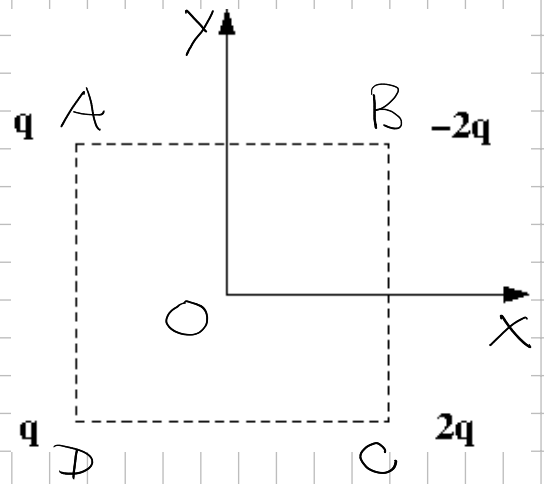


em-que-02005

Find the direction and magnitude of \vec{E} at the center of a square with charges at the corners shown in the figure.

Assume that $q = 1 \times 10^{-8} \text{ C}$

$a = 50 \text{ cm}$



Let the sides of square be a .

The fields due to the diagonally opposite charges act along the same line.

Electric field due to the charges q and $2q$ located at A & C respectively

$$= \frac{1}{4\pi\epsilon_0} \frac{2q - q}{(a/\sqrt{2})^2} = \frac{2q}{4\pi\epsilon_0} \frac{1}{a^2} \text{ along } \vec{OA}$$

Electric field due to $-2q$ and $-q$ located at corners B and D

$$= \frac{1}{4\pi\epsilon_0} \frac{2q}{a^2} \text{ along } \vec{OB}$$

$$\begin{aligned} \vec{E} &= \frac{1}{4\pi\epsilon_0} \frac{2q}{a^2} (\hat{OA} + \hat{OB}) \\ &= \frac{1}{4\pi\epsilon_0} \frac{2q}{a^2} \left(-\frac{\hat{i} + \hat{j}}{\sqrt{2}} + \frac{\hat{i} - \hat{j}}{\sqrt{2}} \right) \\ &= \frac{1}{4\pi\epsilon_0} \frac{2\sqrt{2}q}{a^2} \hat{j} \end{aligned}$$

$$|E| = \frac{1}{4\pi\epsilon_0} \frac{2\sqrt{2}q}{a^2}$$

$$= \frac{2\sqrt{2} \times (9 \times 10^9) \times 1.0 \times 10^{-9}}{25 \times 10^{-4}}$$

$$|E| = 1.02 \times 10^4 \text{ N/C}$$