First name:

Last name:

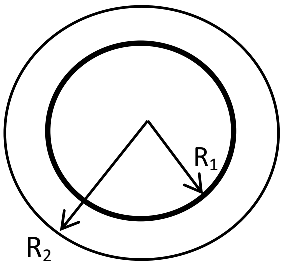
# Face-To-Face Test

Let be two concentric spheres with center O and respective radii $R_1$ and $R_2$ such that $\mathbf{R_1 < R_2}$. The sphere of radius $R_1$ is surface-loaded with **density σ**. The second of radius $R_2$ carries a surface distribution of **density σ'.**

1- Using GAUSS' theorem find the expression of the electrostatic field E(r) outside the system.

2- Deduce the expression of the electric potential V(r) outside the system.

3- Tracer l'allure de E(r) et V(r).



**University of Tlemcen**
**Faculty of Science**
**Duration: 30mn**

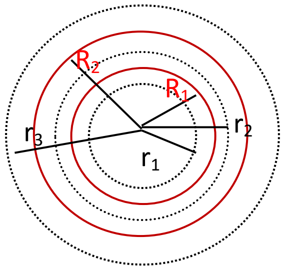
**Academic Year 2023/2024**
**1st Year LMD-M and MI**

## Correction of Test:

The Gaussian surface is a sphere with center O and radius r. For reasons of symmetry, the field is radial and constant at any point on the Gaussian surface.

$$\emptyset = \oiint \vec{E}.\overrightarrow{ds} = \frac{\sum Q_{int}}{\varepsilon_0}$$

$\overrightarrow{E} // \overrightarrow{ds}$ so : $\oiint \vec{E}.\overrightarrow{ds} = \iint E.ds = E \iint ds = E.S = E4\pi r^2 \Rightarrow \boldsymbol{E4\pi r^2} = \frac{\sum \boldsymbol{Q_{int}}}{\boldsymbol{\varepsilon_0}}$




1- The electrostatic field $E_3(r)$:.
   We have 2 cases

**3rd case $r \geq R_2$**

$Q_{int} = Q_1 + Q_2$ with $Q_1 = \sigma 4\pi R_1^2$ and $dq_2 = \sigma' ds \Rightarrow Q_2 = \sigma' 4\pi R_2^2$

so $Q_{int} = \sigma 4\pi R_1^2 + \sigma' 4\pi R_2^2$

and $E_3 = \frac{\sigma 4\pi R_1^2 + \sigma' 4\pi R_2^2}{4\pi r^2 \varepsilon_0}$

$$\text{then} \quad \boldsymbol{E_3} = \frac{\boldsymbol{\sigma \ R_1^2}}{\boldsymbol{\varepsilon_0 r^2}} + \frac{\boldsymbol{\sigma' R_2^2}}{\boldsymbol{\varepsilon_0 r^2}}$$

The electrostatic potential $V_3(r)$.

$\vec{E} = -\overrightarrow{grad} v \Rightarrow E = -\frac{dv}{dr}$ so $v = -\int E dr$

**3rd case $r \geq R_2$**

$E_3 = \frac{\sigma R_1^2 + \sigma' R_2^2}{r^2 \varepsilon_0} \Rightarrow v_3 = -\frac{\sigma R_1^2 + \sigma' R_2^2}{\varepsilon_0} \int \frac{dr}{r^2} = \frac{\sigma 4 R_1^2 + \sigma' R_2^2}{\varepsilon_0 r} + C_3$

Infinite potential ($r \rightarrow \infty$) v=0 so $\lim_{r\to\infty} v = 0$

Then $C_3 = 0$

$$\text{And} \quad \boldsymbol{v_3} = \frac{\sigma R_1^2 + \sigma' R_2^2}{\varepsilon_0 r}$$