CheggSolutions - Thegdp

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## Subject: Physics | Topic: Electric Fields

### Given:

**Charge \( q_1 \)** = +8.97 μC = +8.97 × 10^-6 C
**Position of \( q_1 \) ( \( x_1 \) )** = +3.18 cm = +0.0318 m
**Charge \( q_2 \)** = -21.8 μC = -21.8 × 10^-6 C
**Position of \( q_2 \) ( \( x_2 \) )** = +8.64 cm = +0.0864 m

### Objective:

Calculate the x-component of the net electric field at:

1. \( x = 0 \) cm

2. \( x = 6 \) cm

### Step 1: Calculate the x-component of the electric field at \( x = 0 \) cm

**Formula:**

\( E = \dfrac{k \cdot |q|}{r^2} \)

where,

\( E \) = Electric field,
\( k \) = Coulomb's constant = \( 8.99 \times 10^9 \) N·m²/C²,
\( q \) = magnitude of the charge,
\( r \) = distance between the charge and the point of interest.

**Calculation of \( E_1 \) from \( q_1 \) at \( x=0 \):**

\( r_{1} = x_1 - 0 = 0.0318 \) m

\( E_{1} = \dfrac{8.99 \times 10^9 \times 8.97 \times 10^{-6}}{(0.0318)^2} \)

\( E_{1} = \dfrac{8.99 \times 10^9 \times 8.97 \times 10^{-6}}{0.00101124} \)

\( E_{1} \approx 7.968 \times 10^5 \) N/C

**Direction:** The direction of \( E_1 \) due to \( q_1 \) (positive charge) at \( x = 0 \) is along the negative x-axis.

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**Calculation of \( E_2 \) from \( q_2 \) at \( x=0 \):**

\( r_{2} = x_2 - 0 = 0.0864 \) m

\( E_{2} = \dfrac{8.99 \times 10^9 \times 21.8 \times 10^{-6}}{(0.0864)^2} \)

\( E_{2} = \dfrac{8.99 \times 10^9 \times 21.8 \times 10^{-6}}{0.00746496} \)

\( E_{2} \approx 2.627 \times 10^6 \) N/C

**Direction:** The direction of \( E_2 \) due to \( q_2 \) (negative charge) at \( x = 0 \) is along the positive x-axis.

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**Net Electric Field at \( x = 0 \) cm:**

\( E_{net} = E_2 - E_1 \)

\( E_{net} = 2.627 \times 10^6 - 7.968 \times 10^5 \)

\( E_{net} = 1.83 \times 10^6 \) N/C

**Supporting Statement:** The net electric field at a point is the vector sum of fields due to all charges. Here, \( E_2 \) was greater and in the positive x-direction.
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Step 2: Calculate the x-component of the electric field at x=6 cm

Position of the charges relative to x=6 cm:

$r_{1,6} = |0.06 - 0.0318| = 0.0282$ m from q_1
$r_{2,6} = |0.06 - 0.0864| = 0.0264$ m from q_2

Calculation of $E_{1,6}$ from q_1 at $x=6$ cm:

$$E_{1,6} = \dfrac{8.99 \times 10^9 \times 8.97 \times 10^{-6}}{0.0282^2}$$

$$E_{1,6} = \dfrac{8.99 \times 10^9 \times 8.97 \times 10^{-6}}{0.00079524}$$

$$E_{1,6} \approx 1.01 \times 10^6 \text{ N/C}$$

Direction: The field $E_{1,6}$ due to q_1 (positive charge) at $x = 6$ cm is along the positive x-axis.

Calculation of $E_{2,6}$ from q_2 at $x=6$ cm:

$$E_{2,6} = \dfrac{8.99 \times 10^9 \times 21.8 \times 10^{-6}}{0.0264^2}$$

$$E_{2,6} = \dfrac{8.99 \times 10^9 \times 21.8 \times 10^{-6}}{0.00069696}$$

$$E_{2,6} \approx 2.81 \times 10^6 \text{ N/C}$$

Direction: The field $E_{2,6}$ due to q_2 (negative charge) at $x = 6$ cm is along the positive x-axis.

Net Electric Field at $x = 6$ cm:

$$E_{net,6} = E_{1,6} + E_{2,6}$$

$$E_{net,6} = 1.01 \times 10^6 + 2.81 \times 10^6$$

$$E_{net,6} = 3.82 \times 10^6 \text{ N/C}$$

Supporting Statement: Both electric fields $E_{1,6}$ and $E_{2,6}$ are in the same direction (positive x-axis), hence they add up.

Final Solution:

1. The x-component of the net electric field at x = 0 cm is **1.83×10^6 N/C** (positive direction).

2. The x-component of the net electric field at x = 6 cm is **3.82×10^6 N/C** (positive direction).

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