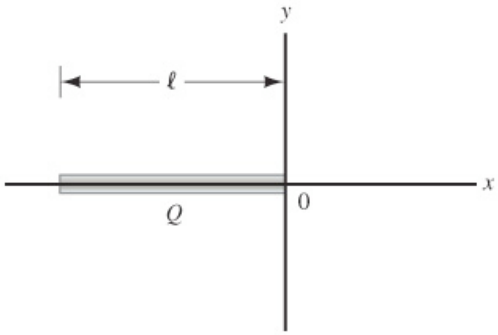
University of California, Berkeley
Physics 7B, Fall 2008 (*Xiaosheng Huang*)

**Midterm 2**
Monday, 11/3/2007
6:30-8:30 PM

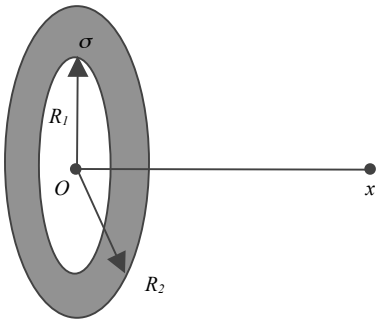
Name:_____ D/L Section:_____

 1) (20 pts.) A thin rod of length *l* carries a total charge *Q* distributed uniformly along its length. Determine the electric field along the axis of the rod starting at one end. That is, find **E**(*x*) for $x \geq 0$ in the figure below, both its direction and magnitude.




Answer:

 2) (20 pts.) A flat ring of inner radius $R_1$ and outer radius $R_2$ (see the figure below) carries a uniform surface charge density $\sigma$.



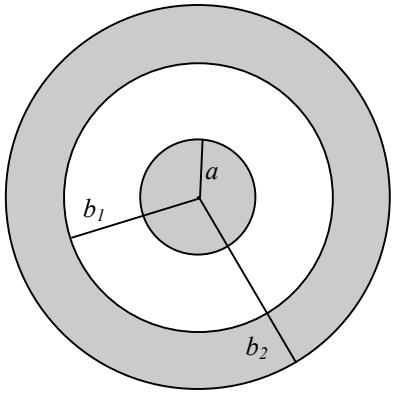

*a*) Find the electric potential along the axis (the *x* axis), assuming the electric potential at infinity is zero.

Answer:

*b*) Find the magnitude and the direction of the electric field along the axis by using the relationship between the electric potential and the electric field.

Answer:

3) (25 pts.) A capacitor consists of two concentric spherically-shaped conductors. The smaller one has radius $a$, and the larger one has inner radius $b_1$ and outer radius $b_2$.




If we put $-q_1$ on the smaller conductor and $+q_2$ on the larger one, assuming $q_2>q_1>0$, find the electric field (magnitude and direction) for
*a*) $r<a$;

Answer:

*b*) $a<r<b_1$;

Answer:

*c*) $b_1<r<b_2$;

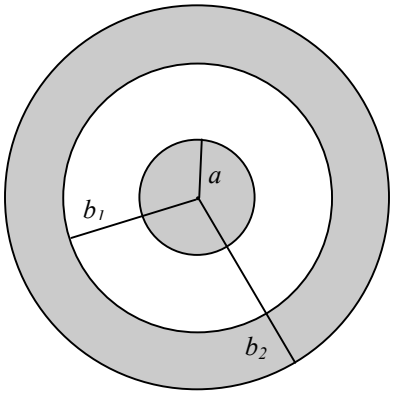
Answer:

*d*) $r>b_2$;

Answer:

*e*) use the picture below and words, if necessary, to describe how the charge is distributed on the two conductors.

Answer:



*f*) If $q_1=q_2$ (but the two conductors still carry opposite charge), find the electric potential difference between the two conductors.

Answer:

*g*) Find the capacitance of this capacitor.

Answer:

 4) (15 pts.) Two resistors when connected in series to a battery with voltage $V_0$ use one-fourth the power that is used when they are connected in parallel. If one resistor has resistance $R_1$, what is the resistance of the other?

Answer:

 5) (20 pts) A conductor is charged after it is brought into contact with a metal plate, which initially had charge $Q$. The conductor now has charge $q$.

Suppose the electric potential of the metal plate after the contact is $V$ relative to infinity. (That is, take the electric potential to be zero at infinity.)
*a*) What is the electric potential of the conductor after the contact?

Answer:

*b*) Find the charge on the metal plate after the contact.

Answer:

*c*) Find the capacitance of the conductor, $C_c$.

Answer:

*d*) Find the capacitance of the metal plate, $C_p$.

Answer:

*e*) Find the ratio $C_p/C_c$ in terms of $Q$ and $q$.

Answer:

After the metal plate is recharged to the same initial charge $Q$, the conductor is brought into contact with the metal plate a second time. Suppose the metal plate loses an amount of charge $x$.

*f*) Find the charge on the conductor.

Answer:

*g*) Find $x$ in terms of $Q$ and $q$.

Answer:

We can add more charge to the conductor by repeatedly contacting it with the metal plate, which after each contact is recharged to the same amount of charge $Q$, until the charge on the conductor reaches a maximum.

*h*) What is the ultimate charge on the conductor?

Answer: