Recitation 2

Exercise 1:

I. An isolated metallic sphere S_1 of radius $R=9cm$, initially has a charge $Q_0=10$ nC.

1. Find the distribution of charge Q_0.
2. Determine the electric field everywhere in space, and the potential of S_1 ?what is the capacity of this sphere ?

II. A second metallic sphere S_2, initially neutral with radius R_2, is connected by a long and thin conductive wire to the sphere S_1. It will be assumed that the wire does not carry charges and that the effects of influence from one sphere to the other are negligible.

1. Assuming that the distribution of charge is uniform on each sphere, Determine the new charge distribution Q_0.
2. Find the electric field E_1 and E_2 in the vicinity of each sphere for $Q_0 = 10nC$, $R_1 = 9cm$ and $R_2 = 1cm$.
3. Discuss the behavior of the ratio E_2/E_1 as a function of the ratio R_1/R_2 .

Exercise 2:

A conductive sphere A, of radius R_1, is connected to a constant electric potential V_0 by a generator (Figure.1.)

1. Give the expression of the potentialV_M due to point M.
2. If $V_0=100V$ et $R_1 =3cm$, Determine the value of the charge Q_A .
3. 3. Conductor A is surrounded by a spherical conductive shell B with radius $R_2=5cm$ and $R_3=6cm$ (Figure.2.) and grounded. the conductor B is initially discharged.

a. Rrepresent the distribution of charges on the two conductors.

b. By a method of your choice, calculate the electric charge carried by the sphere A, always carried at a constant potential $V_0 =100V$ (conclusion).

c. Calculate the value of the capacity thus formed.

d. Calculate the energy stored in the capacitor in each figure. What will happen if:

- The generator is isolated from A and then connected to ground by a conductive wire (In Figure 1)..
- the generator is isolated from A and A is connected to B by a conductive wire (In Figure 2)

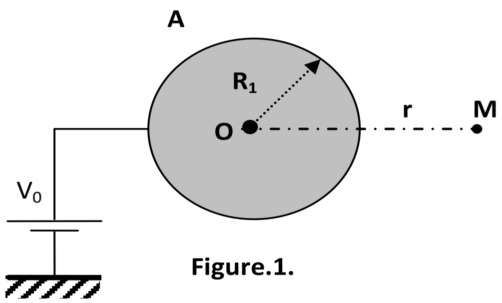


Figure.1.

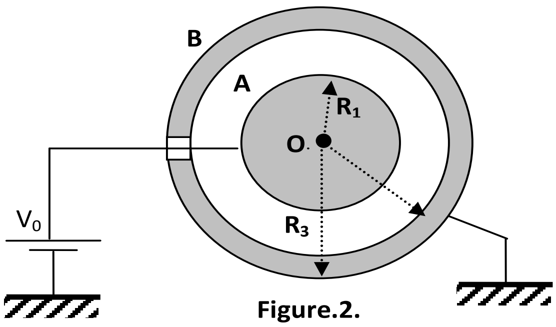
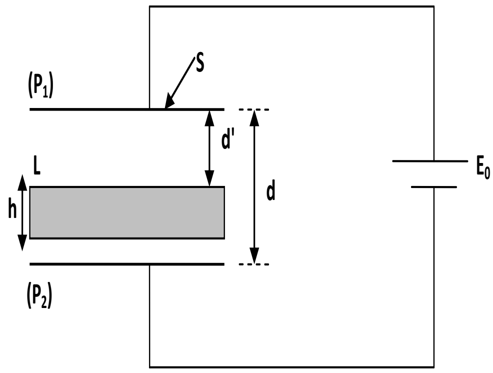


Figure.2.

Exercise 3:

Consider an ideal parallel plate capacitor formed by two conducting plates (P_1) and (P_2), with plate area $S=226cm^2$ and separated by a vacuum layer of thickness d=0.3mm.



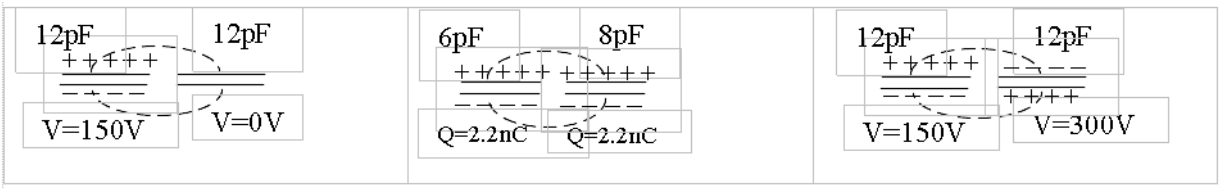
1. The capacitor is connected to an emf generator $E_0 = 120V$.
   - **a.** Find and calculate the capacitance of the capacitor .
   - **b.** Calculate the charge carried by each plate as well as the energy stored.
   - **c.** Determine the forces acting on the plates.
2. A neutral conductive plate (L) of the same size and thickness h is inserted parallel to the plates (Fig. 3). the generator plugged in:
   - **a.** Qualitatively explains what is happening and represents the new distribution of charges.
   - **b.** Give the expression of the equivalent capacitance of the system.
   - **c.** What is the thickness h of the plate if the equivalent capacitance is 1μF.
   - **d.** In the case where the inserted plate (L) covers only half of the surface area of the two plates (P1) and (P2), calculate the equivalent capacitance of the system.

Exercise 4:

In the figures below, the initial states of each capacitor are shown. The connection is indicated in dotted lines.

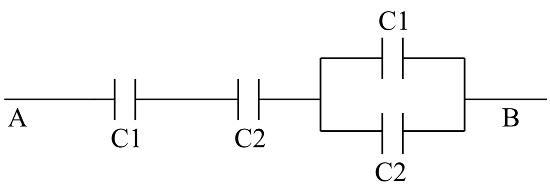
Calculate for each of the cases considered:

- Charges and potential difference of each capacitor after connection.
- The internal energies of the whole before and after. Compare and explain.



Exercise 5: Consider the following arrangement of capacitors:

Capacitor C1 has a known capacitance value.



1. Determine the capacitance C2 required between points A and B such that the equivalent capacitance between A and B, denoted as Ce, equals half of C2. Provide the numerical answer for the case when C1=8μF.
2. If a voltage $U_{AB}=500V$ is applied between points A and B:
   - **a.** Calculate the voltages across each capacitor in the arrangement.
   - **b.** Determine the charges stored on each capacitor.