $A_4$  is tuned to 440 Hz.
  - major triad with root  $G_3$
  - minor triad with root  $A_4^\flat$
  - minor seventh chord with root  $D_3$
  - diminished seventh with root  $B_5^\flat$

5. Suppose a string on a banjo has length 50cm. Indicate positions of the 12 frets which will allow the string to play one octave of the ascending chromatic scale.

6. On the banjo string above, indicate positions of the frets which will allow the string to play one octave of the ascending 5-chromatic scale.

7. A string on a stringed instrument has length 100 cm. Indicate the positions of the single fret which will allow the string to play the note (a) a keyboard major third above the original pitch, and (b) a ratio  $5/4$  above the original pitch. (Note the closeness of these two positions.)

8. Sketch the graphs of:

(a)  $f(x) = 2^x$    (b)  $g(x) = 2^{x/12}$    (c)  $r(x) = 5^x$    (d)  $s(x) = 2^{(x+1)}$

Explain how (b) and (d) can be obtained from (a) by geometric transformations.

9. Give a plausible harmonization of this melody by providing, in the bass clef, one whole note chord for each measure. The melody should have no non-chord tones. Label each chord by root scale tone and chord type (e.g.,  $\text{VI}m^7$ ).

The image shows a musical score for a melody in 4/4 time, key of D major. The melody is written in the treble clef. The first measure contains a dotted quarter note D4, an eighth note E4, a quarter note F#4, and a quarter note G4. The second measure contains a dotted quarter note A4, an eighth note B4, a quarter note C5, and a quarter note D5. The third measure contains a quarter note E5, a quarter note D5, a quarter note C5, and a quarter note B4. The fourth measure contains a whole note A4. The bass clef is empty for all four measures.

10. Analyze the basic harmony in the first 16 measures of *Maple Leaf Rag*. Each measure will have at most two chords. Label the chords by root note class and chord type (e.g.,  $G^7$ ). (Note: In a few places the chords are incomplete.) The music can be downloaded as a pdf file from the website. It is listed under Handouts.