Math 5: Music and Sound. Quiz 1

30 mins (4 questions. Question 4 is worth more than Question 3)

Please write on this paper, show your working. The last page has useful information.

1. Consider the signal $3\sin(100\pi t + \pi/4)$

   (a) What is its period?

   (b) Rewrite the signal $3\sin(100\pi t) + 4\cos(100\pi t)$ in the form $C\sin(\omega t + \phi)$. (You can leave C and ϕ as expressions).

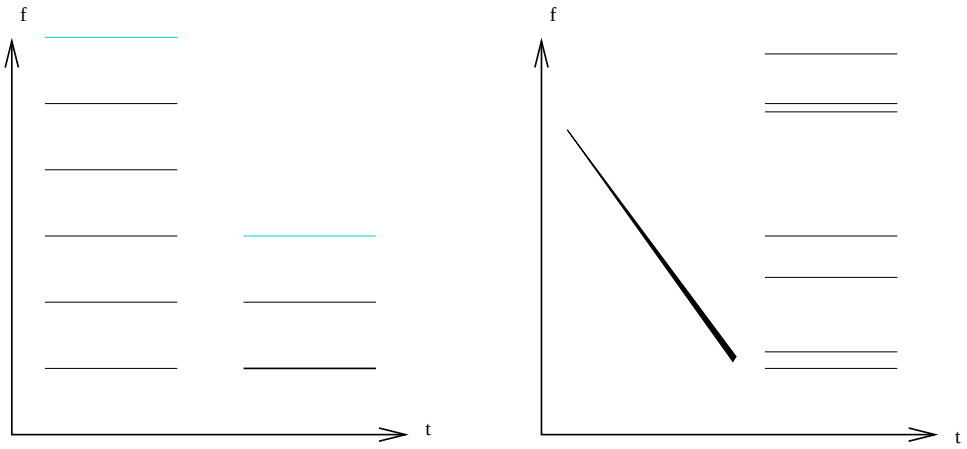
2. (a) What musical pitch (give name and octave, *e.g.* D#3) is nearest the frequency 1109 Hz?

(b) Compare the Pythagorean whole tone (9:8) and the equal-tempered whole tone, expressing their difference in *cents*.

3. What would you hear if two pure tones at frequencies 2000 Hz and 2004 Hz but the same amplitude were played together? (For full points you must state all relevant new frequencies of phenomena which occur. But you do not need to write out any trig formulae.)

Sketch a graph of the combined signal:

4. Describe in as much detail as you can what sounds these two spectrograms correspond to. For full points you must address: periodicity, pitch, timbre, loudness, and explain which sounds have these various aspects in common.



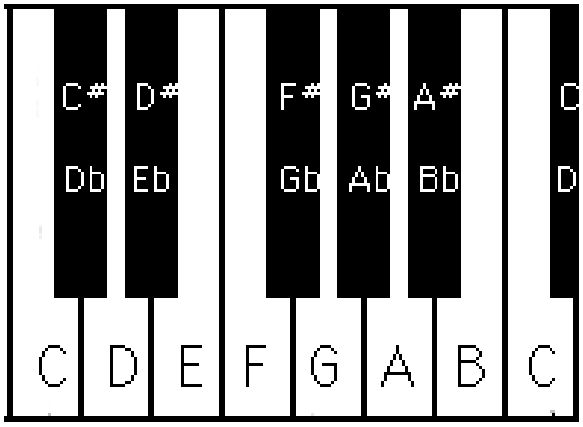
Possibly useful information

$$\sin(a+b) = \sin a \cos b + \cos a \sin b$$

$$\sin a + \sin b = 2\cos(\frac{a-b}{2})\sin(\frac{a+b}{2})$$

Intervals by number of semitones:

1. minor second
2. whole tone (major second)
3. minor third
4. major third
5. perfect fourth
6. tritone (augmented fourth)
7. perfect fifth
8. minor sixth
9. major sixth
10. minor seventh
11. major seventh
12. octave



The standard musical pitch A4 is 440 Hz