Physics 4B Name: _____
Cascarano 5/3/06

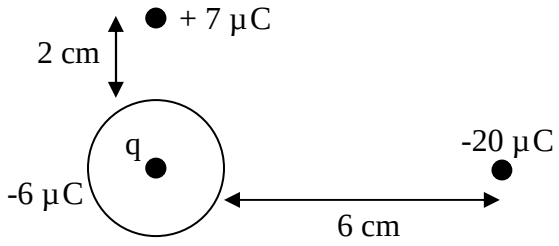
Midterm Exam #1

1) Closed book and notes, except for the supplied formula sheet
2) You may use a scientific calculator
3) Please ask me if anything is unclear and let me know right away if you see a typo

Problem	Points Possible	Your Score
1	5	
2	5	
3	12	
4	23	
5	20	
6	15	
Total	80	
Percentage	100	

Problem 1 (5 points)

The drawing shows a charge (q = -5 µC) at the center of a conducting spherical shell of radius 2 cm and total charge -6 µC. Two other charges are also part of the system. What is the net force on the -5 µC charge?



Problem 2 (5 points)

A (positively or negatively) charged rod is brought up to the same distance from each set of metal spheres as shown in the separate situations below. The spheres in each pair are initially in contact, but they are separated while the rod is still in place. Then the rod is removed.

Rank the net charge on each sphere from most positive to the most negative after the spheres have been separated and the charged rod removed.

Most positive: _____

_____

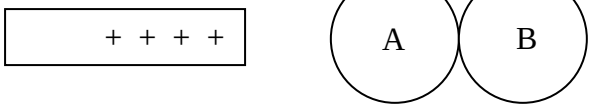
_____

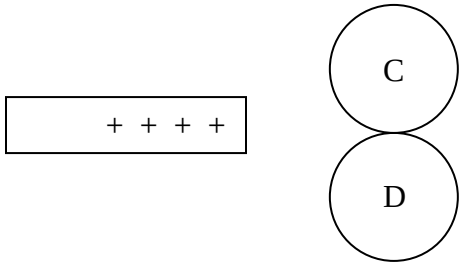
_____

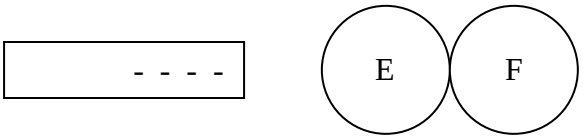
_____

Most negative: _____

(If there is a tie place both spheres on the same line)

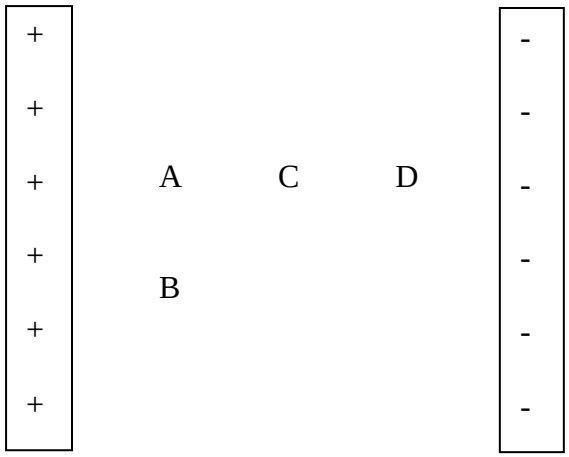






Problem 3 (12 points)

Two parallel plates have been charged to create a uniform electric field between the two plates. Rank the electric potential differences of the different combinations listed from greatest to least (negative values are less than positive values)



Condition	Initial position	Final position
1	A	B
2	B	C
3	A	C
4	C	A
5	A	D

a) Which condition(s) has the greatest positive potential difference: _____

b) Which condition(s) has the greatest negative potential difference: _____

c) Which condition(s) has zero potential difference: _____

d) In which condition(s) does the field do positive work in moving a negative particle from the initial position to the final position: _____

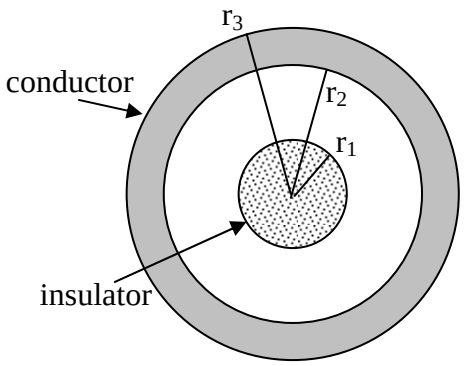
Problem 4 (23 points)

An insulating sphere (radius r_1) has a net charge of +Q uniformly distributed throughout its volume. It is surrounded by a concentric, conducting spherical shell of inner radius r_2 and outer radius r_3 which carries a net charge of -3Q.

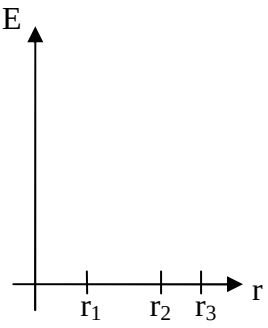
a) What is the charge on the inner surface of the spherical shell (at r_2)?

b) What is the charge on the outer surface of the spherical shell (at r_3)?

c) Find the electric field (magnitude and direction) as a function of r for $r<r_1$



d) Find the electric field as a function of r for $r_1<r<r_2$



e) Find the electric field as a function of r for $r_2<r<r_3$

f) Find the electric field as a function of r for $r_3<r$

g) Plot the magnitude of the electric field verses r on the graph provided

Problem 5 (20 points)

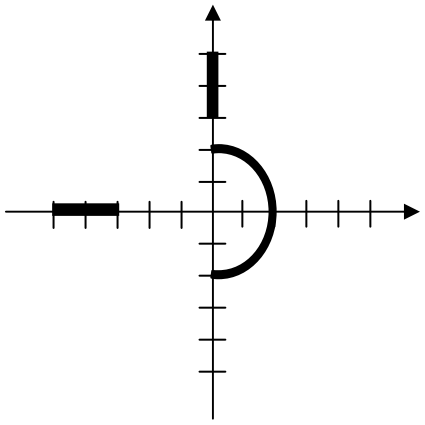
Three wires are shown.

Wire 1 is a straight wire that lies on the x-axis in the region x = -5 m to –3 m and carries charge -Q uniformly distributed over its length

Wire 2 is a semi-circle that is centered on the origin and has radius 2 m and carries charge +Q uniformly distributed over its length

Wire 3 is a straight wire that lies on the y-axis in the region y = 3 m to 5 m and carries charge -Q uniformly distributed over its length

Find the electric potential at the origin.



Problem 6 (15 points)

A proton starts from the midpoint of the capacitor, shown below, with an initial speed of 200,000 m/s toward the positive plate. The potentials of the plates are given in the drawing. What is the proton's speed when it collides with the plate of the capacitor and which plate does it collide with?