Physics 2B Name: _____
Cascarano 3/1/06

Midterm Exam #2

1) Closed book and notes, except for one 3" x 5" card (both sides ok)
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

Constants:

$\varepsilon_o = 8.85 \times 10^{-12}\ C^2/Nm^2$
$k = 8.99 \times 10^{9}\ Nm^2/C^2$
$q_{electron} = -1.6 \times 10^{-19}\ C$
$m_{electron} = 9.11 \times 10^{-31}\ kg$
$m_{proton} = 1.67 \times 10^{-27}\ kg$
Volume of a sphere: $V = \frac{4}{3}\pi r^3$
Surface area of a sphere: $A = 4\pi r^2$

Problem	Points Possible	Your Score
1	15	
2	10	
3	10	
4	15	
5	18	
6	12	
Total	80	
Percentage	100	

Problem #1 (13 points)

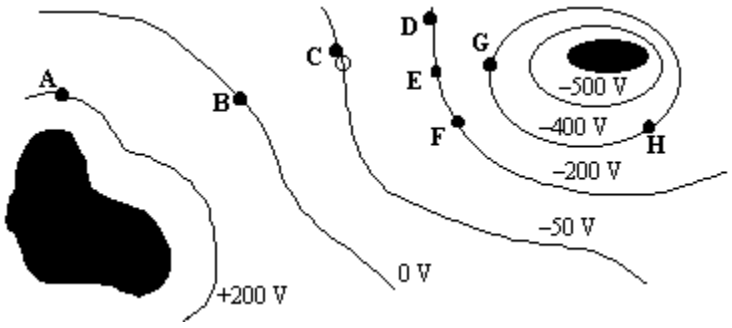
A parallel plate capacitor is charged to 48 V by a battery. The battery is disconnected, but the charge of 9.6×10^{-5} C remains on the plates. A dielectric is then inserted between the plates ($\kappa = 3.5$).

a) What is the new capacitance?

b) What is the potential difference between the plates?

c) What happens to the electric field between the plates (increases, decreases, or remains the same) and why?

d) The sketch shows cross sections of equipotential surfaces between two charged conductors (shown in solid black). Points on the equipotential surfaces near the conductors are labeled **A**, **B**, **C**, ..., **H**.



What is the direction of the electric field at point **E** (draw an arrow at point E indicating the direction)?

Problem #2 (10 points)

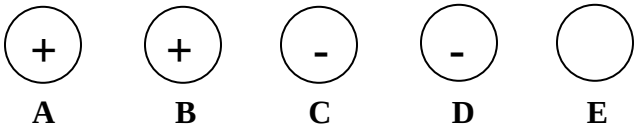
The intensity of a lightbulb is proportional to the power it uses. The following light bulbs are rated at 120 V and have the following power ratings:
bulb A is 60 W at 120 V
bulb B is 100 W at 120 V

a) If the two bulbs are connected in series, which burns with more intensity (which consumes more power)?

b) If the two are connected in parallel, which burns with more intensity (which consumes more power)?

Problem #3 (10 points)

a) Five conducting spheres are charged as shown:
A and B are positively charged, C and D are negatively charged, and E is neutral.



What happens to each pair when they are brought near each other, but well away from any other charges?

Pair	Result (circle one)		
A – B	Attracted	Repelled	No force is observed
A – C	Attracted	Repelled	No force is observed
A – E	Attracted	Repelled	No force is observed
C – D	Attracted	Repelled	No force is observed
C – E	Attracted	Repelled	No force is observed

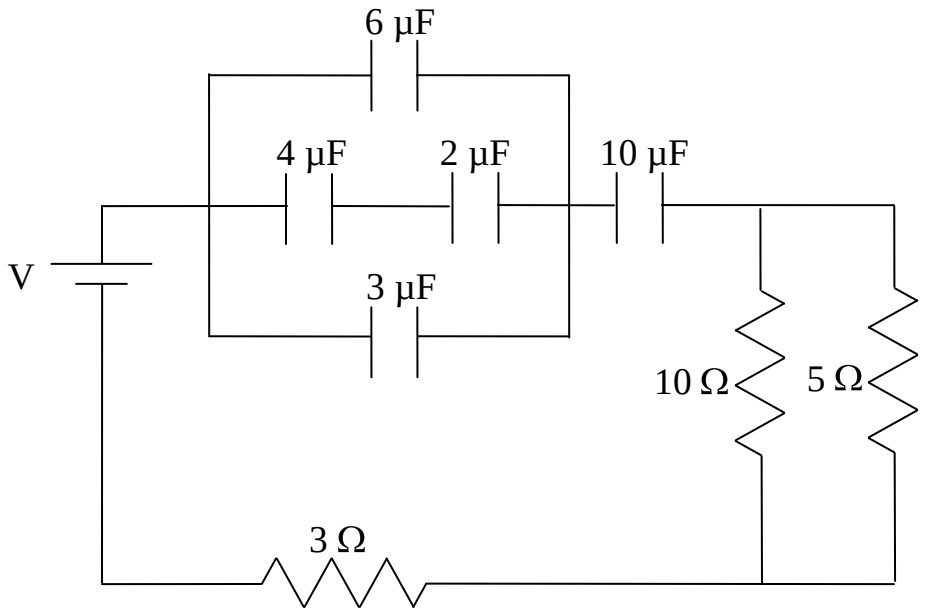
b) A positively charged rod is brought near two uncharged, conducting spheres that are touching each other (picture a). The spheres are moved apart and then the charged rod is removed (picture b).

After the spheres are separated (picture b):
What is the sign of the net charge on sphere A?

Compared to the charge on sphere A, how much charge is on sphere B and what is its sign?

Problem #4 (15 points)

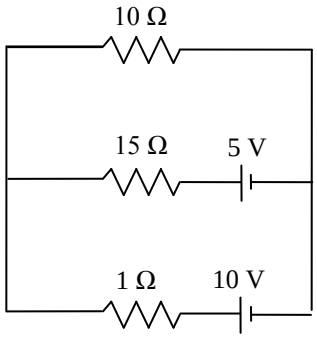
a) Reduce the following circuit down to one equivalent resistor and one equivalent capacitor.



b) What is the time constant of the above circuit?

Problem #5 (18 points)

In the circuit shown, find the current in the 1 Ω resistor. Specify the direction of the current.



Problem #6 (12 points)

Two identical point charges (+5 μC) are fixed to corners of a square as shown. The square has sides of length 0.4 m. One charge is released, but constrained to move along the edges of the square. Find the work done by the field as this charge moves to an empty corner of the square.