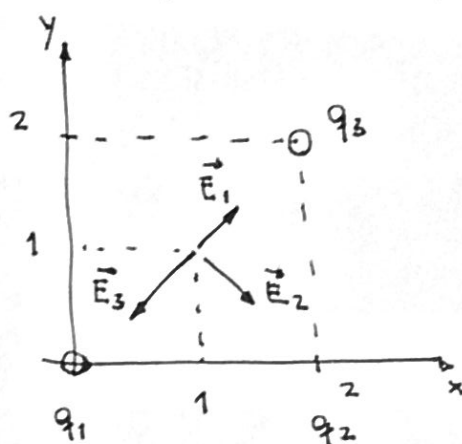


(a) Camp elèctric en el pun A (centre del quadrat)

Primer adoptem un marc de referència:



Calcularem els 3 camps i després els sumarem (vectorialment) per trobar el camp resultant:

$$\vec{E}_1 = k \frac{q_1}{r_1^2} \hat{r}_1 \quad (1)$$

$$\text{on } q_1 = 6 \times 10^{-6} \text{ C}$$

$$\vec{r}_1 = \hat{i} + \hat{j} / |\vec{r}_1| = \sqrt{1^2 + 1^2} = \sqrt{2} \quad / \quad \hat{r}_1 = \frac{\vec{r}_1}{|\vec{r}_1|} = \frac{1}{\sqrt{2}} \hat{i} + \frac{1}{\sqrt{2}} \hat{j}$$

Reemplaçant els valors anteriors en (1) obtenim:

$$\vec{E}_1 = k \frac{q_1}{r_1^2} \hat{r}_1 = 9 \times 10^9 \frac{6 \times 10^{-6}}{2} \left(\frac{1}{\sqrt{2}} \hat{i} + \frac{1}{\sqrt{2}} \hat{j} \right) = (19092 \hat{i} + 19092 \hat{j}) \text{ N/C}$$

El camp creat per la càrrega q_2 :

$$\vec{E}_2 = k \frac{q_2}{r_2^2} \hat{r}_2$$

$$\text{on } q_2 = -6 \mu\text{C} = -6 \times 10^{-6} \text{ C}$$

$$\vec{r}_2 = -\hat{i} + \hat{j} / |\vec{r}_2| = \sqrt{1^2 + 1^2} = \sqrt{2} \quad / \quad \hat{r}_2 = \frac{\vec{r}_2}{|\vec{r}_2|} = -\frac{1}{\sqrt{2}} \hat{i} + \frac{1}{\sqrt{2}} \hat{j}$$

$$\vec{E}_2 = k \frac{q_2}{r_2^2} \hat{r}_2 = 9 \times 10^9 \frac{(-6 \times 10^{-6})}{2} \left(-\frac{1}{\sqrt{2}} \hat{i} + \frac{1}{\sqrt{2}} \hat{j} \right) = (19092 \hat{i} - 19092 \hat{j}) \text{ N/C}$$

El camp creat per la càrrega q_3 :

$$\vec{E}_3 = k \frac{q_3}{r_3^2} \hat{r}_3 =$$

on $q_3 = 8 \times 10^{-6} \text{ C}$.

$$\vec{r}_3 = -\hat{i} - \hat{j} \quad / \quad |\vec{r}_3| = \sqrt{2} \quad \left| \frac{\vec{r}_3}{|\vec{r}_3|} \right| = -\frac{1}{\sqrt{2}} \hat{i} - \frac{1}{\sqrt{2}} \hat{j}$$

$$\vec{E}_3 = k \frac{q_3}{r_3^2} \hat{r}_3 = 9 \times 10^9 \cdot \frac{8 \times 10^{-6}}{2} \cdot \left(-\frac{1}{\sqrt{2}} \hat{i} - \frac{1}{\sqrt{2}} \hat{j} \right) = (-25456 \hat{i} - 25456 \hat{j}) \text{ N/C}.$$

$$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 = (19092 \hat{i} + 19092 \hat{j}) + (19092 \hat{i} - 19092 \hat{j}) + (-25456 \hat{i} - 25456 \hat{j}) = \boxed{(-6344 \hat{i} - 44528 \hat{j}) \text{ N/C}}.$$

(b) El treball per portar una càrrega $q = 6 \text{ C}$ des del infinit fins al punt A.

El potencial en el punt A:

$$V_A = V_{1A} + V_{2A} + V_{3A} = k \frac{q_1}{r_1} + k \frac{q_2}{r_2} + k \frac{q_3}{r_3} = 9 \times 10^9 \left(\frac{6 \times 10^{-6}}{\sqrt{2}} + \frac{(-6 \times 10^{-6})}{\sqrt{2}} + \frac{8 \times 10^{-6}}{\sqrt{2}} \right)$$

$$V_A = 50912 \text{ V}$$

El treball per portar la càrrega des del infinit fins a A serà

$$W = \Delta U = q \Delta V = q(V_A - V_\infty) = qV_A = 6 \cdot 50912 = \boxed{305472 \text{ J}}$$

Per traslladar del punt A al B:

$$W = q(V_B - V_A)$$

$$\text{on } V_B = k \frac{q_1}{r_B} + k \frac{q_2}{r_{2B}} + k \frac{q_3}{r_{3B}} = 9 \times 10^9 \left(\frac{6 \times 10^{-6}}{2} + \frac{-6 \times 10^{-6}}{\sqrt{2^2 + 2^2}} + \frac{8 \times 10^{-6}}{2} \right)$$

$$V_B = 43908 \text{ V}.$$

$$W = 6(43908 - 50912) = \boxed{-42024 \text{ J}}$$