1

Ph
TD2

Electrostatique

Exercice 1

1. $V_{BDE}(A) = k \sum \frac{q_i}{r_i} = \frac{k}{r} \sum q_i = \frac{k}{a}(-3q) = \frac{-3kq}{a}$

2.a $V(A) = V_{BDE}(A) + V_{CHF}(A) + V_G(A)$

Volt $= -\frac{3kq}{a} + \frac{k}{a\sqrt{2}}(3q) + \left(\frac{-kq}{a\sqrt{3}}\right)$

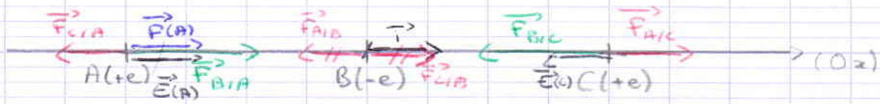
$= \frac{kq}{a}\left(-3 + \frac{3}{\sqrt{2}} - \frac{1}{\sqrt{3}}\right) < 0$

b $E_{pe}(A) = q(A) \times V(A)$

Joule $= q \times \frac{kq}{a}\left(-3 + \frac{3}{\sqrt{2}} - \frac{1}{\sqrt{3}}\right)$

$= \frac{kq^2}{a}\left(-3 + \frac{3}{\sqrt{2}} - \frac{1}{\sqrt{3}}\right) < 0$

Exercice 2.



1. $F(A) = F_{B/A} - F_{C/A}$

$= \frac{k \times e^2}{a^2} - \frac{k \times e^2}{(2a)^2}$

$= \frac{4ke^2 - ke^2}{4a^2}$

$= \frac{3}{4} \frac{ke^2}{a^2}$

$\vec{F}(A) = \vec{F}_{B/A} + \vec{F}_{C/A}$

$F_{B/A} > F_{C/A}$

$\Rightarrow \vec{F}(A) = \frac{3}{4}\frac{ke^2}{a^2}\vec{i}$

$F(C) = F(A) = \frac{3}{4}\frac{ke^2}{a^2}$

$\vec{F}(C) = -\frac{3}{4}\frac{ke^2}{a}\vec{i}$

↳ car $\vec{F}(C)$ est opposé à $\vec{i}$ (vecteur unitaire)

$\vec{F}(B) = \vec{F}_{A/B} + \vec{F}_{C/B}$

$= \vec{0}$ de même norme et de sens opposé

$\vec{E_A} = \frac{\vec{F}(A)}{e} = \frac{3}{4}\frac{ke}{a^2}\vec{i}$ $\qquad$ $\vec{E_B} = \frac{\vec{F}(B)}{-e} = \vec{0}$

$\vec{E_C} = \frac{\vec{F}(C)}{e} = -\frac{3}{4}\frac{ke}{a^2}\vec{i}$

2. $V(A) = k\sum\frac{q_i}{r_i}$

$= k\left(\frac{-e}{a} + \frac{e}{2a}\right)$

$= -\frac{ke}{2a} < 0$

$V(C) = V(A) = -\frac{ke}{2a}$

$V(B) = k\left(\frac{+e}{a} + \frac{e}{a}\right) = \frac{2ke}{a} > 0$

3. $E_{pe}(A) = q(A) \times V(A) = e \times -\frac{ke}{2a} = -\frac{ke^2}{2a} < 0$

$E_{pe}(C) = E_{pe}(A) = -\frac{ke^2}{2a} < 0$

$E_{pe}(B) = q(B) \times V(B) = -e \times \frac{2ke}{a} = -\frac{2ke^2}{a} < 0$

Exercice 3

1. $\vec{E} = -\overrightarrow{grad}(V)$

$V(r)$ ne dépend que de r => $\vec{E}$ n'aura qu'une seule composante $E = E_r$, $\vec{E} = \vec{E_r}$, on dit que $\vec{E}$ est radical.

21

Ph
TD2.

$$\overrightarrow{grad} = \begin{pmatrix} \frac{\partial}{\partial r} \\ \frac{1}{r}\frac{\partial}{\partial \theta} \\ \frac{1}{r\sin\theta}\frac{\partial}{\partial \varphi} \end{pmatrix}$$

$E_r = -\frac{\partial}{\partial r}$

$E_\theta = \frac{1}{r}\frac{\partial}{\partial \theta} = 0$

$E_\varphi = \frac{1}{r\sin\theta}\frac{\partial}{\partial \varphi} = 0$

2. $E_r = -\frac{\partial V}{\partial r} = -\frac{dV}{dr} = -V'(r)$

$V(r) = \frac{q}{4\pi\varepsilon_0} \times \underbrace{\frac{1}{r}}_{u} \underbrace{e^{-\frac{r}{a_0}}}_{v}$

$u = \frac{1}{r} \Rightarrow u' = -\frac{1}{r^2}$ et $v = e^{-\frac{r}{a_0}} \Rightarrow v' = -\frac{1}{a_0} e^{-\frac{r}{a_0}}$

Donc $E_r = -V'(r)$

$= -\frac{q}{4\pi\varepsilon_0}\left(-\frac{1}{r^2} e^{-\frac{r}{a_0}} + \left(-\frac{1}{ra_0}\right) e^{-\frac{r}{a_0}}\right)$

$= \frac{q}{4\pi\varepsilon_0} e^{-\frac{r}{a_0}} \left(\frac{1}{r^2} + \frac{1}{ra_0}\right)$

$E_r(r) = \frac{q}{4\pi\varepsilon_0}\frac{e^{-\frac{r}{a_0}}}{r^2}\left(1 + \frac{r}{a_0}\right)$