

Math, Mind, and Music

Quiz 2

March 18, 2005

Solve 3 out of four questions for a 100% score. Extra credit is possible.

1. Psychophysics is interested in determining the relationship between the magnitude of a sensation experienced in the mind and the magnitude of the physical stimulus that gave rise to it (e.g., frequency of a tone and pitch).
 - (a) Briefly (!) describe the mel scale.
 - (b) Why is the mel scale not an appropriate musical scale?
 - (c) Briefly (!) describe the probe-tone technique, and what it is used for.

(5)
2. Gestalt heuristics are powerful grouping mechanisms in auditory scene analysis.
 - (a) List at least four heuristics that play part in auditory stream segregation.
 - (b) Describe an example of competing heuristics (and the winner and why).
 - (c) Speculate about the relationship between (left/right)handedness and pitch perception.

(5)
3. The list on the next page contains an intricate description of the subjective characteristics of different key signatures from 1784.

Comment on the music-historical context that provided the basis for such judgments. (You are not required to analyze the descriptions of single keys in any detail!)

Would you find similar descriptions in our times?

(5)
4. The following statement can be found on the internet. Find arguments in support of, or against this thesis.

“If the electromagnetic zone around the earth vibrates, it does so with a frequency of 7.5 Hz because the speed of light is 300,000 km/s and the circumference of the earth is 40,000 km. Therefore the predicted strong harmonics of this vibration should have frequencies of 7.5 Hz times the various harmonics numbers. Interestingly, the frequencies resulting exactly match those used in Indian music.

Harmonic h	48	54	60	64	72	80	90	96
Frequency $h \cdot 7.5$ Hz	360	405	450	480	540	600	675	720
Indian note	pa	dha	ni	sa	ri	ma	ga	pa
Western scale	F	G	A	Bb	C	D	E	F

The modern standardised scale has A=440 Hz and the others adjusted according to the equitempered scale which does not quite fit this table. However the trend has been for A to increase with time and it had got to 450 Hz before the standard was set. Based on Indian music, the earth's natural resonance, a study of the rhythm speed for great composers and on other evidence, I believe that 450 Hz is the true and correct A." (5)