

Midterm 2
Monday, 4/6/2009
6:00 – 8:00 PM

Name: _____

SID: _____

D/L Section: _____

GSI: _____

Physical Constants:

Speed of light, c : 3.00×10^8 m/s

Mass of electron, m_e : 9.11×10^{-31} kg

Elemental charge, e : 1.60×10^{-19} C

Permittivity of free space, ϵ_0 : 8.85×10^{-12} C²/N·m²

Note: You are allowed one formula sheet (3½" by 5", double sided) and a calculator (without wireless capabilities). Do NOT just write down an answer in the answer box; show your steps. Formulaic answers may only involve the quantities given in a problem and constants. Please pay attention to whether you are asked to give a numerical answer or a formulaic answer. Good Luck!

Check the box	
#1	
#2	
#3	
#4	
Total	

Check this box after you have read and filled out the information on this page (1 pt.)

1) (24 pts.)

a) Calculate the electric potential at a point that is on the symmetry axis of and at a distance z above a disk with radius a , and uniform charge density σ , assuming the electric potential at infinity is zero.

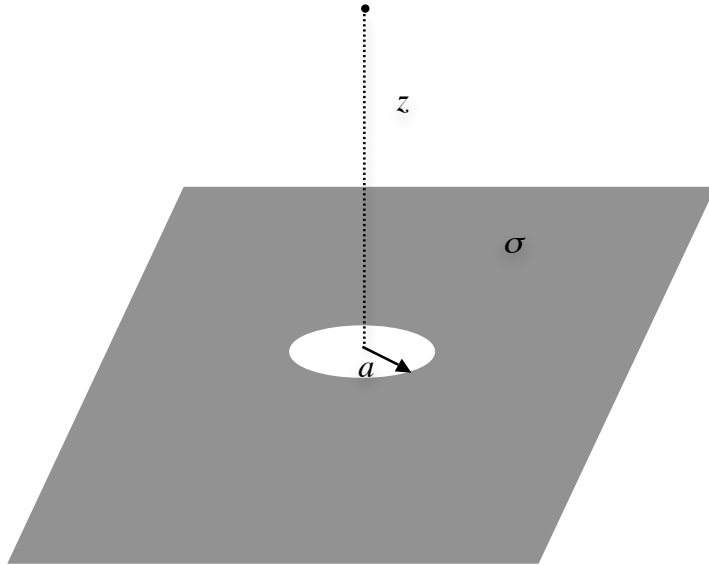


Answer:

b) Find the electric field \mathbf{E} at the same point above the same disk (you can do the calculation either directly or by using the result from part *a*.)

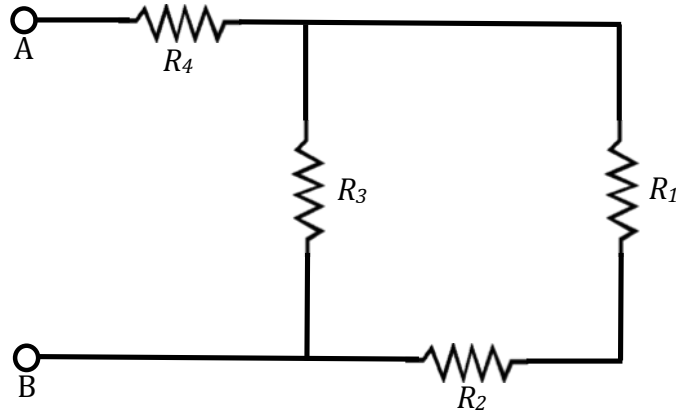
Answer:

c) Find the electric field \mathbf{E} on the symmetry axis of and at a distance z above a circularly shaped hole in an infinite plane with uniform charge density σ .



Answer:

2. (20 pts.) In the following circuit, if $R_1=R$, and $R_2=R_3=R_4=R'$, what value must R' have (in terms of R) in order that the resistance between the two terminals A and B shall be equal to R ?



Answer:

b) If the terminals A and B are connected to a battery with voltage V , find the power dissipation for each of the four resistors. Express your answers in terms of V and R .

Answer:

3) (25 pts.) A capacitor with capacitance C_1 is charged to V_1 and a second capacitor with capacitance C_2 is charged to V_2 .

a) These capacitors are then disconnected from their batteries, and the positive plates are now connected to each other and the negative plates are connected to each other. What will be the potential difference across each capacitor?

Answer:

b) What will be the charge on each capacitor?

Answer:

c) What is the voltage for each capacitor if plates of opposite sign are connected?

Answer:

d) What is the charge on each capacitor if plates of opposite sign are connected?

Answer:

4) (30 pts.)

a) A spherical volume of radius a is filled with charge of uniform density ρ . We want to know the potential energy U of this sphere of charge, that is, the work done in assembling it. Calculate U by building the sphere up layer by layer.

Answer:

b) It was thought by some people at the beginning of the twentieth century that the origin of the mass of the electron might be purely electrical. Imagine the electron as a ball of charge of constant volume density out to a radius b . Set the potential energy of such an electron to $m_e c^2$. What is b ? (This is known as the classical radius of the electron, which actually showed that classical physics is not adequate to understand the electron.)

Formulaic Answer:

Numerical Answer:

The End