Phys 341 Midterm Name_____

Wednesday 2017.02.17 11-11:50

Attempt all 10 questions. Write on this paper.

The midterm is "closed book", except for one page of *handwritten* notes. Both sides OK.

Obey all UBC's usual examination rules.

For questions 1 to 3, fill in the gaps in each paragraph, choosing from the set of words/phrases at the start of each question (each of which may be used more than once) to form the most correct, precise statements.

1. **amplitude, medium, frequency, gas, liquid, longitudinal, medium, solid, transverse, wavelength.**

A pure tone sound wave is a longitudinal disturbance, generated by something vibrating, propagated through a medium. The speed of the wave depends entirely on the medium. The original vibration frequency is preserved throughout the wave, but the wavelength will vary if the medium changes. Our perception of the pitch depends on the frequency of the wave. Our perception of loudness, depends on the amplitude and the frequency of the wave.

2. **acoustic pressure, acoustic velocity, amplitude, energy, frequency spectrum, integers, pattern, pressure, sound waves, velocity, voltage, wavelength.**

The output of a microphone is a voltage that is proportional to acoustic pressure. The analog-digital converter in a computer converts this signal into a time-ordered sequence of integers, which a Fast Fourier Transform (FFT) code converts into another sequence that represents the frequency spectrum of the original signal.

3. **acoustic displacement, acoustic energy, acoustic pressure, acoustic velocity, amplitude, decreases, even, frequency, half, increases, integer, numbers, odd, radiate, signal, sound waves, spectrum, voltage, wavelength, whole.**

An acoustic standing wave exists in a uniform tube, closed rigidly at each end. At each end there must be an acoustic velocity node and an acoustic pressure antinode. Thus the length of the tube must be an integer number of half wavelengths of the standing wave. If the tube is opened at one end, the fundamental frequency decreases and the open end is an approximate acoustic pressure node. The last sentence can only be an approximation, because the open end of the tube can now radiate acoustic energy to the environment.

For questions 4 to 7, circle all statements that are correct.

4. A siren in the middle of an open field produces a pure tone at 3 kHz. You listen at the edge of the field. Now the tone changes frequency to 10 kHz with no change in acoustic power. What you hear is:

(a) Quieter ✓

(b) Louder

(c) Neither quieter nor louder

The tone changes back to the original 3 kHz, and then moves to 100 Hz, again with no change in acoustic power. What you hear is:

(d) Quieter ✓

(e) Louder

(f) Neither quieter nor louder

5. A taut uniform string, length *L*, is held rigidly at each end, mounted on a sound board. The string is plucked with a plectrum in the centre of the string. The sound spectrum:

(a) has two harmonics.

(b) has one frequency, twice the fundamental frequency.

(c) has one frequency, half the fundamental frequency.

(d) has a harmonic spectrum of frequencies 1,3,5,7... times the fundamental frequency ✓

(e) has a harmonic spectrum of frequencies 2,4,6,8... times the fundamental frequency.

6. Circle all true statements about the concept of acoustic velocity in a wind instrument:

(a) It is the speed of airflow caused by a player blowing into a wind instrument.

(b) It is caused by the thermal motion of air molecules which is why wind instruments are out of tune if played cold.

(c) It is the small collective motion of air molecules at audible frequencies superimposed on motions (a) and (b). ✓

(d) It has to be zero at the rigid end of a pipe. ✓

(e) It has to be zero at the open end of a pipe.

7. Circle all true statements concerning the resonant frequencies of a thin bar of wood:

(a) The thicker the piece (all else being equal), the lower the resonant frequencies.

(b) The thicker the piece (all else being equal), the higher the resonant frequencies. ✓

(c) The denser the piece (all else being equal), the lower the resonant frequencies. ✓

(d) The denser the piece (all else being equal), the higher the resonant frequencies.

(e) The longer the piece (all else being equal), the lower the resonant frequencies. ✓

(f) The longer the piece (all else being equal), the higher the resonant frequencies.

For questions 8-10, draw a simple diagram to to illustrate your answer, as clearly and precisely as you can.

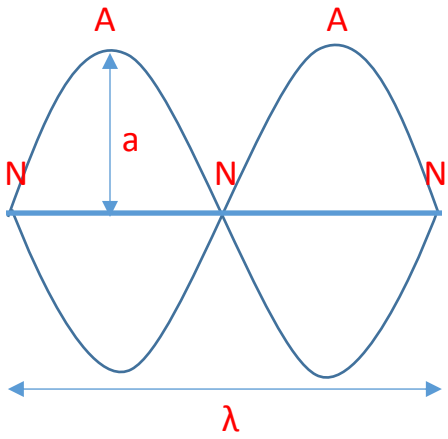
8. Draw a diagram of a standing wave on a string with two loops. Indicate:

(a) The nodes (with arrows and letter "N"s)

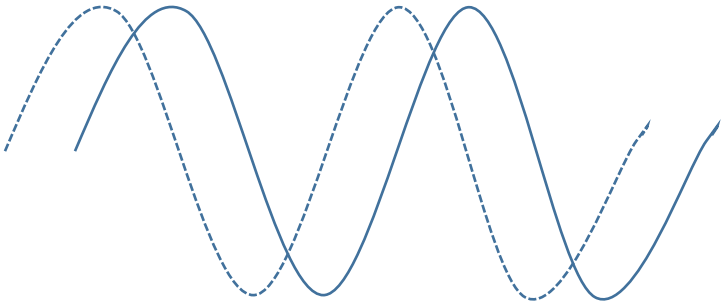
(b) The antinodes (with arrows and letter "A"s)

(c) The wavelength (with the length of a double-ended arrow and the Greek letter "λ")

(d) The amplitude (with the length of a double-ended arrow and the letter "a")



9. Draw a diagram of a sinusoidal transverse travelling wave at an instant in time. Use a solid line. Show with a dashed line, on the same diagram, the same wave a quarter of a period later, if the wave is moving toward the left.



10. Two sound sources (labelled A and B below) radiating identical pure tones, in phase with each other, are placed in an open field, half a wavelength apart. Draw a diagram to illustrate where you would be likely to hear a loud sound, and where you would hear a much quieter sound.