Purdue University
PHYS221
EXAM I
September 30,2003

Please use a #2 pencil to fill in data for name, student ID #, and section on
the computer sheet. Mark the correct answer for each problem on the same
sheet. There will by no penalty for wrong answers. Please check to see that
your exam has all 16 problems. All useful basic equations and constants are
provided. Note that you will not need all of the equations and constants
provided to do this exam.

(1) A portable compact disc player is designed to play for 2.0 h on a fully charged battery pack. If the battery pack provides a total of 180 C of charge, how much current does the player use in operating? (5 points)

a) 90 A
b) 1.33 A
c) 0.025 A *
d) 0.0025 A
e) None of the above

(2) A beam of protons is moving toward a target in a particle accelerator. This beam constitutes a current whose value is 0.50 μA. How many protons strike the target in 15 seconds? (5 points)

a) 4.7×10^{13} *
b) 1.6×10^{-19}
c) 5.3×10^{-25}
d) 4.7×10^{12}
e) none of the above

Questions 3 through 5 refer to the statement and figure below:
The sketch below shows cross sections of equipotential surfaces between
two charged conductors that are shown in solid black. Various points on the
equipotential surfaces near the conductors are labeled A, B, C, ..., I.
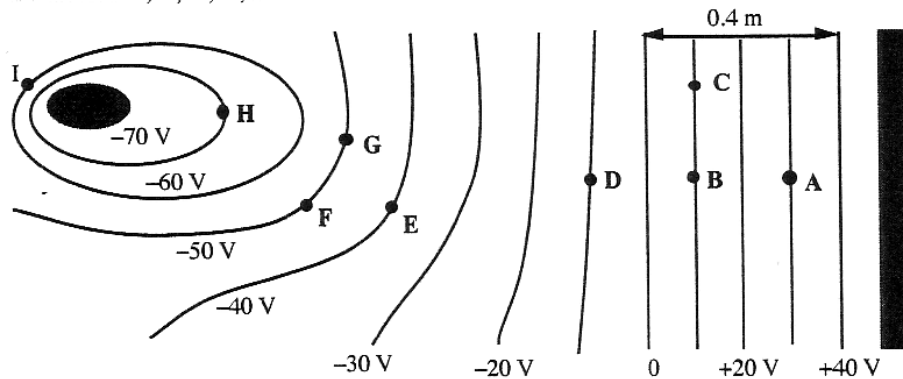
(3) At which of the labeled points will an electron have the greatest
potential of energy? (5 points)

a) A	c) G	e) I
b) D	d) H *	

(4) What is the potential difference between points B and E? (5 points)

a) 10 V	c) 40 V	e) 60 V
b) 30 V	d) 50 V *	

(5) What is the direction of the electric field at B? (5 points)

a) toward A	c) toward C	e) up and out of the page
b) toward D *	d) into the page	

(6) A 14-Ω coffee maker and a 16-Ω frying pan are connected in series across a 120-V outlet. A 23-Ω bread maker is also connected across the 120-V outlet and is in parallel with the series combination. Find the total current supplied by the outlet.
(10 points)

a) 9.2 A *
b) 0.9 A
c) 0 A
d) 18.4 A
e) none of the above

(7) Two charged particles move in the same direction with respect to the same magnetic field. Particle 1 travels three times faster than particle 2. However, each particle experiences a magnetic force of the same magnitude. Find the ratio q_1/q_2 of the magnitudes of the charges.(5 points)

a) 3
b) 1/3 *
c) 9
d) 1/9
e) none of the above

(8) Each chamber in the figure below has unique magnetic field. A particles with charge +25 mC and mass of 10^{-10} kg enters the right chamber where B = 1.0 T directed into the page, with a velocity of 75 m/s. At what velocity does it leave the second chamber? The magnetic field in the second chamber is 0.5T directed out of the page.? (5 points)

(a) 37.5 m/s
(b) 150 m/s
(c) 75 m/s *
(d) 5625 m/s
(e) the size of the chambers and location of the entrance and exit have not been given and so there is insufficient information to solve this problem
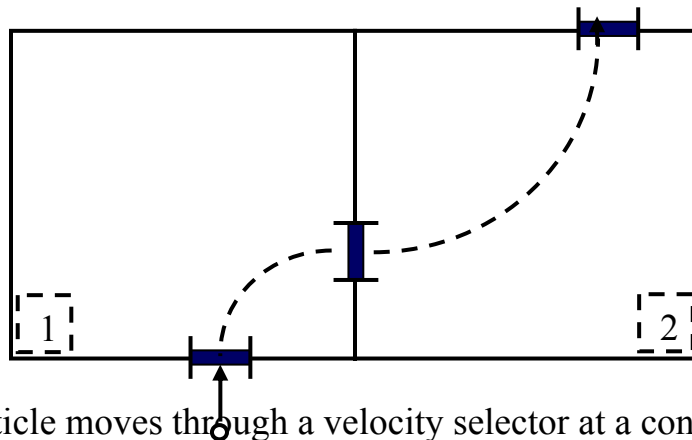

(9) A charged particle moves through a velocity selector at a constant speed in a straight line. The electric field of the velocity selector is 3.80×10^3 N/C, while the magnetic field is 0.360 T. When the electric field is turned off, the charged particle travels on a circular path whose radius is 4.30 cm. Find the charge-to-mass ratio of the particle.(10 points)

a) 1.5×10^{-6} C/kg
b) 4.1×10^7 C/kg
c) 6.8×10^5 C/kg *

d) 2.5×10^5C/kg
e) none of the above

(10) The picture below shows the trajectories of particles produced in a particle physics experiment. The particles are moving from the center of the picture outward to the edges of the picture. There is a magnetic field present directed into the page. What are the signs on the charges of particles A and B? (5 points)
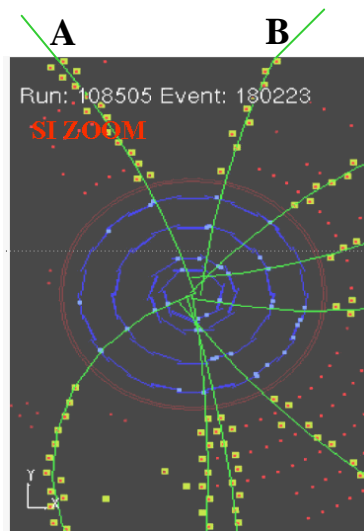
(a) + +   (b) + - *   (c) - +   (d) - -   (e) 0 0

(11) A Gaussian surface completely surrounds a $+2.0 \times 10^{-6}$ C charge. Which of the following Gaussian surfaces has the largest electric flux? (5 points)

a) The surface of a sphere centered on the charge with radius 0.25 m
b) The surface of a sphere centered on the charge with radius 0.50 m
c) The surface of a sphere centered on the charge with radius 0.75 m
d) The surface of a sphere centered on the charge with radius 1.0 m
e) The electric flux is the same for all four Gaussian surfaces. *

(12) The electronic flash attachment for a camera contains a capacitor for storing the energy used to produce the flash. In one unit the potential difference between the plates of a 750 μF capacitor is 330V. How much energy is used to produce the flash in this unit? (10 points)

a) 82 J
b) 0.12 J
c) 0.06
d) 41 J *
e) none of the above

(13) A conducting hollow metal sphere of radius 5 cm has a charge of +6 μC placed upon it. What is the electric field at the center of the sphere? (5 points)

a) 0 N/C *
b) 1.2 x 10 $^{-4}$ N/C
c) 8.33 x 10 ^{3} N/C
d) 2.4 x 10 $^{-3}$ N/C
e) 416.7 N/C

(14) An electron traveling horizontally enters a region where a uniform electric field is directed upward. What is the direction of the force exerted on the electron once it has entered the field? (5 points)

a) to the left
b) to the right
c) upward
d) downward *
e) out of the page, toward the reader

electron
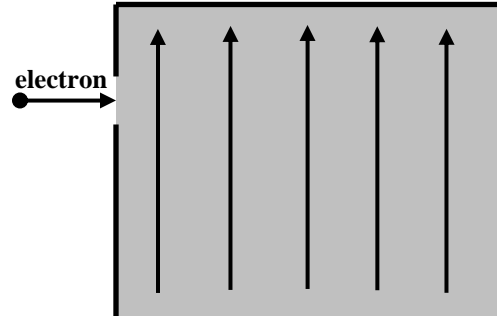
(15) The drawing below shows five possibilities for the potential at two points, A and B. In each case the same positive charge of +3 µC is moved from A to B. In which case is the most work done?(10 points)

A	B	A	B	A	B	A	B	A	B
●	●	●	●	●	●	●	●	●	●
150V	100V	25 V	-25 V	-10V	-60V	200V	150V	-20V	-80V
case a		case b		case c		case d		case e	

(a) case a
(b) case b
(c) case c
(d) case d
(e) case e *

(16) You are given three 3 Ω resistors. By using all three resistors first arrange them so that they have the largest total resistance possible. Second arrange them so that they have the smallest resistance possible.   How many times larger is the resistance in the first arrangement than the second arrangement? (5 points)

(a) 3
(b) 9 *
(c) 1 (equal)
(d) 27
(e) none of the above