Friday 8 The ear and hearing.

Name_____ Section_____

The critical band.

The ear performs frequency analysis on sound. The place theory of hearing associates a specific location on the cochlea for each frequency. The response of the cochlea is a maximum at this location for a given frequency, but even a pure frequency will excite the cochlea over a region called the "critical band". Sounds composed of multiple frequencies will be heard differently depending on whether the critical bands of these frequencies overlap.

When sound at one frequency affects your ability to hear sound at another frequency this is called "masking". Masking is influenced by whether or not the critical bands of two sounds overlap.

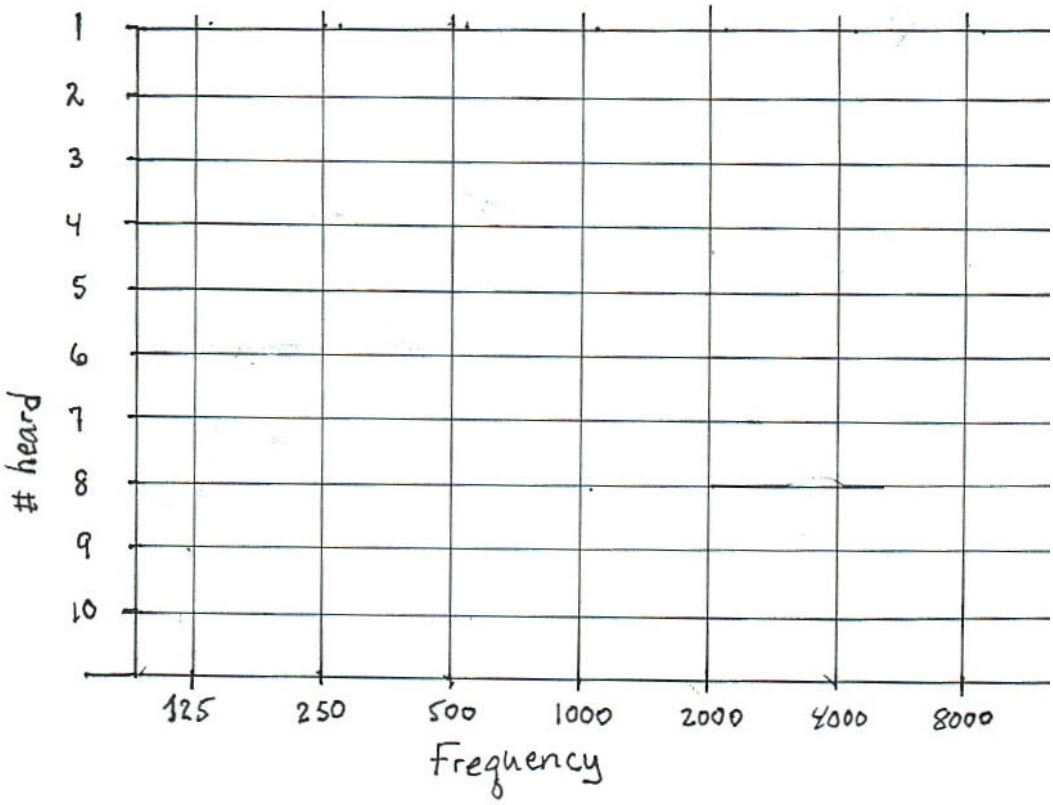
1) You will hear a sequence of tones from a tape. Observe how masking is affected by overlapping critical bands. How is it affected?

If two tones are close in frequency then the louder one can mask the softer one. One tone does not have to be at the same frequency to mask another. If you have noise, which has sound power over a range of frequencies, then masking of a sound will occur more strongly if the noise is at frequencies which are close to the sound.

2) Sounds enter the cochlea through the oval window and reach the receptors for high frequencies first before reaching the receptors for low frequencies. What effect does this have on masking?

A low pitched sound can mask a higher pitch easier than a high pitch can mask a low one. You heard an example of this on tape.

3) The sensitivity of the ear is not the same at all frequencies. You will hear a sequence of seven frequencies 125, 250, 500, 1000, 2000,4000, and 8000 Hz. In each case the tone will be played ten times with different intensity levels. Plot, on the back of this page, the number of intensity levels that you can hear verses frequency to determine your frequency dependent threshold of hearing.



Your curve should look a bit like Figure 6-4 in the text. Every ear is different, however.

4) Psychoacoustics is the study of sound perception. One example of this is called "virtual pitch". If you hear a sound with overtones, which lacks the fundamental, you will nevertheless perceive the fundamental. You will hear examples of this. What is 'Shepherd's scale' ?

It is a musical scale played with sounds that have lots of overtones. Furthermore the amplitudes of the overtones are varied as the scale proceeds so that it becomes ambiguous to the mind where the scale actually is. Virtual pitches coming in at low frequency give the impression of the scale ever going upward but never reaching the top.

5) What are combination tones and how are they produced?

The production of combination tones is due to nonlinearity in the ear. For example, if 2000 Hz and 1200 Hz are played at the same time you will also hear some 800 Hz (which is equal to the difference between 2000, and 1200). If a tone at 804 Hz is played at the same time as 2000 and 1200 you will hear beats between the 804 Hz and the 800 Hz which your ear produces.