PHYSICS 102 - PHYSICS OF MUSIC
Dr. Richard E. Berg
Make-Up Test – May 12, 2004

Before beginning the test please enter your name, last name first (both in letters and by blackening the letters in the columns under the name line) and your social security number (enter the numbers without hyphenation, leaving line J blank, both writing the numbers and blackening the numbers in the columns under the identification number line).

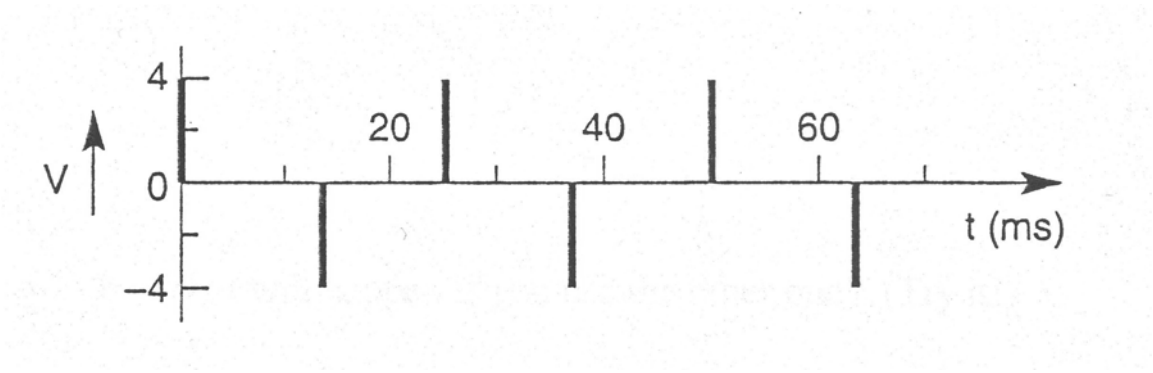
Each question is on a line numbered from 1 through 100. You are to answer each question either in the affirmative (Yes, True) or in the negative (No, False) by blackening either response A/1 for affirmative or response B/2 for negative. Leaving an answer blank or blackening responses C/3, D/4, or E/5 are not correct answers. Your score is the number of correct answers, so guessing may help.

Fruits used in grandma's old-fashioned apple-raisin pie include:
(1) apples.
(2) passion fruit.
(3) sugar.

Examples of periodic motion include:
(4) the swinging pendulum of a cuckoo clock.
(5) a basketball player bouncing the ball twice per second.
(6) a mass oscillating up and down on a spring.
(7) a square wave.
(8) the earth revolving around the sun.
(9) motion of a loudspeaker driven by a sine wave.
(10) a violin playing the note G#.

Examples of simple harmonic motion include:
(11) the swinging pendulum of a cuckoo clock.
(12) a violin playing the open string note G.
(13) a square wave.
(14) a super ball bouncing without losing energy.
(15) motion of a loudspeaker driven by a sine wave.
(16) a mass bouncing up and down on a spring.
(17) a satellite revolving around the earth.
(18) a sine wave.

Which of the following periods and frequencies go together?
(19) 1 millisecond, 1 Hertz.
(20) 5 milliseconds, 500 Hertz.
(21) 0.01 second, 10 Hertz.
(22) 50 microseconds, 20 kilohertz.



The wave in the Figure above:
(23) has an amplitude of 8 V.
(24) has a period of 12.5 millisecond.
(25) has a frequency of 40 Hertz.
(26) includes exactly two periods.

The following are examples of driven resonances:
(27) a note played by a clarinet.
(28) white noise.
(29) pink noise.
(30) beats.
(31) a large loudspeaker driven by a 500 Hz sine wave.
(32) hitting a nail with a hammer.

The following are examples of diffraction:
(33) you can hear your mother calling even though you cannot see her.
(34) a flute rises in pitch as the air within it heats up.
(35) at the ocean waves are aligned parallel to the beach as they come in.
(36) the sounds from two loudspeakers cancel if they are out of phase.

The velocity of sound:
(37) is about 345 miles per second.
(38) is greater in helium than in sulfur hexafluoride.
(39) is much slower than the velocity of light.

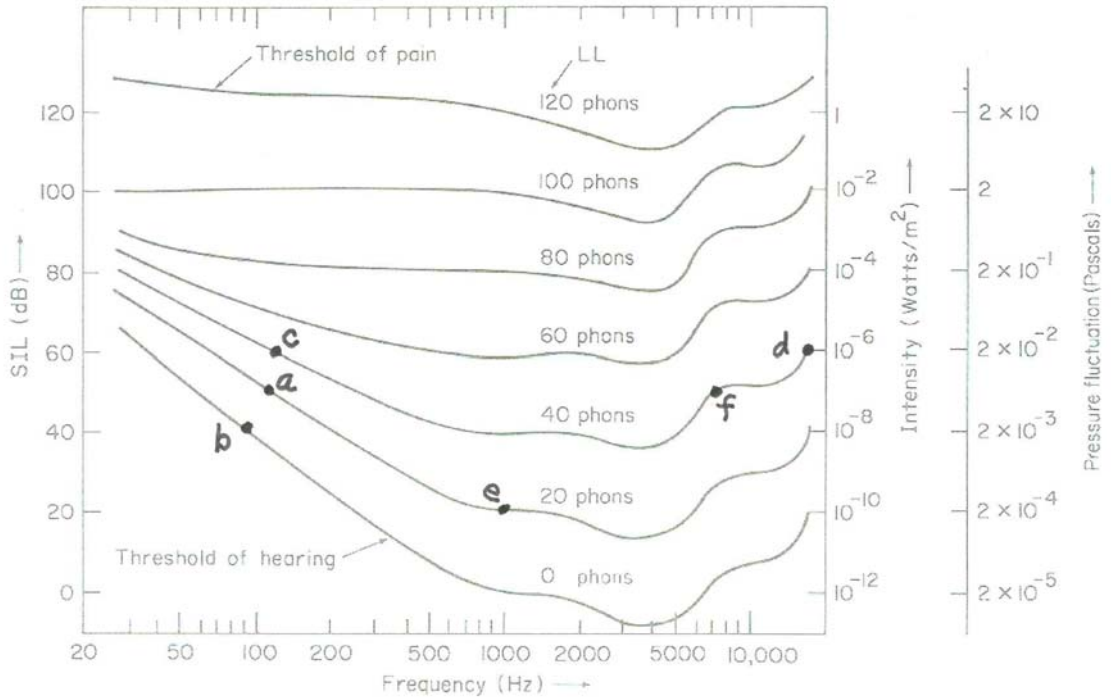
Tuning bars of 398 Hz and 402 Hz are sounded simultaneously with the same intensity.
(40) You hear a 400 Hertz tone.
(41) You hear two beats per second.

The tones produced by a violin string are:
(42) the notes of the overtone series.
(43) harmonics of the fundamental frequency of the string.
(44) standing waves.
(45) resonant frequencies of the string.
(46) the same series of notes as those produced by a closed tube with the same fundamental frequency.

The following elements apply to the sound of a bell:
(47) transients.
(48) vibrato.
(49) inharmonicities.
(50) the chorus effect.

(51) A Fourier spectrum is a graph showing the amplitudes of the harmonics in a wave.
(52) One can reconstruct a complex wave from information contained in the Fourier spectrum alone.
(53) One can identify formant regions from the Fourier spectrum of a vowel sound.
(54) One can identify transients from the Fourier spectrum of a vowel sound.
(55) A sine wave has features in common with a clarinet spectrum that cause it to sound like a clarinet.
(56) Both a square wave and a triangular wave have only odd harmonics.
(57) Both a sawtooth wave and a pulse train have all harmonics.
(58) When a complex wave is missing its fundamental, its pitch rises by one octave.
(59) A square wave sounds louder than a sine wave of equal amplitude primarily because it has more Fourier components.

(60) The three ossicles form the bone chain that transmits sound from the ear drum to the helix area.
(61) The resonant frequency of the ear canal acting as a closed tube 2.5cm long may help to explain why the threshold of hearing is a minimum between 3000 and 4000 Hz.
(62) The basilar membrane is in the large semicircular canal.
(63) Muscles attached to the bone chain help to protect the ear from loud noises.
(64) The *place* theory of hearing refers to the correlation of frequency sensitivity with position along the basilar membrane..



Referring to the Figure above showing equal loudness contours:

(65) The horizontal scale is logarithmic.

(66) One phon is equal to one db at 1000 Hz independent of intensity.

(67) The unit of loudness level is the decibel.

(68) The vertical scale is linear in decibels.

(69) Sounds of the same loudness at all frequencies are an equal number if decibels.

(70) The threshold of hearing for all frequencies is a constant number of phons.

(71) A factor of 100 increase in intensity of a pure tone source corresponds to an increase of 20 dB.

(72) Point (c) is about the same loudness as point (d) to your average human.

(73) Point (f) has the same intensity as point (a), but sounds softer to your average human.

(74) Point (b) sounds softer than point (e) to your average human.

Suppose that tones of 350 Hz and 450 Hz are sounded together at a loud level.

(75) A difference tone of 100 Hz might be heard.

(76) A difference tone of 200 Hz might be heard.

(77) A sum tone of 250 Hz might be heard.

(78) A sum tone of 800 Hz will be present but cannot be heard due to masking.

(79) All sum and difference tones that can actually be heard are members of the overtone series based whose fundamental frequency is 100 Hz.

(80) The four types of beats discussed in class are first-order beats, second-order beats, quality beats, and longitudinal beats.
(81) Longitudinal beats occur when two very closely spaced tones are presented to your ears binaurally.

(82) Diplacusis refers to problems in locating the lateral position of a sound source.
(83) Tinnitus can usually be corrected through use of a hearing aid.

(84) The vocal tract functions as an open tube with a fundamental frequency of about 1000 Hertz.
(85) Resonances in the vocal tract lead to formants in the voice.
(86) The frequencies of vocal formants can be affected by the shape of the throat.
(87) A graph of the amplitude of various frequencies of the voice as a function of time is called an audio spectrogram.
(88) Audio spectrograms of bird calls can be used to identify birds from their calls.
(89) Your voice appears to rise when you breathe helium because the frequencies of the fundamental and the harmonics all rise.
(90) The vowel sound “ee” consists primarily of noise.

(91) A spectrum analyzer such as those used in classroom demonstrations displays a Fourier spectrum.
(92) An audio spectrogram is basically a way to display changes in a Fourier spectrum with time.
(93) An oscilloscope was often used in class to display the logarithm of a wave as a function of time.
(94) A small loudspeaker held first alone then behind a small hole in a large board demonstrated interference and refraction.
(95) Two identical tuning bars can be used to demonstrate a resonance.
(96) The Bernoulli effect is in part responsible for the closing of your vocal folds as the air flows between them.
(97) According to the inverse square law, the frequency of a horn becomes lower as it recedes from the observer.
(98) A balloon filled with carbon dioxide was used in class to demonstrate refraction.
(99) A corrugated plastic tube about three feet long was used in class to demonstrate how all notes of the overtone series are produced in closed tubes.
(100) A Fourier synthesizer was used in class to play music, but only one line at a time.