



## SW N° 02 Gauss's theorem

### Exercise 1:

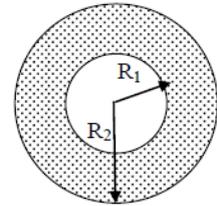
Let be two concentric spheres with center O and radius  $R_1, R_2$  such that  $R_1 < R_2$ . The sphere of radius  $R_1$  is volume-charged with a constant volume charge **density**  $\rho$ . The second of radius  $R_2$  is surface-charged with a constant surface charge **density**  $\sigma$ .

- 1- Using Gauss's theorem find the expression for the electrostatic field  $E(r)$  at any point in space.
- 2- Deduce the expression of the electric potential  $V(r)$  at any point in space.
- 3- Plot the curves of  $E(r)$  and  $V(r)$ .

### Exercise 2:

Let be two concentric spheres of center O of radius  $R_1$  and  $R_2$  respectively such that  $R_1 < R_2$ . Using GAUSS' theorem:

- 1- Calculate the electrostatic field at any point in space for a volume distribution of charges uniformly distributed between these two spheres.
- 2- Deduce the electric potential at any point in space.



### Exercise 3:

A cylinder of infinite height and radius  $R$  is surface-charged with a constant surface charge **density**  $\sigma$ . On the axis of this cylinder we place a conducting wire of infinite length and constant linear charge **density**  $\lambda$ .

- 1- Write the expression for the electric flux through the Gauss surface.
- 2- Calculate, at any point in space, the electrostatic field  $E(r)$  created by this distribution of charges.
- 3- Deduce the expression of  $\lambda$  so that the field outside the cylinder is zero.

### Exercise 4:

Consider two infinitely long coaxial cylinders of radius  $R_1$  and  $R_2$  such that  $R_1 < R_2$ . The first of radius  $R_1$ , charged with surface **density**  $+\sigma$ ; and the second of radius  $R_2$ , charged with surface **density**  $-\sigma$ .

- 1- Calculate the electrostatic field at any point in space, Plot the graphs  $E(r)$  as a function of  $r$ .
- 2- Deduce the electrostatic potential.

### Supplementary exercises :

#### Exercise 1:

Using Gauss's theorem, calculate the electrostatic field at any point in space for a volumetric distribution of charge uniformly distributed **between two coaxial cylinders** of infinite lengths and radius  $R_1, R_2$  respectively such that  $R_1 < R_2$ . Deduce the potential at any point in space.

#### Exercise 2 :

A sphere of center O and radius  $R$  charged in volume with **a variable** volume charge density  $\rho = A/r$  positive.

- 1- Applying GAUSS' theorem, calculate the electric field at any point in space.
- 2- Deduce the electric potential at any point in space.
- 3- Plot the graphs  $E(r)$  and  $V(r)$  as a function of  $r$ .