Department of Physics

Please insert in the circle the initial of your last name inside

Please Print Clearly:

Student:_____ _____
Last Name *First Name*

Student Number: _____ **Student Section:** _____

PCS 125 – Waves and Fields

Mid -Term Test – February 26, 2010

Check the name of your professor:

Dr. Abbas		Dr. Carvalho		Dr. Hu		Dr. Holder		Dr. Yuan	

Read the following attentively

- **Duration of the test: 1 hour and 30 minutes (90 minutes).**
- **The test consists of 2 full answer question (10 marks) and 10 multiple-choice questions (2 marks each). Answer ALL questions.**
- **For each multiple choice question:**
  - **You need to show, in the space provided in this booklet, a justification for your answer.**
  - **The work shown in your exam booklet for the multiple choice questions will be checked, at least for three of the ten questions. These questions will be chosen randomly. If no work or correct argument is shown, the resultant mark may be zero, even if the answer in the bubble sheet is correct.**
  - **Transfer your choices to the bubble sheet only when you're sure of them.**
  - **Some answers may be rounded off.**
- **For the full answer questions, show, in the space provided, all your work. For part marks to be awarded, the steps leading to the answers in each part of the problem have to be organized, unambiguous and clear.**
- **All Ryerson examination rules apply**
- **Sharing of pens, erasers and calculators is not permitted.**
- **Talking to another student or glancing over another student's paper is not permitted and may result in a charge of academic misconduct.**
- **Formula sheet provided with the test booklet. No other sheets allowed.**
- **The only calculators allowed are either the Sharp EL-546 or Casio FX-991. If you are found to have another type of calculator (even if not programmable) it will be confiscated for the duration of the test.**

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Student signature (no signature, no mark!)

MULTIPLE CHOICE QUESTIONS

(1) The motion of a particle connected to a spring is described by $x = 10 \sin(\pi t)$ where x is in cm and t in seconds. At what time t is the potential energy equal to the kinetic energy?

ANS: 0.25 s or 0.75 s

(2) A sinusoidal wave travels along a stretched string. A particle on the string has a maximum velocity of 2 m/s and a maximum acceleration of 200 m/s^2. What is the frequency of the wave?

ANS:15.9 Hz

(3) A long stretched string is shaken, at its left end, with a frequency of 5.0 Hz, sending a sinusoidal wave down the string at 2 m/s. After the wave has traveled 1.0 m, the linear density of the string suddenly decreases by a factor of four. Find the wavelength of the traveling wave on the light part of the string.

ANS: 0.8 m

(4) An emergency vehicle, travelling south at a speed of 70 km/h, has a siren designed to emit an 8000 Hz sound. As you are traveling north, on the same road, at 40 km/h, what are the frequencies you hear as the emergency vehicle has passed by you?

Assume the speed of sound is 340 m/s.

ANS: 7320 Hz

(5) An opera singer sings a note at a frequency $f_1 = 440$ Hz. If she increases the frequency to

$f_2 = 880$ Hz without changing the displacement amplitude of the generated sound, by what factor does the intensity of the sound change?

ANS: 4

(6) The path difference between two waves is 5 m. If the wavelength of the waves emitted by the two sources is 4 m, what is the phase difference (in degrees)?

ANS: 450

(7) A violin string is 34 cm long. It sounds the musical note A (with fundamental frequency 440 Hz) when played without fingering. How far form the end of the string should you place your finger to play the note C (with fundamental frequency 523 Hz)?
ANS: 5.4 cm

(8) What is the temperature of air (in degrees Celsius) at a height of 11 km from the surface of the earth knowing that the speed of sound at that height is 291 m/s.

ANS: $-62\,^{o}C$

(9) Which one of the following superposition of waves will result in *beats*?

ANS: The superposition of waves that are identical except for slightly different frequencies

(10) Your friend is talking to you at a sound level of $50\,dB$. At the same time, a mosquito is buzzing near your ear. If the combined sound intensity perceived by you is $1.10\times10^{-7}\ W/m^2$, what is the sound level (in dB) of the buzzing mosquito?

ANS: 40

FULL ANSWER QUESTIONS

1. An air-track glider of mass 100 g is attached to a spring which oscillates horizontally with a period of 1.5 s.

At $t = 0$ s the glider is 5.0 cm left of the equilibrium position (x=0) and is moving to the right at 36.3 cm/s. Write the equation of motion for the glider.

ANS: x=10 (cm) cos (4.19 t + ϕ) with $\phi = -2\,\pi/3$ or $4\pi/3$

2. See the figure below. A thin pipe, open at both ends, with length 0.400 m and 1.0 cm diameter is placed vertically in a cylindrical bucket so that it nearly touches the flat bottom of the bucket, which has an area of 0.100 m^2. The air temperature is 22°C.

Water is slowly poured into the bucket until a sounding tuning fork of frequency 440 Hz, held over the pipe, produces resonance. Find the volume of the water in the bucket at this moment. (Assume the same water level in the pipe and in the bucket, as shown in the diagram.)

ANS:2.04×10^{-2} m^3