PHYS-1200 PHYSICS II EXAM 2B Oct 30, 2007 NAME __KEY_________

Please circle the number next to your section below.

SECTION NUMBER	**EXAMINATION ROOM**	**INSTRUCTOR**	**Section time**
___1	DCC 308	SCOTT DWYER	MR 8:00 A.M.
___2	DCC 308	SCOTT DWYER	MR 10:00 A.M.
___3	SA 3303	HEIDI NEWBERG	MR 10:00 A.M.
___4	SA 3303	JOEL GIEDT	MR 12:00 NOON.
___5	DCC 318	THOMAS SHANNON	MR 12:00 NOON
___6	SA 3303	ANGEL GARCIA	MR 2:00 P.M.
___7	RI 203	WAYNE ROBERGE	MR 2:00 P.M.
___8	RI 203	GLENN CIOLEK	MR 4:00 PM
___9	DCC 308	KIM LEWIS	TF 10:00 A.M.
___10	DCC 308	KIM LEWIS	TF 12:00 NOON
___11	DCC 330	JOHN SCHROEDER	TF 12:00 NOON.
___12	DCC 318	GYORGY KORNISS	TF 2:00 PM

There are 6 different pages in this quiz, including the cover page. Check now to see that you have all of them. Place your name on every page.

	CREDIT	GRADE
PART A	40%	
PART B	24%	
PART C-1	21%	
PART C-2	15%	
TOTAL	100%	

All work and answers must be given in the spaces provided on these pages.

<u>Work must be shown for parts B and C.</u>

You are permitted the use of one 8 ½ x11" sheet of notes. Use of any other materials will result in a zero for this examination. You may use a calculator for math functions.

Collaboration on this exam will result in zero grade and letter to the Dean of Students for all students involved.

On parts B and C, answer questions in the space provided. Show your work logically and neatly. On questions or explanations, use complete sentences. You must show adequate work to justify your answer to receive credit. Ambiguous answers will be graded incorrect.

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PART A. (5% each) Each question is worth 5%. In the space provided, to the left of the question number, write the letter corresponding to the best answer to the question.

__E__A1) The largest number of beats per second will be heard from which pair of sources?

a) 200 and 203 Hz
b) 395 and 400 Hz
c) 400 and 404 Hz
d) 796 and 800 Hz
e) 660 and 666 Hz

_B___A2) An electromagnetic wave is traveling in the +x direction. The electric field is given by $\vec{E} = E_m \sin(kx - \omega t)\,\hat{z}$. Which relation below best represents the magnetic field?

a) $B = \frac{E_m}{c}\cos(kx - \omega t)\,\hat{y}$

b) $B = -\frac{E_m}{c}\sin(kx - \omega t)\,\hat{y}$

c) $B = -\frac{E_m}{c}\sin(kx - \omega t)\,\hat{x}$

d) $B = \frac{E_m}{c}\sin(kx - \omega t)\,\hat{z}$

e) $B = \frac{E_m}{c}\cos(kx - \omega t)\,\hat{z}$

__A__A3) A mass M on a spring with spring constant B oscillates at frequency G. What would the frequency be if the mass were doubled and the spring constant halved?

a) $G/2$ b) $G/\sqrt{2}$ c) G d) $\sqrt{2}\,G$ e) $2G$

__B__A4) A harmonic wave travels on a string according to the relationship $y(x,t) = 0.01\cos(\pi x + 20\pi t)$ where positions are in meters and time is in seconds. What is the maximum velocity with which the string segment at x=5 m travels?

a) $100\pi \quad m/s$
b) $0.2\pi \quad m/s$
c) $0.01\sin(5\pi)$ *m/s*
d) $0.05\sin(5\pi + 20\pi t)$ *m/s*
e) $20\pi \quad m/s$

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__B__A5) A guitar string has its fundamental frequency at 100 Hz. Which frequency below is closest to the fundamental if the tension in the string is increased by a factor of four?

a) 400 Hz
b) 200 Hz
c) 141 Hz
d) 70 Hz
e) It cannot be determined

__B__A6) Which of the following relationships represents a standing wave?

a) $y(x,t) = \sin(kx - \omega t) + \sin(2kx - 2\omega t)$
b) $y(x,t) = \sin(kx - \omega t) - \cos(kx + \omega t)$
c) $y(x,t) = \sin(\frac{k_1 + k_2}{2}x - \frac{\omega_1 + \omega_2}{2}t) \times \cos(\frac{k_1 - k_2}{2}x - \frac{\omega_1 - \omega_2}{2}t)$
d) $y(x,t) = \sin(kx - \omega t) + \sin(kx - \omega t + \phi)$
e) none of the above

__C__A7) The fundamental resonance frequency of a pipe that is open at both ends is 100 Hz. What is the next higher resonant frequency?

a) 150 Hz
b) 200 Hz
c) 300 Hz
d) 400 Hz
e) 800 Hz

__C__A8) A simple LC circuit consists of an inductor of inductance A and a capacitor of capacitance B and oscillates at frequency f_0. A second identical inductor and capacitor are added in series with the first two devices. What is the new frequency of oscillation of the circuit?

a) $4f_0$ b) $2f_0$ c) f_0 d) $f_0/2$ e) $f_0/4$

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PART B. (8% each)

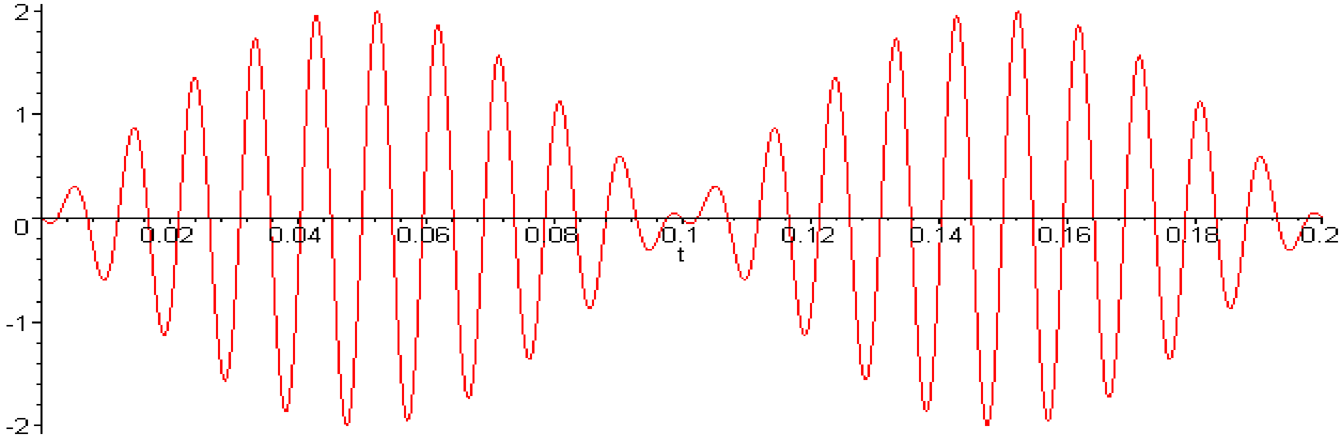
B1) A 10 mH inductor is in a circuit. At a particular moment, the current is 5.0 mA and its rate of change is +200 A/s. Determine the rate at which magnetic energy is changing.

$$U_B = \frac{1}{2} L i^2$$

$$\frac{dU}{dt} = Li\frac{di}{dt} = 10^{-2} \times 5 \times 10^{-3} \times 0.200 \times 10^{3} = 10^{-2}\,\frac{J}{s}$$

Answer_____________units______

B2) An oscilloscope (or LoggerPro system) attached to a microphone picks up the signal shown below from two sources. The abscissa is time in seconds. The ordinate is voltage.



a) What is the average frequency of the two sources?

T_{avg}~0.09s/10=0.009s; f_{avg}=1/T_{avg}=111 Hz (anything with 20% is ok)

Answer 111 Hz_

b) What is the difference in frequency of the two sources?

The period of the beat is 0.2 sec, so difference frequency is 5 Hz. (The system "beats" at twice that frequency because the maximum intensity is heard twice per cycle.)

Answer_____5Hz

B3) A hypothetical banshee emits a scream at 1000 Hz. It flys right by you at a speed of 85 m/s. Assume the speed of sound to be 340 m/s.

a) What is the hypothetical frequency that you hear as it approaches?

$$f = f_0 \frac{v \pm v_D}{v \pm v_S} = 1000\frac{340}{340-85} = \frac{4}{3}1000Hz = 1333Hz$$

b) What is the hypothetical frequency that you hear as it leaves?

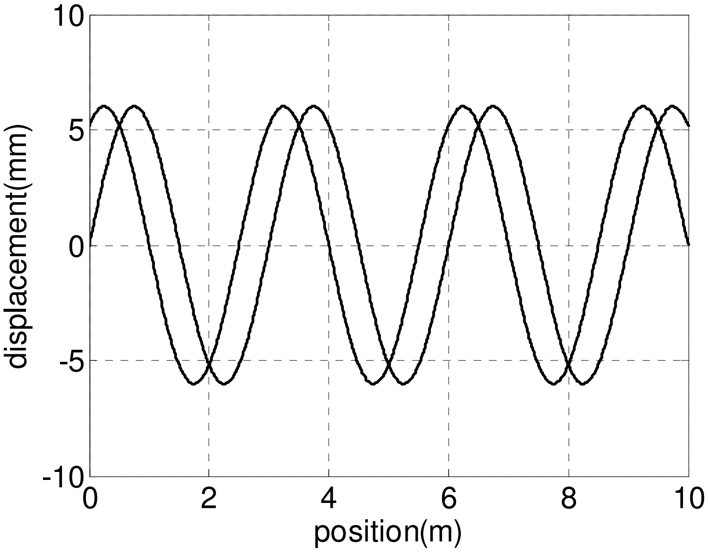
$$f = f_0 \frac{v \pm v_D}{v \pm v_S} = 1000\frac{340}{340+85} = \frac{4}{5}1000Hz = 800Hz$$

NAME ______________________________

Answer_____________units______

PART C. You must show all your work and state your reasoning in order to receive credit.

PART C1) (21%) A wave moves to the <u>left</u> on a string as shown below. The string is 100 m long and has a mass of 200g. (Solid line is at t=2 s. Dashed line is at t=5 s.)



a) What is the velocity of the wave?

<u>0.5 m in 3 sec=0.167m/s or 1/6 m/s</u>

b) What is the wavelength of the wave? **<u>3 m (from the graph directly)</u>**

c) What is the frequency of the wave? **<u>f=v/L=1/18 Hz</u>**

d) What is the tension in the string?

$v = \sqrt{\tau / \mu}$ so $\tau = v^2 \mu$

$\mu = 0.2 \times 10^{-3} kg/m \quad v^2 = 1/36 \frac{m^2}{s^2}$

$\tau = \frac{1}{18} \times 10^{-3} N \cong 2.2 \times 0^{-5} N$

e) What is the smallest x-position at which the transverse velocity of the solid curve has a maximum magnitude?

Answer 0 m (also accept 1.5 m)_

f) What is the smallest x-position at which the transverse velocity of the solid curve is zero?

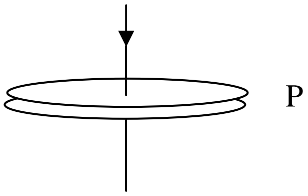
Answer___1 m_

g) What is the smallest x-position at which the magnitude of the transverse acceleration of the solid curve is maximum?

Answer   1 m____

C2) (15%) Current flows into the positive plate of a huge flat circular capacitor of radius 1 m and capacitance 10^{-6} F at the rate of 10^{-6} coulombs per second.

a) (4 %) Which way does the magnetic field outside of the capacitor point at point P?



up	down
right	left
into paper	[✓ out of paper]
none, the field is zero	

b) (11%) Find an expression for the magnetic field as a function of radial distance from the center of the capacitor for r<1m. Assume that the electric field that develops in the capacitor is uniform over the surface and that there are no fringing fields.

$$\oint \vec{B} \bullet d\vec{s} = \mu_0 i_{disp\_enclosed}$$

$$B2\pi r = \mu_0 i_{real\_in} \frac{r^2}{R^2} \quad \Rightarrow \quad B = \frac{\mu_0 i_{in}}{2\pi} \frac{r}{R^2}$$

where i_{in} is the total current flowing into the capacitor

c) Find the numerical value of the magnetic field at a distance of 0.5 m from the center.

$$B = \frac{\mu_0 i_{in}}{2\pi} \frac{r}{R^2} = \frac{4\pi \times 10^{-7} \times 10^{-6}}{2\pi} 0.5 = 10^{-13} T$$