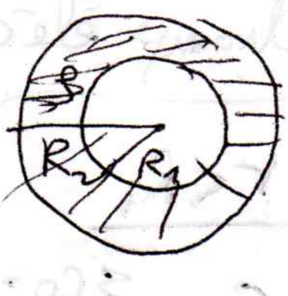
TD04

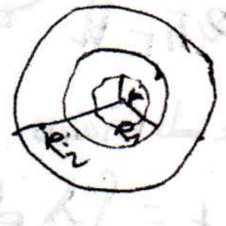
Exo1 :

L'expression du champ électrostatique $\vec{E}_M(r)$:



Le théorème de Gauss : $\oiint \vec{E}\cdot\vec{dS} = \frac{\sum Q_{int}}{\varepsilon_0}$

1) $r < R_1$



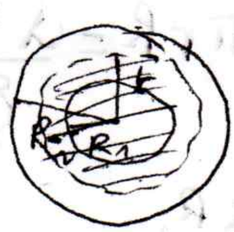
$E \cdot S = \frac{\sum Q_{int}}{\varepsilon_0}$

surface de Gauss

$S = 4\pi r^2$, $Q_{int} = 0$

$E_1 \cdot 4\pi r^2 = \frac{0}{\varepsilon} \Rightarrow E_1 = 0$

2) $R_1 < r < R_2$



$\sum Q_{int} = \iiint \rho \, dV$, $V = \frac{4}{3}\pi r^3$

$dV = 4\pi r^2 dr$

$\sum Q_{int} = \int_{R_1}^{r} \rho 4\pi r^2 dr$

$\sum Q_{int} = \frac{4}{3}\pi\rho(r^3 - R_1^3)$

donc : $E_2 \cdot 4\pi r^2 = \frac{\frac{4}{3}\pi\rho(r^3 - R_1^3)}{\varepsilon_0} \Rightarrow E_2 = \frac{\rho(r^3 - R_1^3)}{3\varepsilon_0 r^2}$

3) $R_2 < r$

$\sum Q_{int} = \iiint \rho \, dV = \int_{R_1}^{R_2} \rho 4\pi r^2 dr$

$\sum Q_{int} = \frac{4}{3}\pi\rho(R_2^3 - R_1^3)$

$E_3 \cdot 4\pi r^2 = \frac{\frac{4}{3}\pi\rho(R_2^3 - R_1^3)}{\varepsilon_0} \Rightarrow E_3 = \frac{\rho(R_2^3 - R_1^3)}{3\varepsilon_0}$