Quiz 5 Version A

1) In an extraordinarily sensitive experiment physicists at UCSD measure the growth rate of crystals by reflecting a laser beam off the crystal surface. The reflected and transmitted beams were combined, and the resulting beat frequency measured. For a laser frequency of 5 10^{14} Hz, what beat Frequency results from a crystal growth rate of 0.2 nanometer/sec ?

~~A) 10^{-5} Hz B) 10^{-4} Hz C) 10^{-3} Hz D) 10^{-2} Hz E) 1 Hz~~

A) 7 x 10^{-5} Hz B) 7 x 10^{-4} Hz C) 7 x 10^{-3} Hz D) 7 x 10^{-2} Hz E) 7 Hz

2) Consider sound waves of the same wavelength for in xenon (Xe) and air. Assume that both gases have the same pressure and temperature. Which wave has the lower frequency?

A) Wave in air has lower frequency.
~~B) Wave in argon has lower frequency.~~ B) Wave in Xenon has lower frequency
C) They have the same frequency given that they have the same wavelength.

What is the pressure amplitude in a sound wave at -5dB in air.

3) Assume the speed of sound is 343m/s. The reference intensity $I_0 = 10^{-12}$ W/m$^{2.}$ The density of air is 1.2 kg/m^3. Give your result in units of 10^{-5} N/m^2 .

A) 0.5 B) 1.1 C) 1.6 D) 2.0 E) 4.0

4) The A-string (440Hz) on a piano is 38.9cm long. It is clamped down on both ends. If the string is under 667N of tension, what is its mass?

A) 10g B) 8g C) 5g D) 2g E) 1g

5) A guitar's G note that should be 392 Hz is playing a bit flat at 381 Hz. By what percentage should the string tension be increased? Assume the string does not stretch significantly. I.e. its mass per unit length does not change.

A) 1% B) 5% C) 10% D) 20% E) 30%

6) A 1dB change in sound level is about the minimum a human ear can perceive. By what factor is does the sound intensity change if the sound level changes by +1dB ?

A) 0.79 B) 1.26 C) 2.05 D) 3.02 E) 0.50

7) You see an airplane straight overhead at an altitude of 5.2km. Sound from the airplane however seems to be coming from a point back along the plane's path at a 35 degree angle to the vertical. What is the plane's speed? How large an error do you make in this calculation if you got the height of the plane wrong, and it is in fact only 3.0km?
Assume the speed of sound is 330 m/s as it travels form the plane to your ear.

A) 200 m/s, and an error of 5.2/3, i.e. ~70%
B) 200 m/s, and no error.
C) 300 m/s, and an error of 5.2/3, i.e. ~70%
D) 300 m/s, and no error.
E) 100 m/s, and an error of 5.2/3, i.e. ~70%

8) One end of a nylon rope is tied to a stationary support at the top of a vertical mine shaft 110m deep. At the bottom end a weight of 20kg is attached. The mass of the rope is 2kg. A geologist at the bottom of the rope signals her colleague by jerking the rope sideways. If she stimulated sinusoidal waves on the rope with frequency 2Hz, how many cycles of the wave fit in the ropes length?

A) 0.5 B) 1 C) 2 D) 4 E) 8 or more

The human ear can hear frequencies in the range 10Hz to 100kHz.
Dogs can hear much higher frequencies. Let's assume a human tried to
Tune an instrument that only dogs can hear, e.g. at a frequency of 200kHz.

9) Which of the following is most accurate?

A) This will never work because humans can't hear the frequency they want to tune in this case.
B) It will work, but only to moderate precision of around 10% or so.
C) It will work, but only to moderate precision of around 30% or so.
D) It will work superbly well as long as the instrument is not more out of tune than about a factor 2.
E) It will work superbly well if the instrument before tuning is within the range 150kHz to 250kHz.

10) Find the wavelength, period, angular frequency, and wave number of a 1kHz sound wave in air. Assume an air pressure of 1atm, a density of 1.2kg/m^3, and an adiabatic exponent of about 7/5. Note: krad/sec below is shorthand for 1000 radians/sec. I.e. an angular frequency of 2π/sec would be ~6 rad/sec.

A) Wavelength = 30cm, T = 1 millisecond, omega = 6krad/sec, wave number = 20/m
B) Wavelength = 60cm, T = 1 millisecond, omega = 6krad/sec, wave number = 10/m
C) Wavelength = 60cm, T = 1 millisecond, omega = 6krad/sec, wave number = 5/m
D) Wavelength = 30cm, T = 1 millisecond, omega = 3krad/sec, wave number = 20/m
E) Wavelength = 30cm, T = 5 millisecond, omega = 6krad/sec, wave number = 20/m