

ELECTRICITY DAY 7: THE ELECTRIC FIELD

CED 10.3 · Skill 1.A · FRQ: TBR · target: field belongs to the source and location; force also needs a placed charge

PREDICT

A field sensor is held 0.30m from a positive source charge. A test charge placed at that point is replaced by one twice as large. Predict the electric field reading: **same / double / half / reversed**.

FIELD DEFINITION

$$\vec{E} = \frac{\vec{F}}{q_{\text{positive test}}} \quad [E] = \text{N/C}$$

The electric field is a property of the source charges and the location. A positive test charge defines the field direction. A test charge is a measuring idea; the field exists without it.

Quantity	Depends on	Vector?	Unit
E	source charges + location	yes	N/C
F on placed q	E + placed charge q	yes	N

DIRECTION Draw E at points to the left and right of (a) a positive source and (b) a negative source.

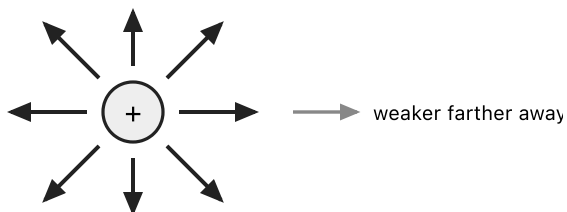
POINT-CHARGE FIELD

$$E = k \frac{|Q|}{r^2}$$

A positive source produces field vectors pointing away. A negative source produces field vectors pointing toward it.

WE DO A $+2.4\mu\text{C}$ source creates a field at $r = 0.30\text{m}$. (a) Find E and its direction. (b) A -1.5nC charge is placed there. Find its force magnitude and direction.

YOU DO A $-3.2\mu\text{C}$ source creates a field 0.40m away. Find E . Then find the force on a $+2.5\text{nC}$ charge placed there.

REPRESENTATION TRANSLATION**POINT-CHARGE FIELD MAP**

Arrow direction is radial. Arrow length decreases with distance because E follows $1/r^2$.

1. At $r = 0.25\text{m}$, a source produces field E_1 . What field does it produce at 0.50m ?

2. At one fixed point, compare (a) E before and after doubling a placed test charge and (b) the force on that test charge.

3. A field vector points east. State the force direction on (a) a positive charge and (b) a negative charge placed there.

PRACTICE

1. Find E 0.45m from a $+2.6\mu\text{C}$ source; include direction.

2. A $+1.8\text{nC}$ charge experiences $3.60 \times 10^{-4}\text{N}$ west. Find E magnitude and direction.

3. A point 0.60m from an unknown source has $E = 7.49 \times 10^4\text{N/C}$ directed toward the source. Find the source charge magnitude and sign.

4. A -3.0nC charge is placed in a uniform $2.20 \times 10^5\text{N/C}$ field directed north. Find the force vector.