

## Chapitre 1 : L'électrostatique

### Exercices

**E1.** Pour faciliter l'écriture, on numérote les charges :  $q_1 = 5 \mu\text{C}$ ,  $q_2 = -2 \mu\text{C}$ ,  $q_3 = 3 \mu\text{C}$ . Le module de la force électrique entre chaque paire de charges est donné par l'équation 1.1. La direction de ces forces dépend du signe des charges et de leurs positions relatives indiquées à la figure 1.17. Toutes les forces sont parallèles à l'axe des  $x$ .

$$(a) \quad \vec{F}_{21} = -\frac{k|q_2 q_1|}{r_{12}^2} \vec{i} = -\frac{(9 \times 10^9)(5 \times 10^{-6})(2 \times 10^{-6})}{(2 \times 10^{-2})^2} \vec{i} = -225 \vec{i} \text{ N}$$

$$\vec{F}_{23} = \frac{k|q_2 q_3|}{r_{23}^2} \vec{i} = \frac{(9 \times 10^9)(2 \times 10^{-6})(3 \times 10^{-6})}{(4 \times 10^{-2})^2} \vec{i} = 33,8 \vec{i} \text{ N}$$

$$\vec{F}_2 = \vec{F}_{21} + \vec{F}_{23} = (-225 + 33,8) \vec{i} = \boxed{-191 \vec{i} \text{ N}}$$

$$(b) \quad \vec{F}_{12} = -\vec{F}_{21} = 225 \vec{i} \text{ N}$$

$$\vec{F}_{13} = -\frac{k|q_1 q_3|}{r_{13}^2} \vec{i} = -\frac{(9 \times 10^9)(5 \times 10^{-6})(3 \times 10^{-6})}{(6 \times 10^{-2})^2} \vec{i} = -37,5 \vec{i} \text{ N}$$

$$\vec{F}_1 = \vec{F}_{12} + \vec{F}_{13} = (225 - 37,5) \vec{i} = \boxed{188 \vec{i} \text{ N}}$$

**E2.** Pour faciliter l'écriture, on numérote les charges :  $q_1 = 2q$ ,  $q_2 = -4q$ ,  $q_3 = -3q$ , où  $q = 1 \text{ nC}$ . Le module de la force électrique entre chaque paire de charges est donné par l'équation 1.1. La direction de ces forces dépend du signe des charges et de leurs positions relatives indiquées à la figure 1.18.

(a) Sur la charge  $q_2$ , la force électrique issue des deux autres charges est orientée directement selon l'un des axes :

$$\vec{F}_{21} = -\frac{k|q_2 q_1|}{r_{12}^2} \vec{j} = -\frac{(9 \times 10^9)(2 \times 10^{-9})(4 \times 10^{-9})}{(3 \times 10^{-2})^2} \vec{j} = -8,00 \times 10^{-5} \vec{j} \text{ N}$$

$$\vec{F}_{23} = \frac{k|q_2 q_3|}{r_{23}^2} \vec{i} = \frac{(9 \times 10^9)(4 \times 10^{-9})(3 \times 10^{-9})}{(4 \times 10^{-2})^2} \vec{i} = 6,75 \times 10^{-5} \vec{i} \text{ N}$$

$$\vec{F}_2 = \vec{F}_{21} + \vec{F}_{23} = \boxed{(6,75 \vec{i} - 8,00 \vec{j}) \times 10^{-5} \text{ N}}$$

(b) Sur la charge  $q_3$ , les forces sont orientées comme suit :



L'angle  $\alpha$  est donné par  $\alpha = \arctan\left(\frac{3}{4}\right) = 36,8^\circ$ , de sorte que  $\theta = 180^\circ - \alpha = 143,1^\circ$ . Le module de  $\vec{F}_{31}$  est  $F_{31} = \frac{k|q_3 q_1|}{r_{13}^2} = 2,16 \times 10^{-5} \text{ N}$ . Si on utilise la méthode énoncée à la section 2.3 du tome 1, alors

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