PHYS-1200 PHYSICS II NAME_____
FINAL - A Dec. 14, 2007

Please check the number next to your section below. IF YOU ARE IN THE WRONG ROOM, MOVE TO THE CORRECT ONE IMMEDIATELY.

SECTION NUMBER	**EXAMINATION ROOM**	**INSTRUCTOR**	**Section time**
___1	DCC 318	SCOTT DWYER	MR 8:00 A.M.
___2	DCC 318	SCOTT DWYER	MR 10:00 A.M.
___3	Sage 3303	HEIDI NEWBERG	MR 10:00 A.M.
___4	Sage 3303	JOEL GIEDT	MR 12:00 NOON.
___5	DCC 330	THOMAS SHANNON	MR 12:00 NOON
___6	Sage 3303	ANGEL GARCIA	MR 2:00 P.M.
___7	West Hall	WAYNE ROBERGE	MR 2:00 P.M.
___8	West Hall	GLENN CIOLEK	MR 4:00 PM
___9	DCC 324	KIM LEWIS	TF 10:00 A.M.
___10	DCC 324	KIM LEWIS	TF 12:00 NOON
___11	DCC 330	JOHN SCHROEDER	TF 12:00 NOON.
___12	West Hall	GYORGY KORNISS	TF 2:00 PM

There are 13 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	120%	
PART B	30%	
PART C-1	20%	
PART C-2	20%	
TOTAL	190%	

- You have 180 minutes for this exam. If you are unclear on any question, ask the proctor.
- All work and answers must be given in the spaces provided on these pages.
- You are permitted the both sides of a single 8 ½ x11" sheet for 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.
- To receive credit on parts B and C you must show adequate work to justify your answer. Show your work logically and neatly.
- Ambiguous or illegible answers will be graded incorrect.

A. Multiple choice (4 pts each)

__B_A1) Electric charges A and B are attracted to each other. Electric charges B and C are also attracted to each other. If A and C are held close to one another, they will

A) attract B) repel C) not affect one another
D) more information is needed to answer

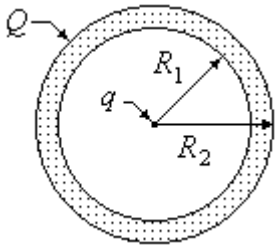
___C_A2) Two identical point charges q are 0.1 m apart. The force between them is 1 N. Which value is closest to the magnitude of q?

A) 1.11×10^{11} C B) 0.95×10^{5} C C) 1.05×10^{-6} C
D) 3.3×10^{-11} C
E) There is not enough information given.

_E__3) A speaker emitting sound at 400 Hz and 100 W is measured to have a sound level of 80 dB when measured at a distance of R. What is the sound level at the same location if the speaker power is decreased by a factor of 10, to 10 W?

A) $1/4R^2$ B) 10 dB C) 81 dB D) 79 dB E) 70 dB

_C__4) A positive charge Q is placed on a hollow conducting sphere of inner radius R_1 and outer radius R_2. A particle with charge q is placed at the center of the cavity in the sphere, as shown in the sketch.



The magnitude of the electric field inside the cavity, at a distance r from the center ($r < R_1$) is:

A. zero B. $\frac{Q}{4\pi\varepsilon_0 R_1^2}$ C. $\frac{q}{4\pi\varepsilon_0 r^2}$ D. $\frac{(q+Q)}{4\pi\varepsilon_0 r^2}$

E. $\frac{(q+Q)}{4\pi\varepsilon_0 (R_1^2 - r^2)}$

_D__5) A battery is used to charge a *series* combination of two identical capacitors. If the potential difference between the terminals of the battery is V, and total charge Q flows through the battery during the charging process, then the charge on the positive plate of each capacitor, and the potential difference across each capacitor are:

A. $Q/2$ and $V/2$, respectively
B. Q and V, respectively
C. $Q/2$ and V, respectively
D. Q and $V/2$, respectively
E. Q and $2V$, respectively

__D_6) A point particle with charge q is at the center of a Gaussian surface in the form of a cube. The electric flux through any one face of the cube is:

A. $\frac{q}{\varepsilon_0}$ B. $\frac{q}{4\varepsilon_0}$ C. $\frac{q}{3\varepsilon_0}$ D. $\frac{q}{6\varepsilon_0}$ E. $\frac{q}{12\varepsilon_0}$

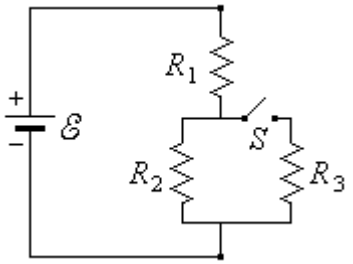
__B_7) The resistance of resistor 1 is twice the resistance of resistor 2. The two are connected in <u>parallel</u> and a potential difference is maintained across the combination. Then:

A. the current in 1 is twice the current in 2
B. the current in 1 is half the current in 2
C. the potential difference across 1 is twice that across 2
D. the potential difference across 1 is half that across 2
E. none of the above is true

__E_8) In an overhead straight wire, the current is north. The magnetic field due to this current, at our point of observation is:

A. east B. up C. north D. down E. west

(Use the diagram below for questions 9 and 10. The diagram shows three resistors, an ideal battery, and an open switch, *S*. The three resistors all have the same resistance.



_A__9) If switch *S* is closed, the current through R_1 will:

A) INCREASE B) DECREASE
C) REMAIN THE SAME D) There is not enough information given

__B_10) If switch *S* is closed, the magnitude of the potential difference across R_2 will:

A) INCREASE B)DECREASE
C) REMAIN THE SAME D) There is not enough information given

_B__11) Energy U_0 is stored on a capacitor by charging it with charge Q_0. What is the energy stored in an identical capacitor that is charged with $2Q_0$?

A) $2U_0$ B) $4U_0$ C) $8U_0$
D) U_0 E) There is not enough information given.

_C__12) A wire 1 km long and 1 mm in diameter has a resistance of 100 ohms. What is the resistance of a similar wire 2 km long and 2 mm in diameter?

A) 100 ohms B) 200 ohms C) 50 ohms
D) 400 ohms E) 25 ohms

_D__13) A particle of mass *m* is confined in a one dimensional box with infinitely high potential walls a distance L_0 apart. The energy of the ground state is E_0. What would be the ground state energy of a particle of mass $2m$ in a box with side $L_0/2$?

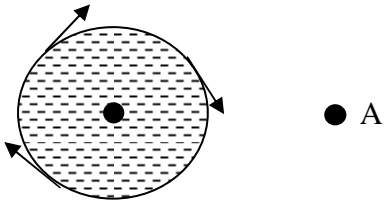
A) $E_0/8$ B) $E_0/2$ C) E_0 D) $2E_0$ E) $8E_0$

__D_14) The speed of a wave on a specific string with linear mass density μ of 0.001 kg/m, tension τ_0, length 100 m, and diameter of 0.1 mm is 10 m/s. What is the value closest to the speed of the wave if the tension is doubled?

A) 7 m/s B) 10 m/s C) 40 m/s D) 14 m/s
E) There is not enough information given.

_C_15) The loop rule $\sum V_i = 0$ for circuits is a direct consequence of
A) Newtons's second law
B) conservation of momentum
C) conservation of energy
D) conservation of charge
E) Ampere's Law

_A__16) The negatively charged disk in the figure below is rotated clockwise. What is the direction of the magnetic field at point A in the plane of the disk?



A) Into the page B) Up the page D) Down the page

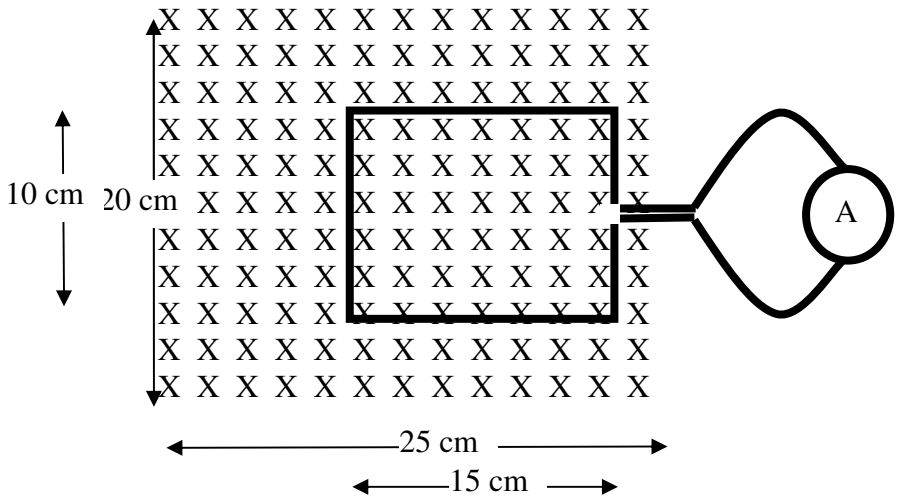
E) Left F) Right

_C__17) Consider a cylindrical solenoid with radius R_0<< length L_0. The magnetic field at the center of the solenoid is B_0. A second solenoid is constructed that has twice the radius, twice the length, and carries twice the current, but has the same number of turns per meter. The magnetic field at the center of the second solenoid is:

A) $B_0/2$ B) B_0 C) $2B_0$

D) $4B_0$ E) Not enough information is given

_A_18) A rectangular coil is placed perpendicular to a uniform magnetic field as shown below. The dimensions for the region of the field and the coil are given in the figure. The field strength drops at a constant rate from 3 T at *t*=0 to 1T at *t*=2 s. The resistance of the wire around the coil is 100 ohms. Which value is closest to the current measured in the ammeter at t=1 s.



A) 1.5×10^{-4} A B) 2.25×10^{-4} A C) 5×10^{-4} A
D) 1.5×10^{-2} A D) There is not enough information given.

_E__19) The magnetic field at a distance of 6m from a long straight wire carrying current *I* is 1T. What is the magnitude of the field if the distance from the wire is doubled and the current is doubled?

A) 1/12 T B) 1/6 T C) ¼ T D) ½ T E) 1T

__B_20) A sound wave in a long thin tube (sealed at both ends) exhibits a fundamental resonance at a frequency of 100 Hz. The length of the tube is closest in length to

A) 3.43 m B) 1.72 m C)1.14 m D) 0.86m

__B_21) 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

A___22) 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) 2*G*

_A__23) The siren on the front end of a fire truck emits at 300 Hz. The truck is moving at 34 m/s. A fireman on the tail end of the truck hears the siren at a pitch closest to: (Assume that the speed of sound is 340 m/s)

A) 300 Hz B) 330 Hz C) 270 Hz D) 343 Hz E) 600 Hz

__C_24) A particle of mass $1x10^{-32}$ kg is confined in a box of with infinite walls at x=+L and x=-L. In the ground state, the kinetic energy of the particle is 1 eV. The left wall is moved from x=-L to x=0, halving the width of the box. The ground state energy of the new box is closest to

A) 1 eV B) 2 eV C) 4 eV D) ½ eV E) ¼ eV

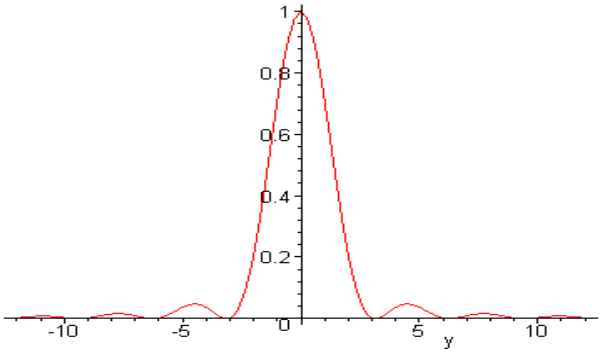
__C_25) When light passes from a low index material to a high index material, the

A) wavelength increases and speed decreases.
B) wavelength decreases and speed increases.
C) wavelength decreases and speed decreases.
D) wavelength decreases and frequency increases.
E) wavelength remains the same and frequency decreases.

__E_26) The intensity pattern for diffraction of light through a single slit of width 100×10^{-6} m is shown below for a screen 1 m distant from the slit. The y axis below is in centimeters. What is the wavelength of the light?

A) 4.5 cm B) 3×10^{-4} m C) 1×10^{-4}m

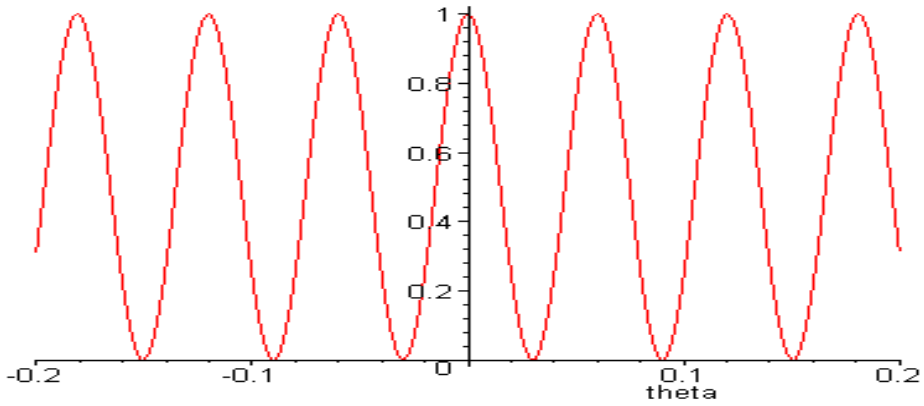
D) 4.5×10^{-6}m E) 3×10^{-6}m f) None of the others.



_B__27) The intensity pattern for interference of light of wavelength 600 nm passing through a pair of narrow double slits is plotted as a function of angle θ in radians. What is the spacing between the slits?

A) 20,000 nm B) 10,000 nm C) 1000 nm

D) 600 nm E) 100 nm



__D_28) A proton is traveling at speed $v_1 << c$ and has a deBroglie wavelength of 0.1 nm. If the speed were increased to $2v_1$, the new wavelength would be closest to:

A) 0.2 nm B) 0.14 nm C) 0.1 nm D) 0.05 nm E) 0.28 nm

__B_29) Two electromagnetic waves have the same electric field amplitude of 1 V/m along the x-axis. They arrive at point P out of phase by $\frac{\pi}{2}$ radians. What is the amplitude of the resultant of the two waves?

A) 2 V/m B) 1.4 V/m C) 1 V/m D) 4 V/m E) zero V/m

__D_30) A particle with energy $E=U_0/2$ is incident on a potential barrier of height U_0 and thickness L. The probability of transmission through the barrier T_0 is much less than one. If the barrier thickness is doubled, with its height and the particle energy remaining unchanged, the new transmission coefficient is closest to:

A) $4T_0$ B) $2T_0$ C) T_0 D)$T_0/4$ E) zero

PART B - (30 pts) Short problems - For full credit you must show equations, or a sketch, or otherwise explain your logic.

B1) (12 pts) Two resistors of resistance R_1=10 ohms and R_2=20 ohms are wired in series with a 5V battery.

a) Sketch the circuit.

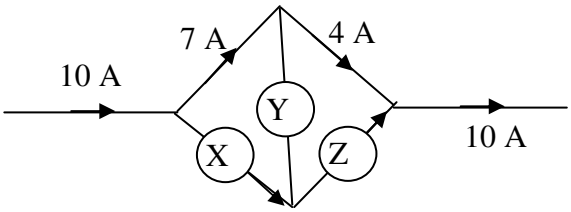
b) Determine the current through resistor R_1.

Total resistance is 30 ohms. I=V/R=1/6 A.

c) Determine the voltage across resistor R_1.

$V_1=IR_1=2V$

B2) (6 pts) The figure below shows a network of wires carrying various currents as shown. What is the current through X, Y, and Z?



X___3A_____

Y___3A_____

Z___6A_____

B3) (6 pts) A voltage of 120 V is applied across a heater. The resistance of the heater is 12 ohms. The diameter of the heater wire is 0.5 mm, its length is 100 m, and it is wound into a coil of 2 cm diameter with 100 turns per meter. What is the current through the heater?

I=120/12=10A

I=_____

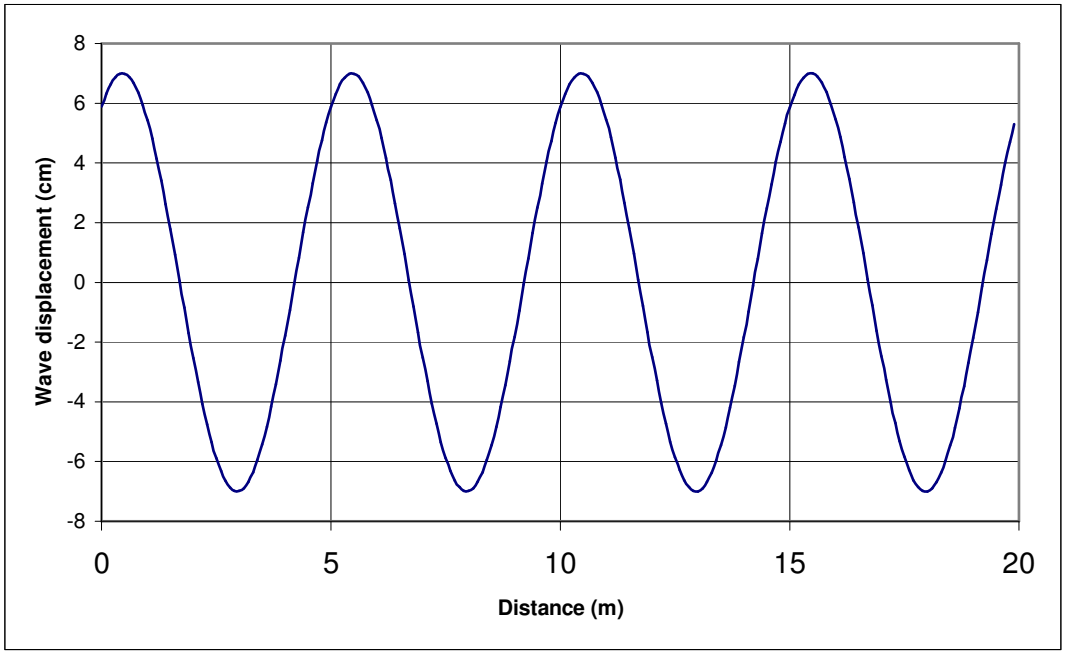
B4) (6 pts) A 10 mH inductor is in a circuit. At a particular moment, the current is 5.0 mA and its rate of change is +200 A/s. Determine the rate at which magnetic energy is changing.

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

$$\frac{dU}{dt} = Li\frac{di}{dt} = 10\times10^{-3}\times5\times10^{-3}\times0.200\times10^{3} = 10\times10^{-3}\,\frac{J}{s}$$

$$\frac{dU_B}{dt} = \_\_\_\_\_$$

C1) (20 pts) A wave on a string travels in the negative x direction at a speed of 2 m/s and can be represented by the graph below.



a) What is the amplitude of this wave (include units)?

amplitude ___7 cm_____

b) What is the wavelength of this wave (include units)?

wavelength __5 m_____

c) What is the frequency of this wave (include units)?

f=velocity/wavelength=2/5 Hz

frequency ___2/5 Hz_____

d) Express this wave using the form: $y = y_{\max} \sin\left(\frac{2\pi x}{\lambda} \pm \frac{2\pi t}{T}\right)$. (Choose the proper sign and units in addition to putting in the numbers.)

__ $y = 7cm \times \sin\left(\frac{2\pi x}{5m} + \frac{2\pi t}{5/2s}\right)$

e) This wave propagates along a string with mass density $0.01\ \text{kg/m}$. What is the tension in the string (include units)?

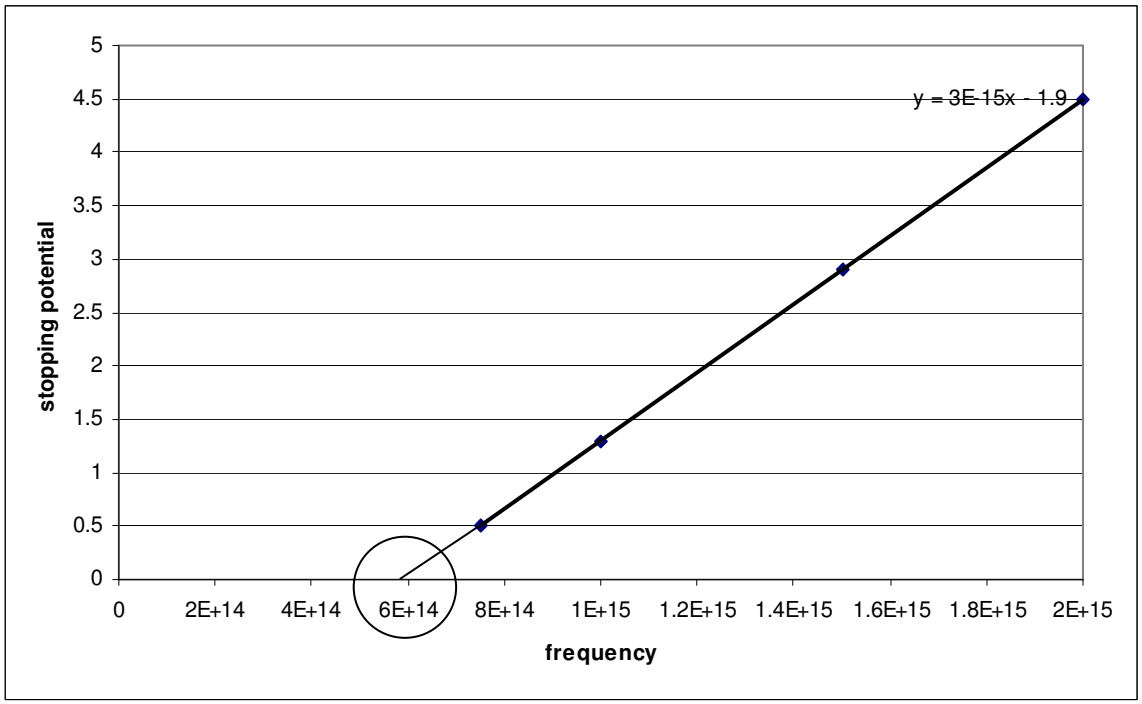
$v = \sqrt{\frac{\tau}{\mu}} \Rightarrow \quad \tau = \mu v^2 = 0.01 \times 2^2 = 0.04N$

tension _____

C-2) (20 pts) A photoelectric effect measurement is carried out on an unknown metal. The results are shown below

wavelength (nm)	150	200	300	400
stopping potential (V)	4.5	2.9	1.3	0.5
frequency (Hz)				

a) (4 %) Fill in the frequencies in the table above.
b) (4%) Plot the stopping potential against frequency below.



c) (4%) Circle the cutoff frequency on your plot. Estimate the cutoff frequency of the material in Hz.

f_c=___5.8e15_Hz

d) (8%) Estimate Planck's constant from your plot. (It is not equal to the textbook value.)

From the slope: h=3e-15 eV-s=4.8e-34 J-s