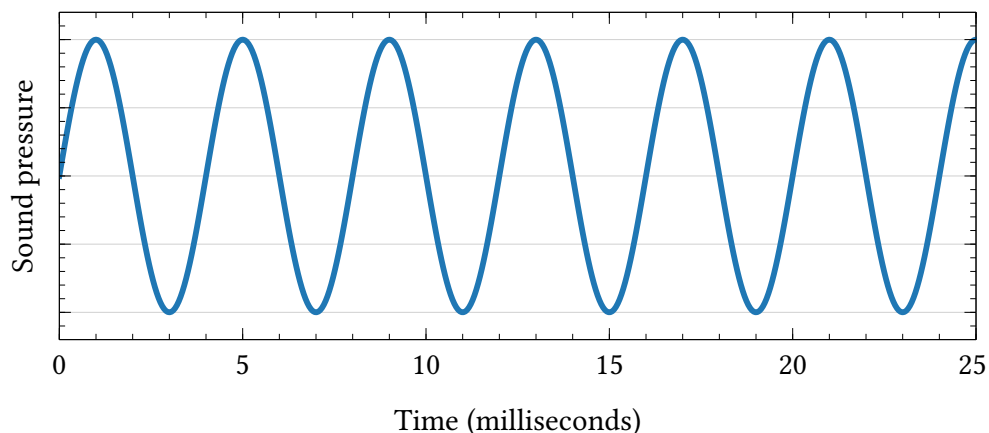


THE SCIENCE OF MUSIC

EXERCISES FOR CHAPTER 2

2.1 The waveform of a certain sound looks like this:



- Give an estimate of the frequency of the sound.
- What is the period in milliseconds?
- What is the wavelength in meters?

2.2 The lowest frequency the human ear can hear is about 20 Hz and the highest is about 20 000 Hz. What are the corresponding wavelengths?

2.3 A certain note has a frequency of 440 Hz. Separately for both just intonation and equal temperament, calculate the frequencies of the notes that are

- Up an octave from this
- Down an octave
- Up a major third
- Up two fifths

2.4 What is the musical interval between the following pairs of frequencies?

- 200 Hz and 800 Hz
- 600 Hz and 1500 Hz
- 400 Hz and 600 Hz

2.5 By what factor would you multiply a frequency to raise the pitch by these intervals in just intonation?

- a) A major sixth
- b) One octave plus a major second
- c) Two octaves plus a major third

2.6 A certain note has a frequency of 220 Hz. What is the frequency of the note five half-steps higher, in equal temperament tuning?

2.7 How many half-steps are there between two notes with frequencies 392 Hz and 587.3 Hz?

2.8 The lowest note on a standard 88-key piano is A0, but some pianos go as low as F0. What is the frequency of F0?

2.9 Suppose we number the keys of the piano from 1 to 88, going from left to right. Derive a general formula for the frequency f_n of key number n .

2.10 Consider a major scale starting on the note A4 at 440 Hz and going upwards.

- a) Calculate the frequency of the major third (the third note of the scale, which is C#5 in this case) if the scale is played using just intonation and if it is played using equal temperament.
- b) Is the difference between these two notes big enough for a human listener to hear?

2.11 Consider this note:



- a) What is the name of this note? Give the full name, including the letter name and the octave number.
- b) What is the frequency of the note in hertz to two decimal places (in equal temperament and at standard pitch)?
- c) What is the wavelength in meters?
- d) Another note has $\frac{1}{3}$ the wavelength. What note is it?

2.12 Most orchestras tune to standard concert pitch in which A4 has frequency 440 Hz, but a few, such as the New York Philharmonic Orchestra, use a higher frequency of 442 Hz.

- a) How many musical cents are there between these two frequencies?
- b) Is this difference big enough for a human listener to hear?

2.13 Consider this musical passage:



- a) What does it mean that the music has a " $\frac{4}{4}$ " time signature?
- b) If this passage is played at 120 beats per minute, how long, in seconds, is each note?