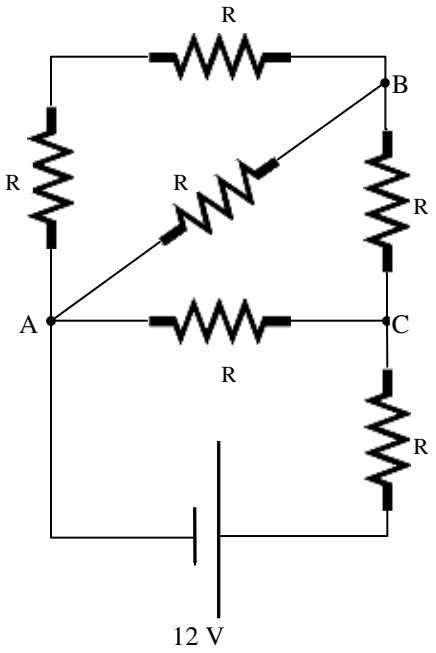
University of California, Berkeley
Physics 7B, Fall 2007 (*Xiaosheng Huang*)

Midterm 2
Tuesday, 11/6/2007
6:00-8:00 PM

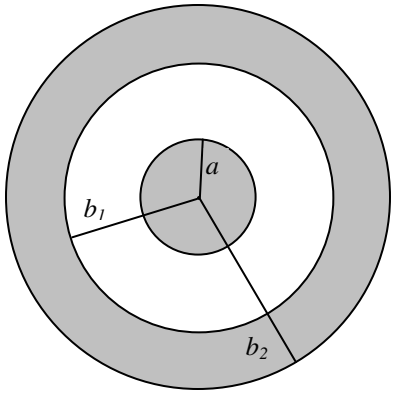
Attention:
A basic integral table is provided at the end of the exam.

1) (20 pts.) What is the net resistance of the circuit connected to the battery in the figure below? Each resistance has R=2.8 kΩ.



Answer:

2) (40 pts.) A capacitor consists of two concentric conductors. The smaller one has radius a, and the larger one has inner radius b_1 and outer radius b_2.



a) Calculate its capacitance.

Answer:

If we put $-q$ on the smaller conductor and $+Q$ on the larger one, assuming $Q>q$, find the electric field for
(b) $r<a$;

Answer:

(c) $a<r<b_1$;

Answer:

(d) $b_1 < r < b_2$;

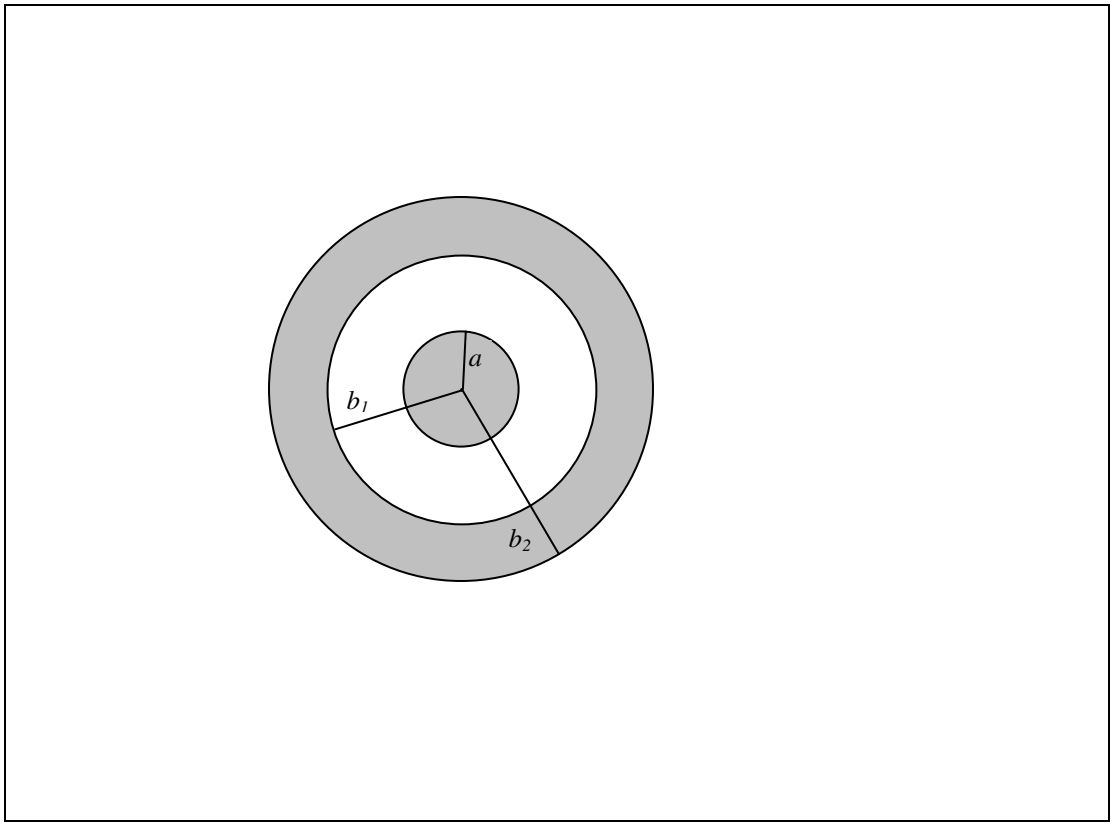
Answer:

(e) $r > b_2$;

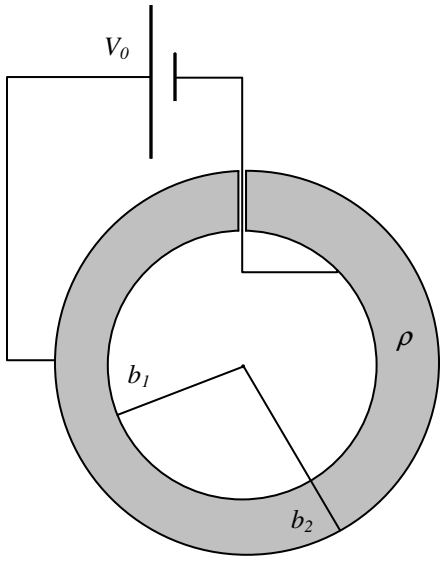
Answer:

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

Answer:

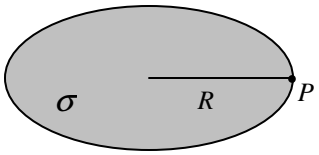


g) We now connect the outer and inner surfaces of the larger conductor to a battery, with voltage V_0. If the resistivity of the conductor is ρ, find the current. The effects of the small hole at the top of the conductor can be ignored. (Note: ρ here is the resistivity, not the charge density!)



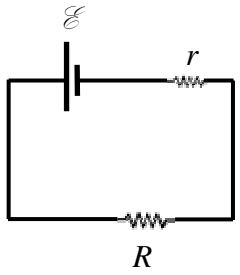
Answer:

3) (20 pts.) A uniformly charged disk, with radius R has surface charge density σ. Find the electric potential at P, located on the rim of the disk.



Answer:

4) (20 pts.) In the circuit below, the battery has EMF, $\mathscr{E}$, and internal resistance, r. If we connect this battery to a resistor with resistance, R, show that the power dissipation for R is the greatest when $R=r$.



Basic Integral Table

$$\int x^n dx = \frac{1}{n+1} x^{n+1}$$

$$\int \frac{1}{x} dx = \ln x$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax}$$

$$\int \sin x dx = -\cos x$$

$$\int \cos x dx = \sin x$$