

Math 250a, Section 2, Fall 2007
Homework #2
Due Thursday, September 6

The first 7 exercises are

Chapter 1.6 (pages 42-44):

Exercises & Problems: 6, 14, 18, 28

Chapter 1 Review Exercises (pages 58-63):

Exercises & Problems: 36, 48, 52

Exercise #8

A decibel is a value that represents the *log* of a ratio of two numbers. It provides a useful scale for expressing physical quantities and is commonly used in many fields such as the study of auditory function. Acoustic sound pressure in decibels referenced to the threshold of hearing (or dB SPL) in a healthy human is defined as

$$\text{dB SPL} = 20 \log \left(\frac{P}{P_{\text{ref}}} \right)$$

where P is the amplitude of the actual acoustic sound pressure (in units of pascals, or Pa) and P_{ref} is the reference pressure defined to be $20 \mu Pa$ (that is $20 \cdot 10^{-6} Pa$). The dynamic range of hearing in humans can be quite large, up to 120 dB. The following table shows some typical sound pressure levels (in dB SPL):

Threshold of hearing	0
Quiet whisper	20
Recording studio	30
Quiet home/office	40
Conversational speech	60
Traffic	60-80
Vacuum cleaner	80
iPod (at max)	100
Rock concert	100-120
Threshold of pain	130

(2) What is the difference in the amplitude of sound pressure between the softest and loudest sounds (i.e., sounds over 120 dB)?

(b) Intensity (energy per unit area) goes as the square of the sound pressure. What is the ratio of energy coming into the ear between the softest and loudest sounds?

(c) To better appreciate the magnitude of scale in (b) make an analogy for your answer in part (b) by comparing some familiar objects (e.g., the weight of a mouse to that of some other object, or size of a postage stamp to some other area, etc.). Comment on the dynamic range of hearing in humans.

(d) Explain why a dB scale would be useful in auditory science.