Physics 116b

Second Practice Examination October 2002

Name: $\underline{PleaseUseWebAssign}$

Please circle your section:

Section 1 Section 2 Section 3 Section 4

Instructions

This is a one hour, closed book examination. Put answers in the boxes provided, or circle the best answer. If numerical answers are needed, you must include units. If required, any work needed to justify the answer must be shown in the space provided. A correct answer without the necessary justifying work may not receive any credit. You may use the formula sheet on the back of the exam.

Total point scores for each problem will appear in the table below and in ( ) beside each problem number. Do what is easiest first. AVOID glancing at anyone else's paper during the exam! The honor code is in effect.

Point Tallies for the Exam Problems

Problem	Description	Max Score	Actual Score
1	Short Answer	25	
2	Momentum	10	
2	Pendulum	15	
3	Total		

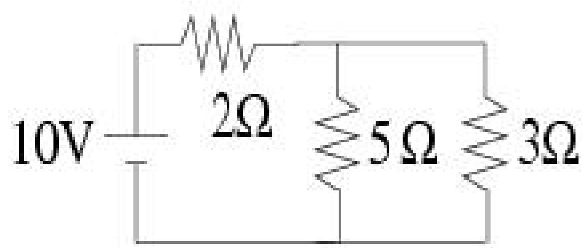
(Problem 1: Circle the Correct Response, or Make a Sketch):
(Showing your work can get you partial credit!)

a) What is the *resistance* of a copper wire of length 2.0 m, *diameter* 1.0 mm and resistivity $1.69 \times 10^{-8}\ \Omega \cdot m$? (2 pts.)

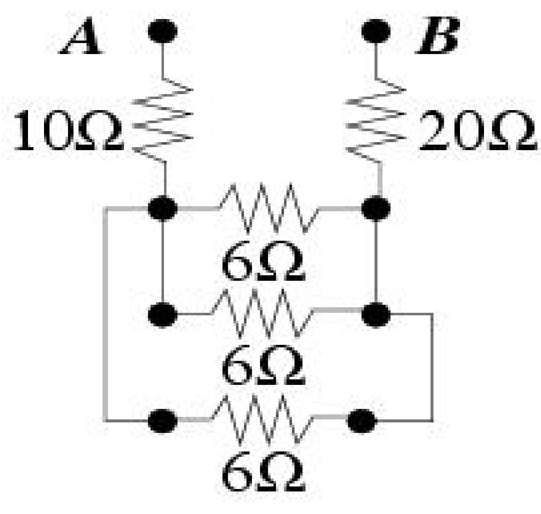
I) 0.011 Ω
II) 0.043 Ω
III) $3.4 \times 10^{-8}\ \Omega$
IV) 90.9 Ω
V) 23.3 Ω

b) How much current passes through the 3 Ω resistor? (3 pts.)

I) 0.77 A
II) 1.0 A
III) 1.6 A
IV) 2.6 A
V) 3.2 A



c) Calculate the resistance between points A and B.(2 pts.)



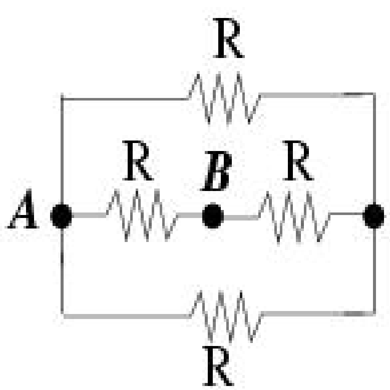
I) 1.5 Ω
II) 48 Ω
III) 25 Ω
IV) 39 Ω
V) 32 Ω

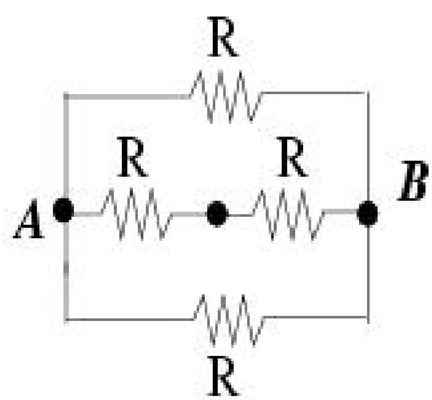
(Circle the Correct Response, or Make a Sketch):

d) The wire in a) (an 18 Gauge copper wire) is being used in a circuit where it has to carry 3A (the rated maximum). How much power is being used just to send the 3A current through the wire? (2 pts.)

I) $3.1 \times 10^{-6}\ W$
II) $0.033\ W$
III) $0.10\ W$
IV) $0.13\ W$
V) $0.39\ W$

e) Circle the system of resistors that has the *Lowest* resistance between points A and B.(2 pts)



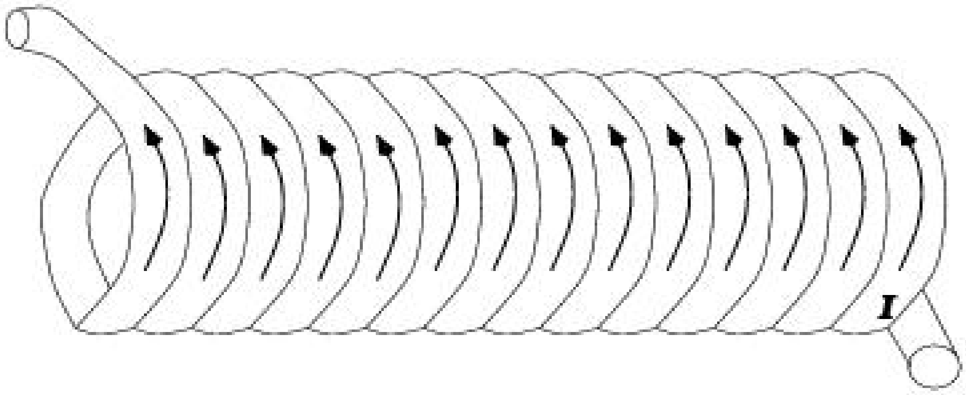


f) A circuit contains an unknown resistor and a charged 1.0 micro-Farad capacitor. If the voltage across the 1.0 micro-Farad capacitor decreases from 3.0 V at t=0 to 1.0 V at t = 10.0 s when a switch is closed, how much current is flowing through the resistor at t = 10.0 s? (2 pts)

I) $0.11\ \mu A$
II) $0.10\ \mu A$
III) $0.091\ \mu A$
IV) $0.91\ \mu A$
V) $1.0\ \mu A$

(Circle the Correct Response, or Make a Sketch):

g) Sketch the magnetic field inside the solenoid carrying a current I as shown in the figure below.(2 pts)



h) A magnetic field of 0.040 T lies along the z axis. A particle with charge 1.3×10^{-9} C, velocity 250 m/s along the x axis, and 300 m/s along the y axis moves through this magnetic field. What is the magnitude of the force on this particle due to the magnetic field? (2 pts)

I) 29×10^{-9} N
II) 20×10^{-9} N
III) 13×10^{-9} N
IV) 16×10^{-9} N
V) 2.6×10^{-9} N

i) A particular proton is in a 0.5 m circular orbit when in a magnetic field of 0.30 T. What is the kinetic energy of this proton? (2 pts)

I) 8.3×10^{19} J
II) 5.8×10^{-40} J
III) 1.2×10^{-20} J
IV) 2.4×10^{-20} J
V) 1.7×10^{-13} J

(Circle the Correct Response, or Make a Sketch):

j) At what point (radius) is the magnetic field from a 4 mm diameter wire carrying a current of 5.0 A about the same magnitude as the magnetic field of the earth (as measured here at Vanderbilt)? (2 pts)

I) $r = 2\ cm$
II) $r = 0.2\ mm$
III) $r = 20\ cm$
IV) $r = 2\ mm$
V) $r = 2\ m$

k) Indicate *clearly* the direction of a magnetic field that creates a force up (and ONLY up) on the wire carrying current as shown below. Is there more than one direction you could have used? (2 pts)

l) What is the magnetic field at the center of the coils of a Toroid with inner radius 0.25 m, outer radius 0.75m, and 5000 turns of wire that carries 2.0 A?(2 pts)

I) 4.0 T
II) 8.0 mT
III) 2.7 mT
IV) 1.4 mT
V) 0.0 mT

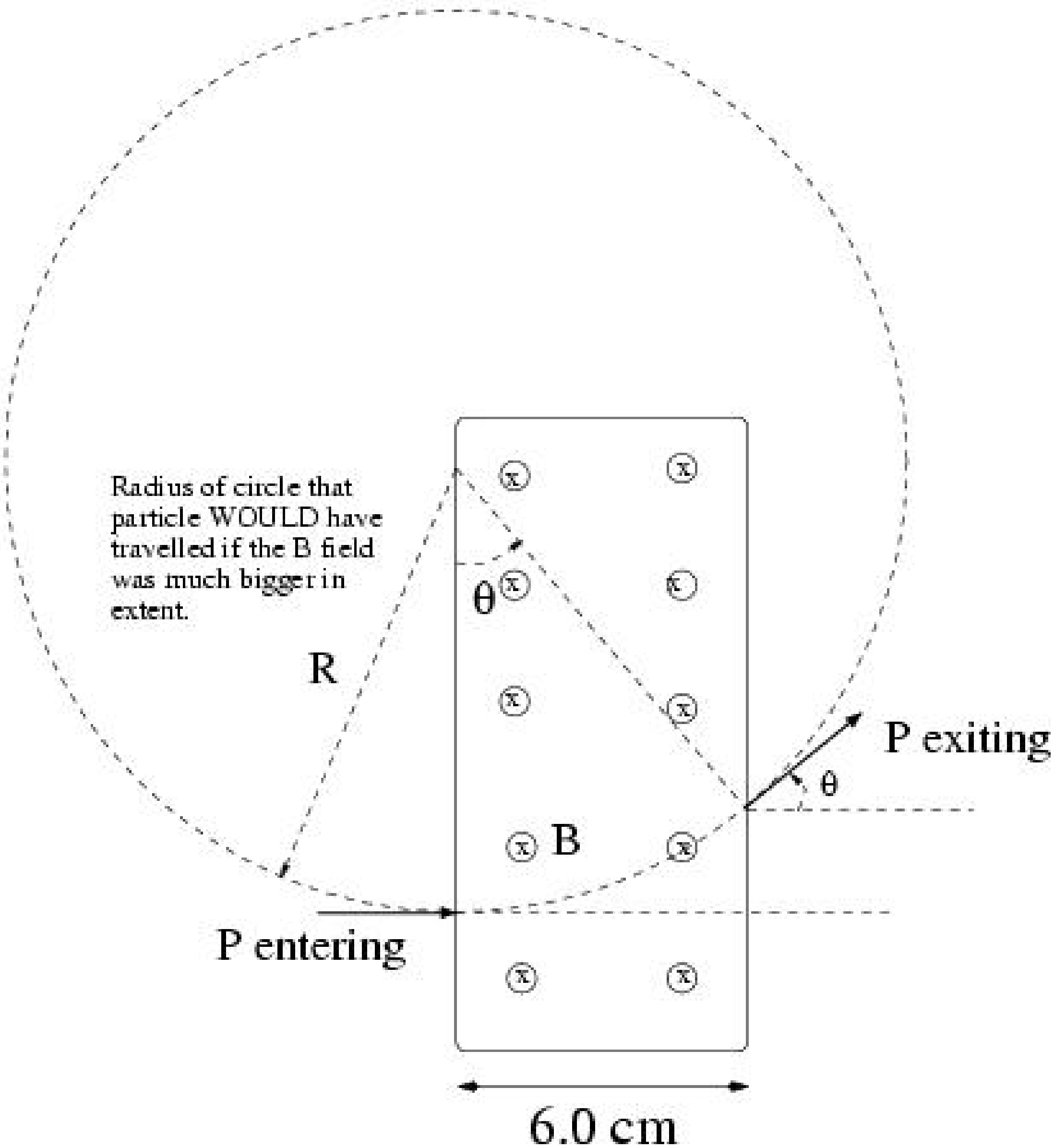
2. Momentum Measurement (10 points)

You are using part of a magnetic field to measure the momentum of a charged particle. You know the initial and final DIRECTIONS of the particle's momentum, the charge of the particle, and the extent and the strength of the magnetic field. Find the momentum of the particle for the situation in the diagram below.

$\theta = 30$ degrees

$B = 0.10$ T

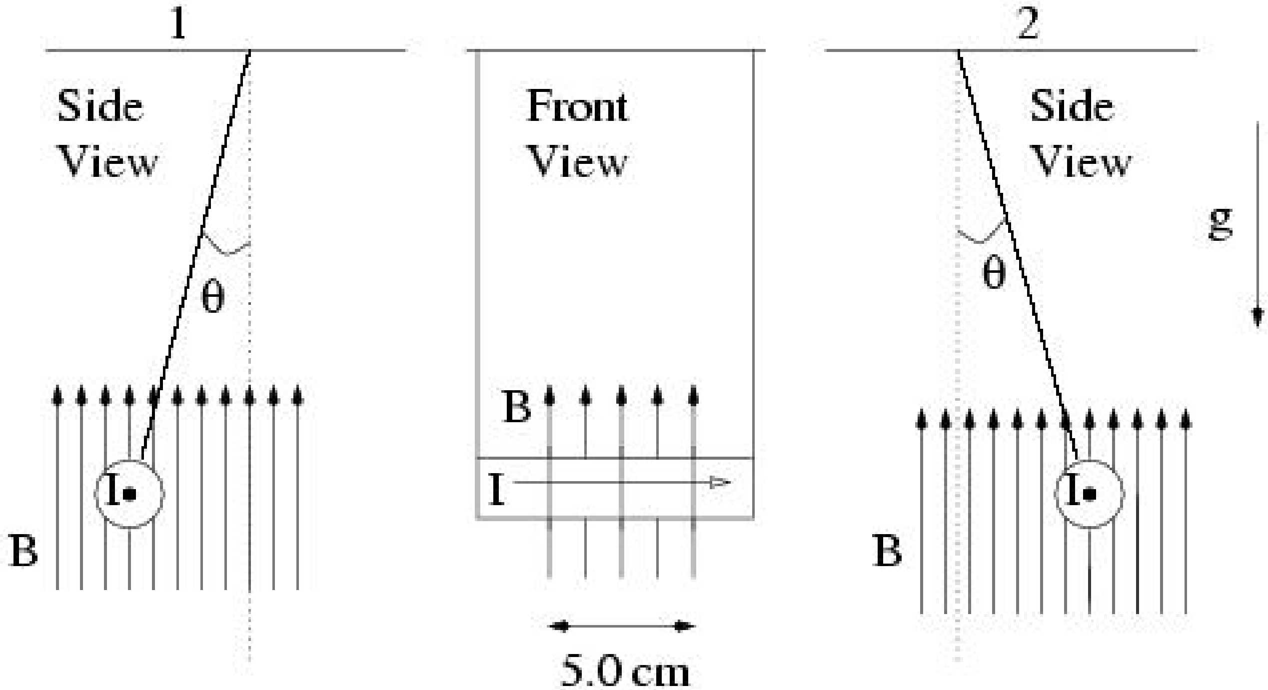
$q = 1.6 \times 10^{-19}$ C



P=

3. Pendulum (15 points)

A pendulum consists of a wire suspended in a magnetic field. The magnetic field exists in the direction shown (up) over a 5.0 cm length of the wire. If gravity acts down as shown, which diagram is more correct (1 or 2) ? (5 pts.)



If B = 0.01T, and the mass of the wire is 40 grams, what is the angle at which the pendulum hangs when 1.0 A flows in the wire? (10 pts)

(Treat the support wires as being massless)

Equations

$$I = \frac{dq}{dt}, \quad I = \int \vec{J} \cdot d\vec{A}, \quad V = IR, \quad R = \frac{\rho l}{A}, \quad \rho = \frac{1}{\sigma}$$

$$\rho - \rho_0 = \rho_0 \alpha (T - T_0), \quad \rho = \frac{m}{e^2 n \tau}, \quad P = IV$$

$$R = R_1 + R_2 + R_3 \ldots \ , \quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

$$(charging) \quad Q = Q_0(1 - e^{-\frac{t}{RC}}), \quad \tau = RC, \quad CV = Q, \quad I = \frac{V}{R} e^{-\frac{t}{RC}}$$

$$(discharging) \quad Q = Q_0 e^{-\frac{t}{RC}}, \quad I = -\frac{Q_0}{RC} e^{-\frac{t}{RC}}, \quad KE = \frac{1}{2} m v^2$$

$$\vec{F} = q\vec{v} \times \vec{B}, \quad n = \frac{BI}{Vle}, \quad qvB = \frac{mv^2}{r}, \quad \omega = 2\pi f, \quad \omega = \frac{v}{r}$$

$$\vec{F} = I\vec{l} \times \vec{B}, \quad d\vec{F} = Id\vec{l} \times \vec{B}, \quad \vec{\tau} = \vec{\mu} \times \vec{B}, \quad \vec{\tau} = \vec{r} \times \vec{F}$$

$$d\vec{B} = \left(\frac{\mu_0}{4\pi}\right) \frac{Id\vec{l} \times \vec{r}}{r^3} = \left(\frac{\mu_0}{4\pi}\right) \frac{Id\vec{l} \times \hat{r}}{r^2}, \quad \oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enclosed}$$

$$B = \frac{\mu_0 I}{2\pi r} \quad (infinite\ wire)$$

$$B = \frac{\mu_0 I \phi}{4\pi R} \quad (center\ of\ circular\ arc\ of\ angle = \phi)$$

$$B = \frac{\mu_0 I}{2R} \quad (center\ of\ whole\ loop)$$

$$B = \mu_0 n I \quad (solenoid)$$

$$B = \frac{\mu_0 N I}{2\pi r} \quad (toroid)$$

Constants

$\mu_0 = 4\pi \times 10^{-7} \ \frac{Tm}{A}$

$\epsilon_0 = 8.85 \times 10^{-12} \ \frac{C^2}{Nm^2}$

$e = 1.60 \times 10^{-19} \ C$

$M_{proton} = 1.67 \times 10^{-27} \ kg$