Field Strength Patterns

Read, compare, and graph the field around one charge

HS-PSII-4.2 "For a single isolated charge, develop and apply graphical and mathematical representations that describe the relationship between the amount of charge..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the equation and the words that explain its changing quantities, then number the table's 2 nC rows from nearest to farthest to trace the change in field strength.

A Charge in an Empty Chamber

1. A tiny charged bead sits at the center of a large chamber. Imagine measuring the electric field at several marked positions around it. Field strength tells how much electric force each coulomb of positive test charge would feel at a position. For a single isolated charge, the amount of source charge and the distance from its center determine that strength.

2. For a charge small enough to treat as a point, field strength follows $E = k|Q|/r^2$. Here Q is the source charge, r is distance from it, and k is about 9.0×10^9 N·m²/C². The bars around Q mean its magnitude: changing the charge's sign reverses field direction but does not change strength.

3. The table gives predicted strengths at different distances and for different amounts of charge. To compare two rows, look for the quantity that stays fixed, then examine what changes. On a graph with distance on the horizontal axis and field strength on the vertical axis, points for a fixed charge form a falling curve rather than a straight line.

ELECTRIC FIELD AROUND A SINGLE ISOLATED CHARGE

Source charge magnitude (nC)	Distance (m)	Field strength (N/C)
2	1	18
4	1	36
2	2	4.5
2	4	1.125

2 ANSWER WITH EVIDENCE

Use the passage

1. At 1 m, how does changing the source charge from 2 nC to 4 nC affect field strength? State the factor.

2. For the 2 nC charge, how does moving from 1 m to 2 m affect field strength? State the factor.

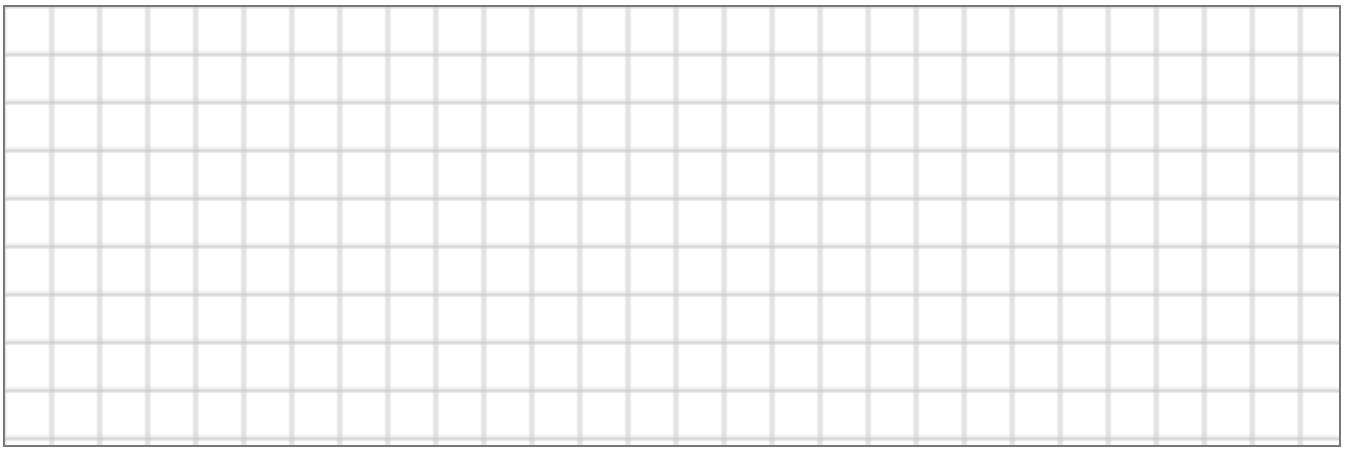
3. For the 2 nC charge, compare the strengths at 2 m and 4 m. How many times stronger is the field at 2 m?

4. Use the equation and the table to predict the field strength of the 2 nC charge at 3 m. Show how you found it.

3 YOUR TURN

Your own words

For a single 3 nC charge, calculate E at distances of 1 m, 2 m, and 3 m, then graph field strength against distance. Label both axes and write two sentences explaining what the graph shows and what E would be at 2 m if the charge changed to 6 nC.



ANSWER KEY

Field Strength Patterns

PART 1 · READ AND MARK

Underline the equation and the words that explain its changing quantities, then number the table's 2 nC rows from nearest to farthest to trace the change in field strength. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	At 1 m, how does changing the source charge from 2 nC to 4 nC affect field strength? State the factor.	**Field strength doubles, from 18 N/C to 36 N/C.**
2	For the 2 nC charge, how does moving from 1 m to 2 m affect field strength? State the factor.	**Field strength falls from 18 N/C to 4.5 N/C, so it becomes one-fourth as strong.**
3	For the 2 nC charge, compare the strengths at 2 m and 4 m. How many times stronger is the field at 2 m?	**The field at 2 m is four times stronger: 4.5 ÷ 1.125 = 4.**
4	Use the equation and the table to predict the field strength of the 2 nC charge at 3 m. Show how you found it.	**$E = 18\ N/C \div 3^2 = 2\ N/C$.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Horizontal axis: distance (m). Vertical axis: field strength (N/C). Plot (1, 27), (2, 6.75), and (3, 3), with a falling curve through the points. The field gets weaker as distance increases, and the curve is not a straight line. At 2 m, doubling the charge to 6 nC doubles the strength from 6.75 N/C to 13.5 N/C.

Accept equivalent calculations using $k = 9.0 \times 10^9\ N{\cdot}m^2/C^2$. In the graph, check axis labels, correctly placed points, and a decreasing curve.