

Test N° 2 Physique2- Durée 1h

Exercise 1: Let A, B, and C be three conducting spheres in electrostatic equilibrium. Sphere A, with a radius of $R_1=1\text{cm}$, has a charge $Q_A=4\text{nC}$. Sphere B is neutral, with $Q_B=0\text{C}$, and is a hollow conductor with an internal radius of $R_2=2\text{cm}$ and an external radius of $R_3=3\text{cm}$. Sphere C is a hollow conductor with an internal radius of $R_4=4\text{cm}$ and an external radius of $R_5=5\text{cm}$, carrying a charge $Q_C=-2\text{nC}$ (see Figure 1)

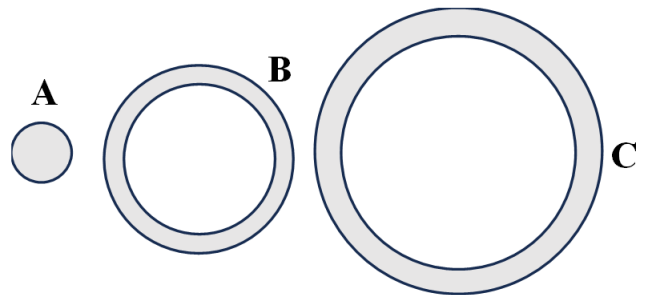


Figure1: A, B, and C are not influencing each other.

- 1- Represent the distribution of charge on each conductor, for the case shown in Figure 1.
- 2- Calculate the charge density of each conductor in Figure 1.
- 3- We surround conductor A with conductor B, as shown in Figure 2.
- Calculate the charge carried by conductors A and B and represent the charge distribution in this case.
- 4- We insert the assembly of the two conductors (A and B) inside conductor C, as shown in Figure 3.
- Calculate the charge carried by conductors A, B, and C, and represent the charge distribution in this case.
- 5- We connect conductor C to the ground (see figure 4)
- a- Draw the new charge distribution on A , B and C.
- b- Using Gauss's theorem, determine the electric field at any point in space.
- c- How many capacitors do you have in this case and how are they connected?

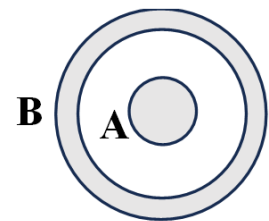


Figure 2: A is surrounded by B

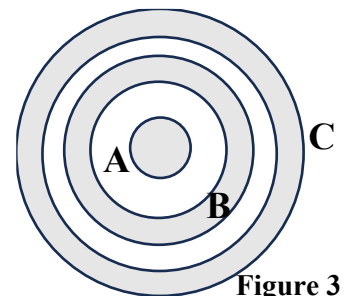


Figure 3

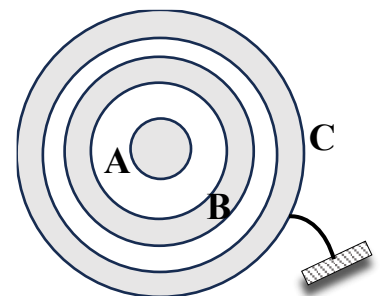


Figure 4

Exercise 2 : Consider the circuit in Figure 5.

- 1- Apply Kirchhoff's loop rule to the loops ABEFA and BCDEB.
- 2- Deduce I_2 if $I_1=1\text{A}$ and $I_3=2\text{A}$.
- 3- Calculate V_{BE} . In reality, R_3 consists of two resistances; see the figure5.a, If $R_a=3$ calculate I_a and I_b , R_b
- 4- Calculate the efficiency of E_1 .
- 5- Calculate the energy dissipated in E_2

As given:

$$R_3 = 10\Omega ; R_a=40\Omega$$

$$(E_1 = 4V, r_1 = 1\Omega) ;$$

$$(E_2 = 5V, r_2 = 1\Omega) ;$$

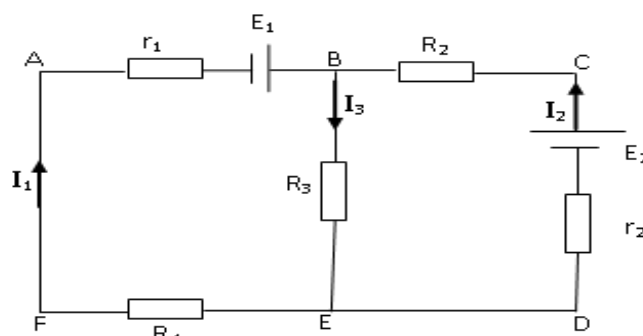


Figure 5

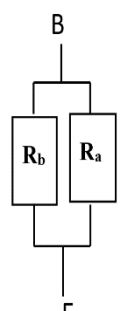


Figure 5.a