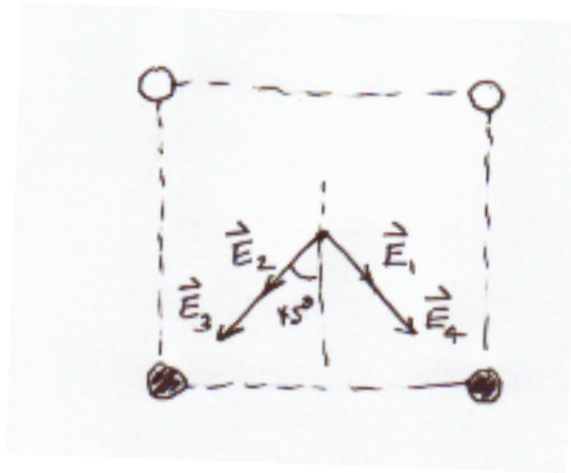


## Physics 11

## Lecture Problem 1 Solution

March 2, 2009



$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} +E_1 \sin 45^\circ \\ -E_1 \cos 45^\circ \end{bmatrix} + \begin{bmatrix} -E_2 \sin 45^\circ \\ -E_2 \cos 45^\circ \end{bmatrix} + \begin{bmatrix} -E_3 \sin 45^\circ \\ -E_3 \cos 45^\circ \end{bmatrix} + \begin{bmatrix} +E_4 \sin 45^\circ \\ -E_4 \cos 45^\circ \end{bmatrix}$$

The magnitudes are all equal:

$$E_1 = E_2 = E_3 = E_4 = k \frac{q}{(\sqrt{2}a)^2} = (9 \times 10^9) \frac{10 \times 10^{-6}}{2(.5)^2} = 1.8 \times 10^5 \frac{\text{N}}{\text{C}}$$

Thus,

$$\begin{aligned} \begin{bmatrix} E_x \\ E_y \end{bmatrix} &= \begin{bmatrix} +E_1 \sin 45^\circ \\ -E_1 \cos 45^\circ \end{bmatrix} + \begin{bmatrix} -E_2 \sin 45^\circ \\ -E_2 \cos 45^\circ \end{bmatrix} + \begin{bmatrix} -E_3 \sin 45^\circ \\ -E_3 \cos 45^\circ \end{bmatrix} + \begin{bmatrix} +E_4 \sin 45^\circ \\ -E_4 \cos 45^\circ \end{bmatrix} \\ &= \begin{bmatrix} 0 \\ -4E \sin 45^\circ \end{bmatrix} \\ &= \begin{bmatrix} 0 \\ -5.1 \times 10^5 \frac{\text{N}}{\text{C}} \end{bmatrix} \end{aligned}$$

The force on a  $1\mu\text{C}$  charge is

$$\mathbf{F} = -1\mu\text{C} \begin{bmatrix} 0 \\ -5.1 \times 10^5 \frac{\text{N}}{\text{C}} \end{bmatrix} = \begin{bmatrix} 0 \\ 0.51\text{N} \end{bmatrix}$$

It is a half a Newton, up.