

A scenic view of a university campus. In the foreground, there is a large, well-maintained green lawn. To the left, a white, modern, curved architectural structure is visible. In the middle ground, a large, multi-story building with a central dome and several windows is situated. The building is surrounded by trees and a paved walkway. In the background, a large, rugged mountain rises under a blue sky with scattered clouds. The text "Welcome to Class" is overlaid in the center of the image in a bold, yellow font.

Welcome to Class

Fun Physics Fact of the Day

1,000

Number of stars known in ancient times

2,000

Number of stars known in 1600 A.D.

3,000

Number of stars known in 1712 A.D.

The machinery of the heavens
is... like a clock... all the variety of
motions is from one simple
force... as in the clock all motions
are from a simple weight.”

Johannes Kepler

225,300

Number of stars known in 1918 A.D.

16 million

Number of stars known in 1983

What is an isotope? ion?

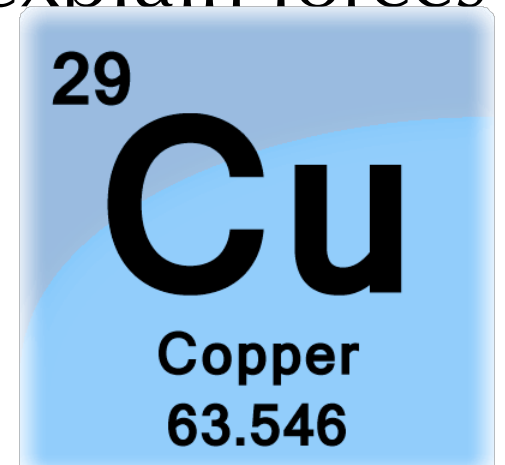
What is charge? What particles have charge?

What is the difference between an insulator and a conductor?

How do you charge an insulator, conductor?

Explain the meaning of the numbers on the periodic table.

What does polarization mean and how does it explain forces on neutral objects?



Metal

What is an isotope? ion?

What is charge? What particles have charge?

Positive
ion cores

What is the difference between an insulator and a conductor?

Valence electrons form
a "sea of electrons."

Insulator

How do you charge an insulator, conductor?

Nucleus

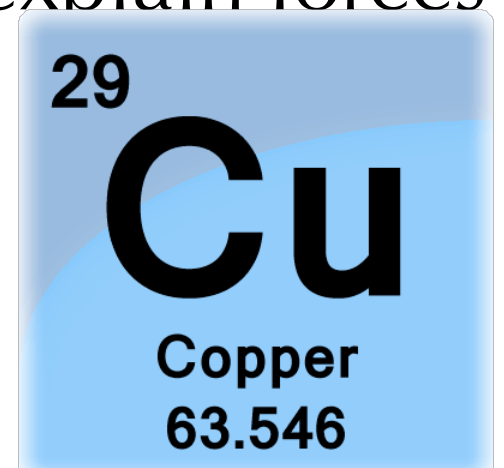
Core electrons

Valence electrons

Explain the meaning of the numbers on the periodic table.

What does polarization mean and how does it explain forces
on neutral objects?

Valence electrons
are tightly bound.



What is an isotope? ion?

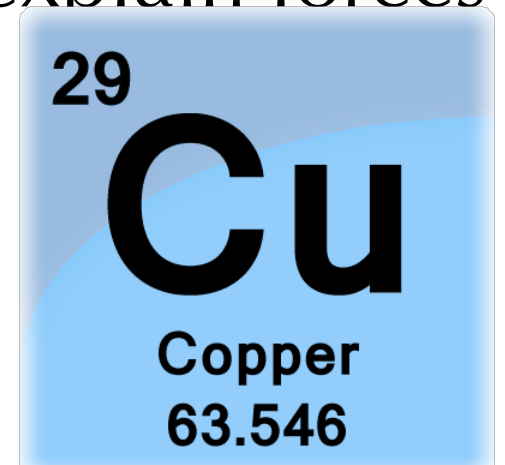
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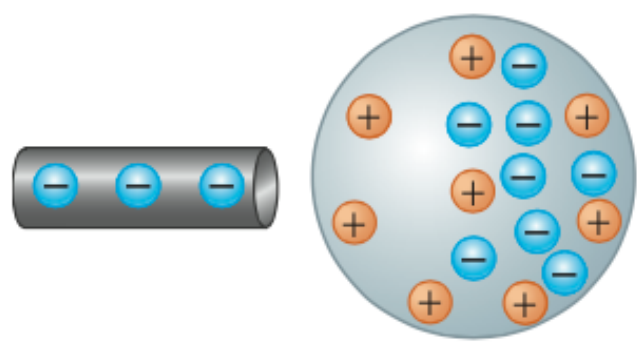
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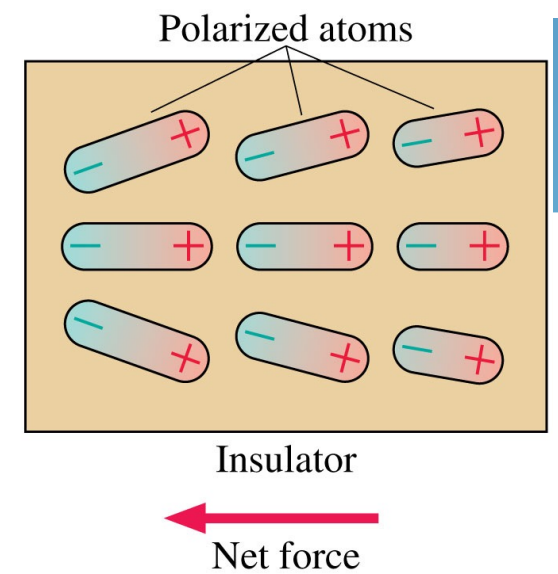
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External
charge



What is an isotope? ion?

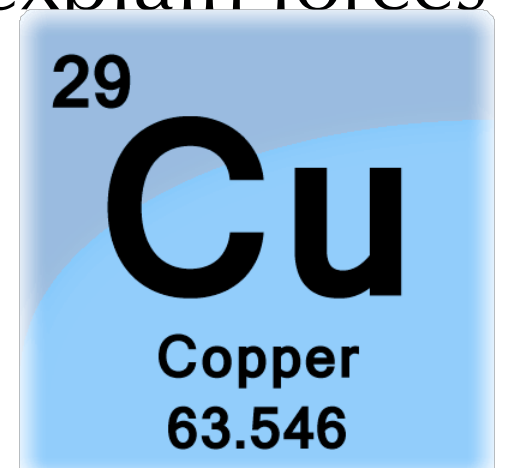
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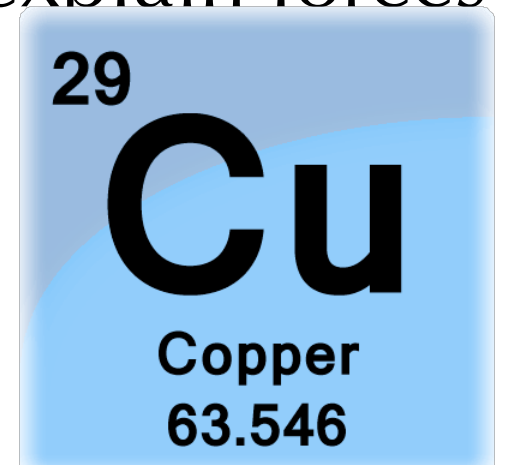
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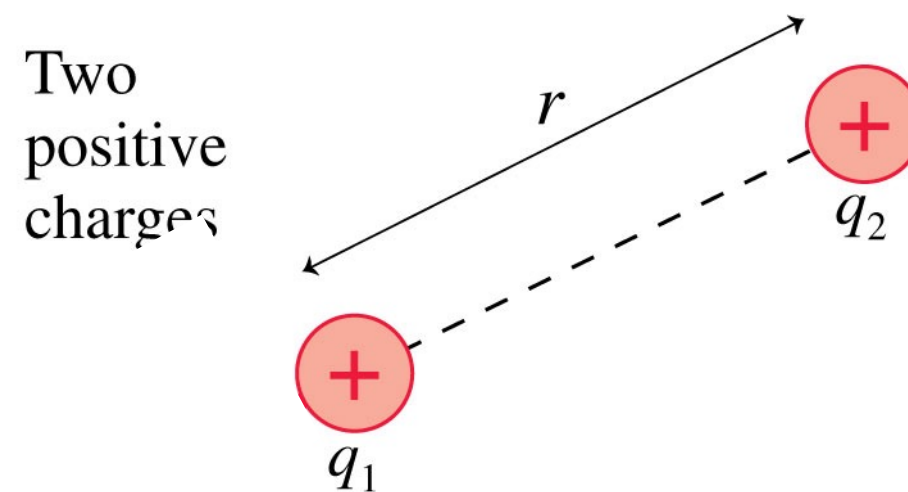
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Coulomb's Law

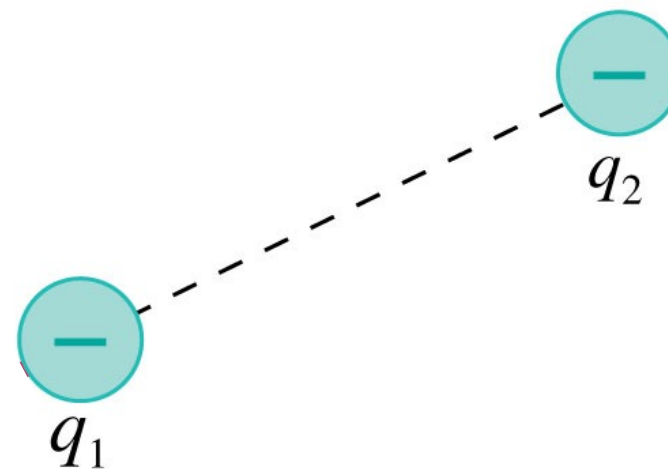
Indicate to your neighbor the direction of the force vectors on both charges.



Coulomb's Law

Indicate to your neighbor
the direction of the force
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Two
negative
charges



Coulomb's Law

Indicate to your neighbor
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Opposite
charges



Coulomb's Law

$$F = \frac{k|q_1||q_2|}{r^2}$$

Indicate to your neighbor
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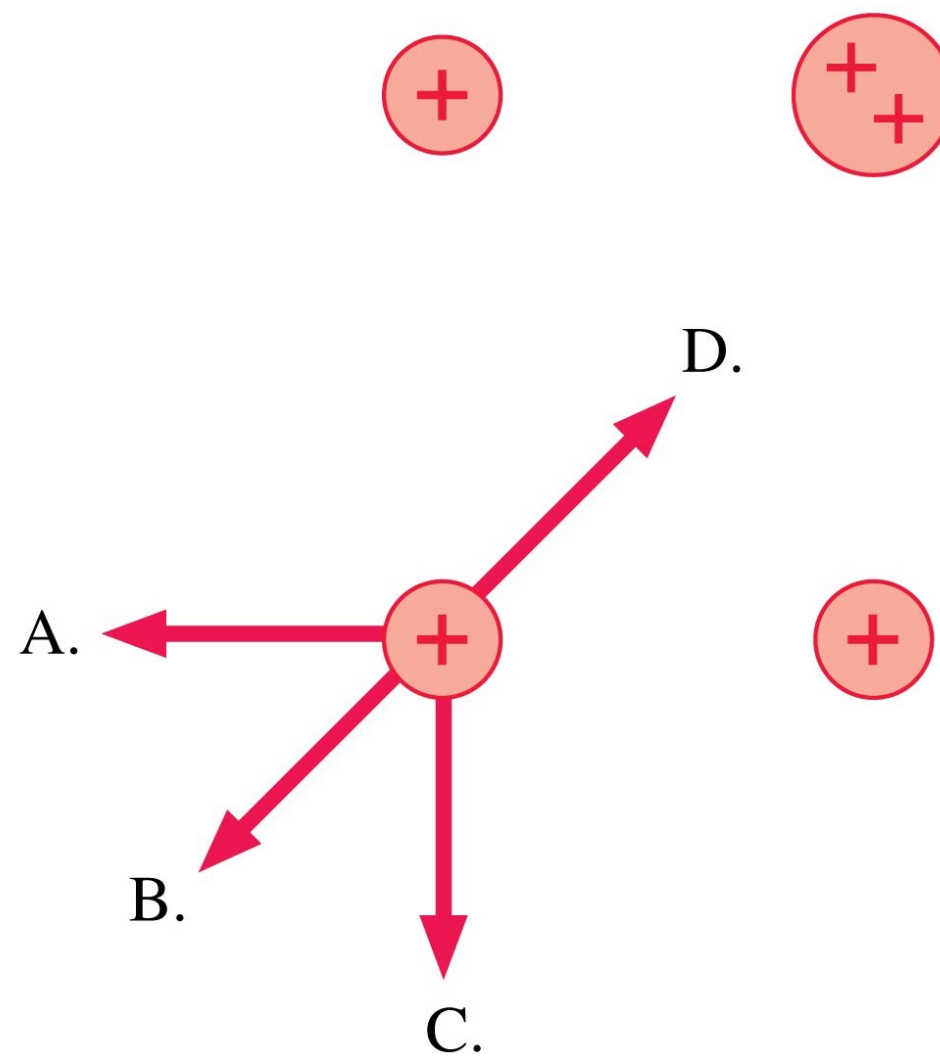
$$k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ N m}^2/\text{C}^2$$

Opposite
charges



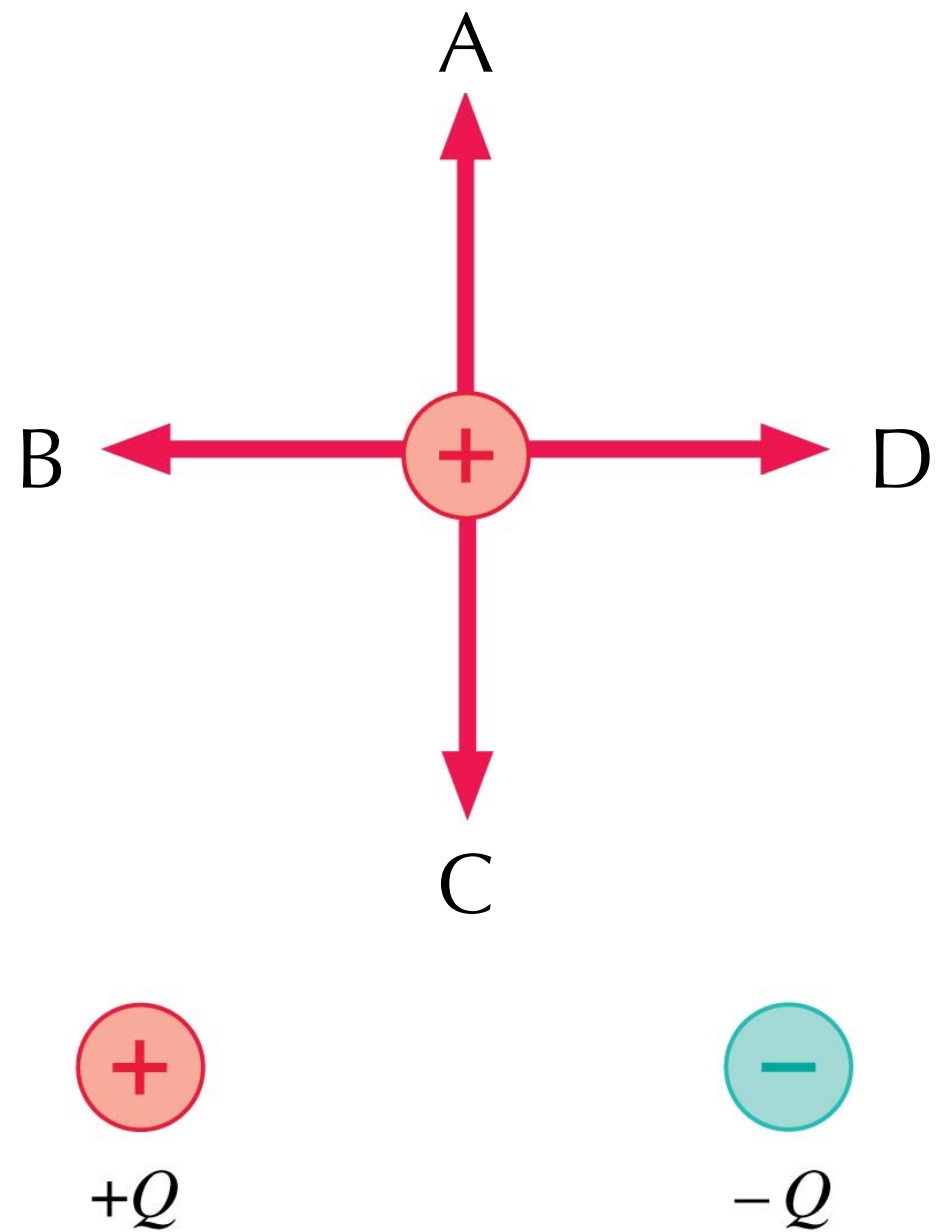
Quiz

Which is the direction of the net force on the charge at the lower left?



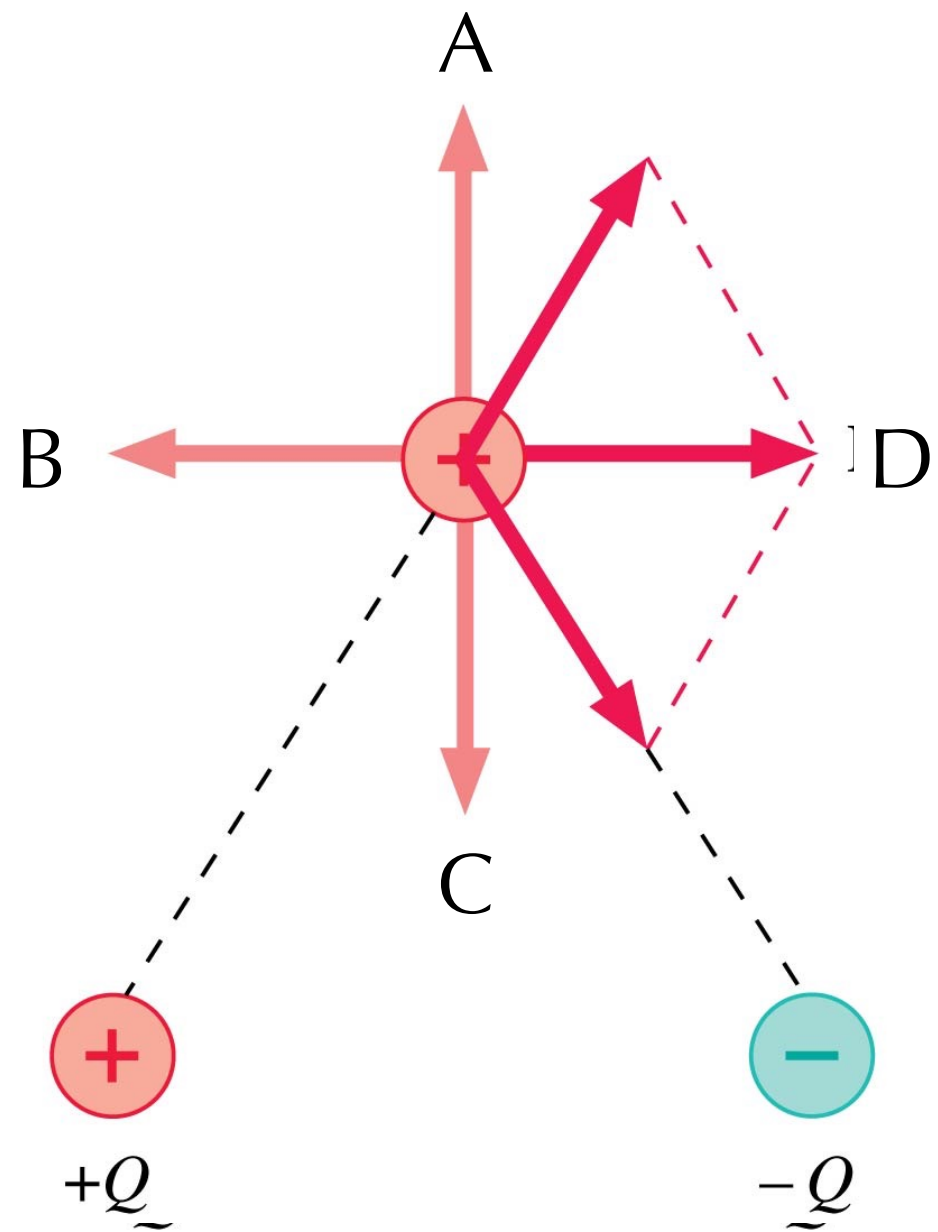
Quiz

Which is the direction of the net force on the charge at the top?



Quiz

Which is the direction of the net force on the charge at the top?



Quiz

The direction of the force on charge $-q$ is

- a) right
- b) left
- c) up
- d) down
- e) zero



$+Q$



$-Q$

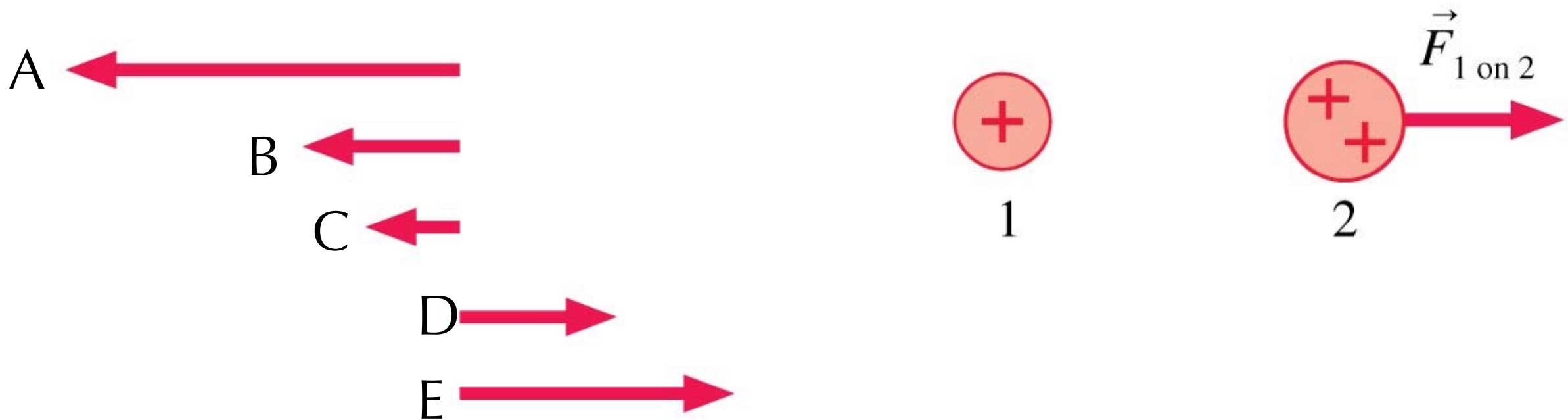


$-q$

Quiz

Question #22

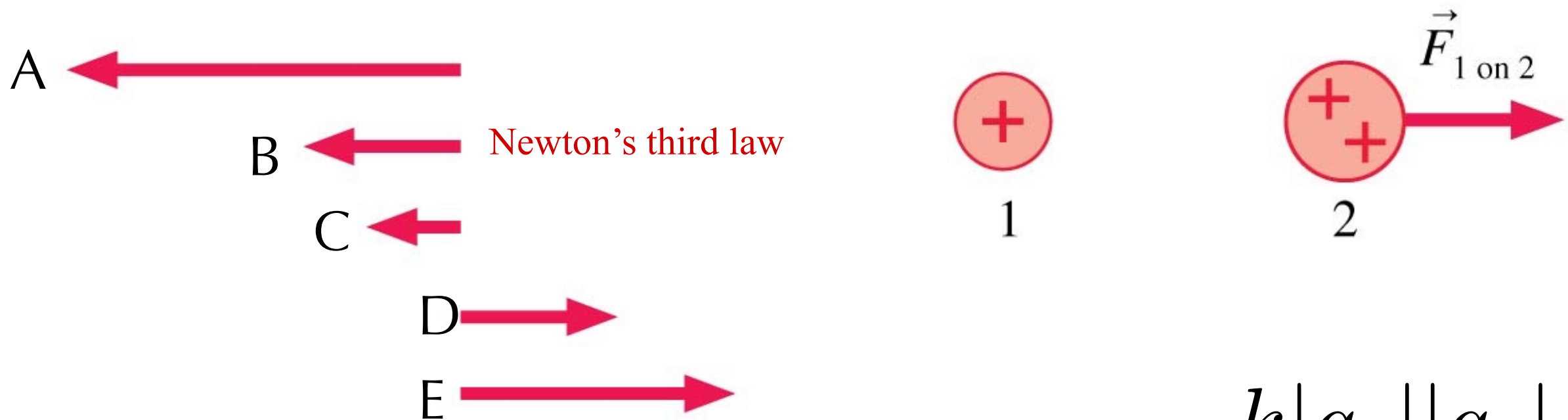
The charge of sphere 2 is twice that of sphere 1. Which vector below shows the force of 2 on 1?



Quiz

Question #22




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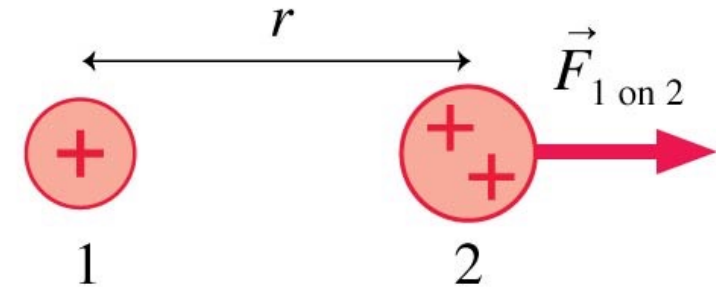


$$F = \frac{k|q_1||q_2|}{r^2}$$

Quiz




The charge of sphere 2 is twice that of sphere 1.
Which vector below shows the force of 1 on 2
if the distance between the spheres is reduced to $r/2$?

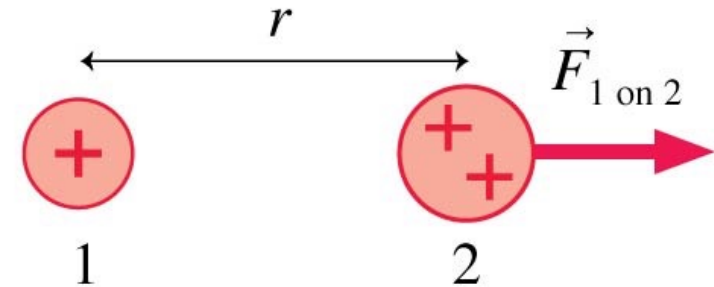
- A  $1/2$
- B  same
- C  double
- D - None of the above



Quiz

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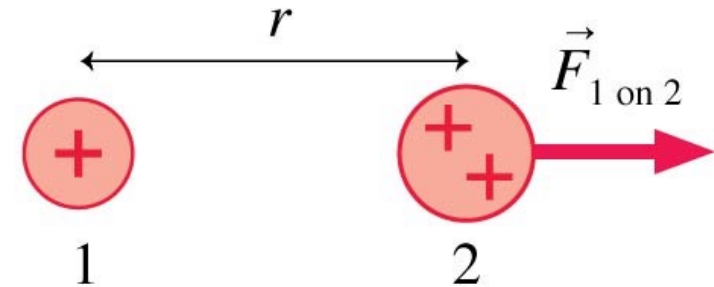


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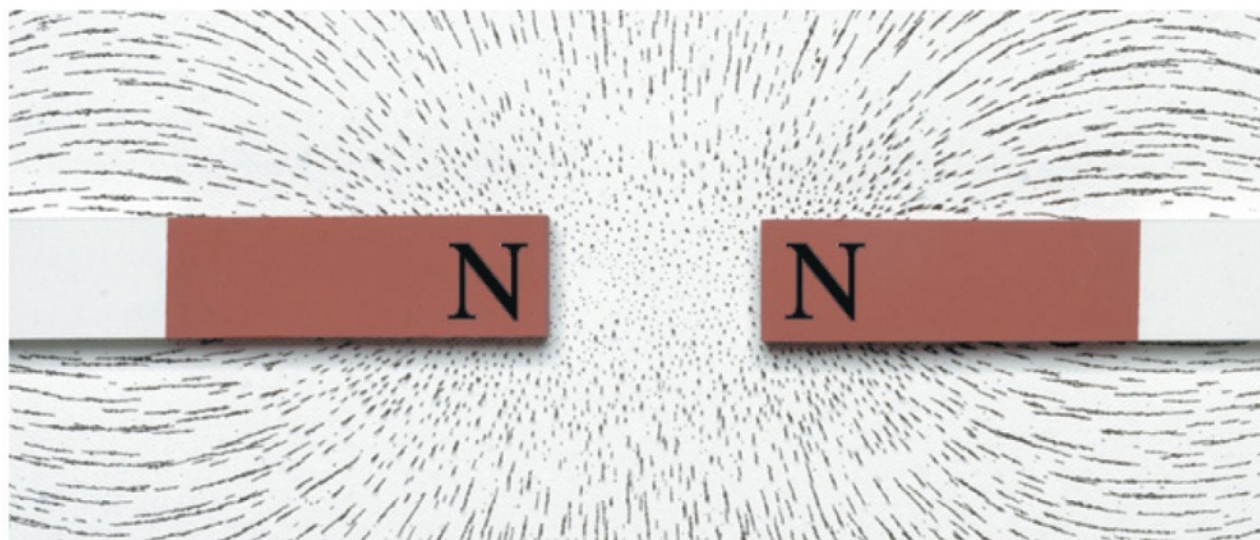
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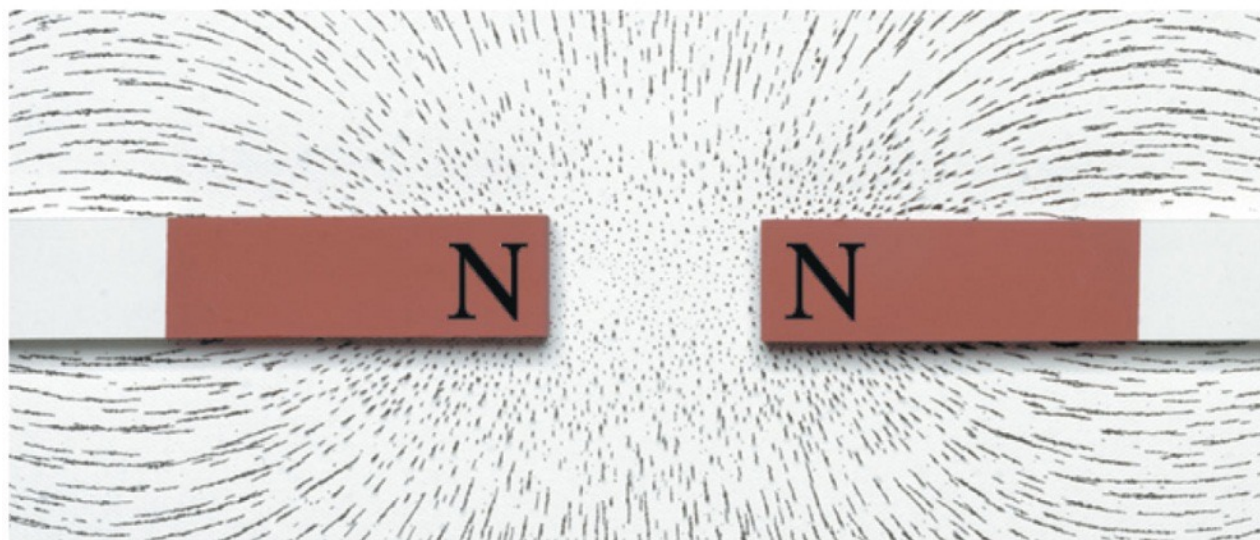
At half the distance, the force is four
times as large: 

$$F = \frac{k|q_1||q_2|}{r^2}$$

The Electric Field



The Electric Field

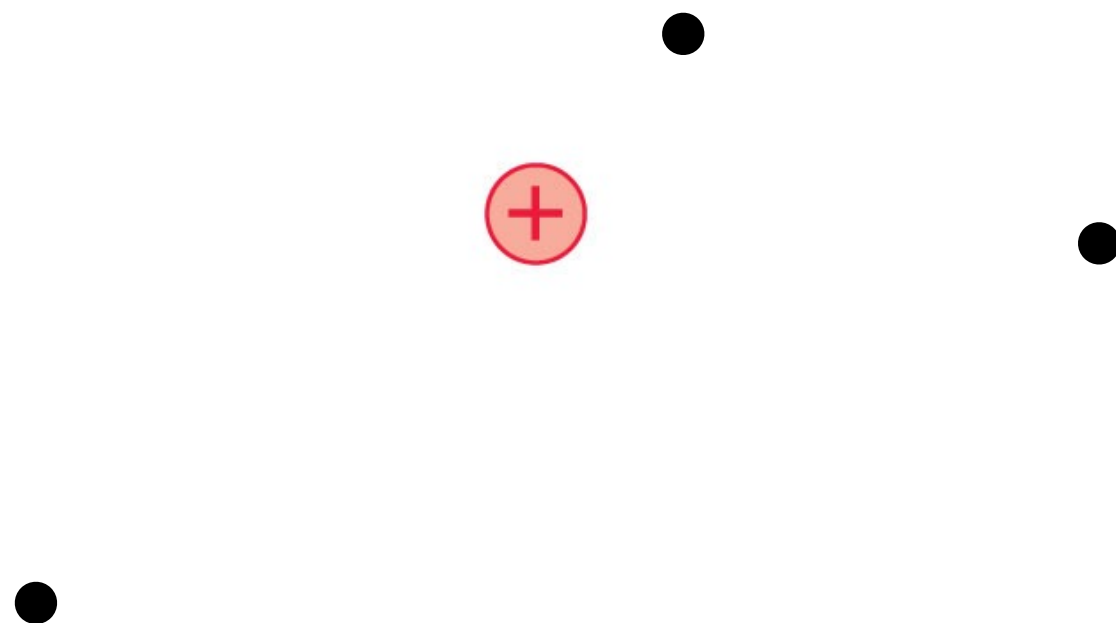


Key question: If you took the iron filings away, would there still be something different about the region of space that they used to occupy?

From Math class

Field: A function which assigns a vector to every point in space.

But what does the vector represent?



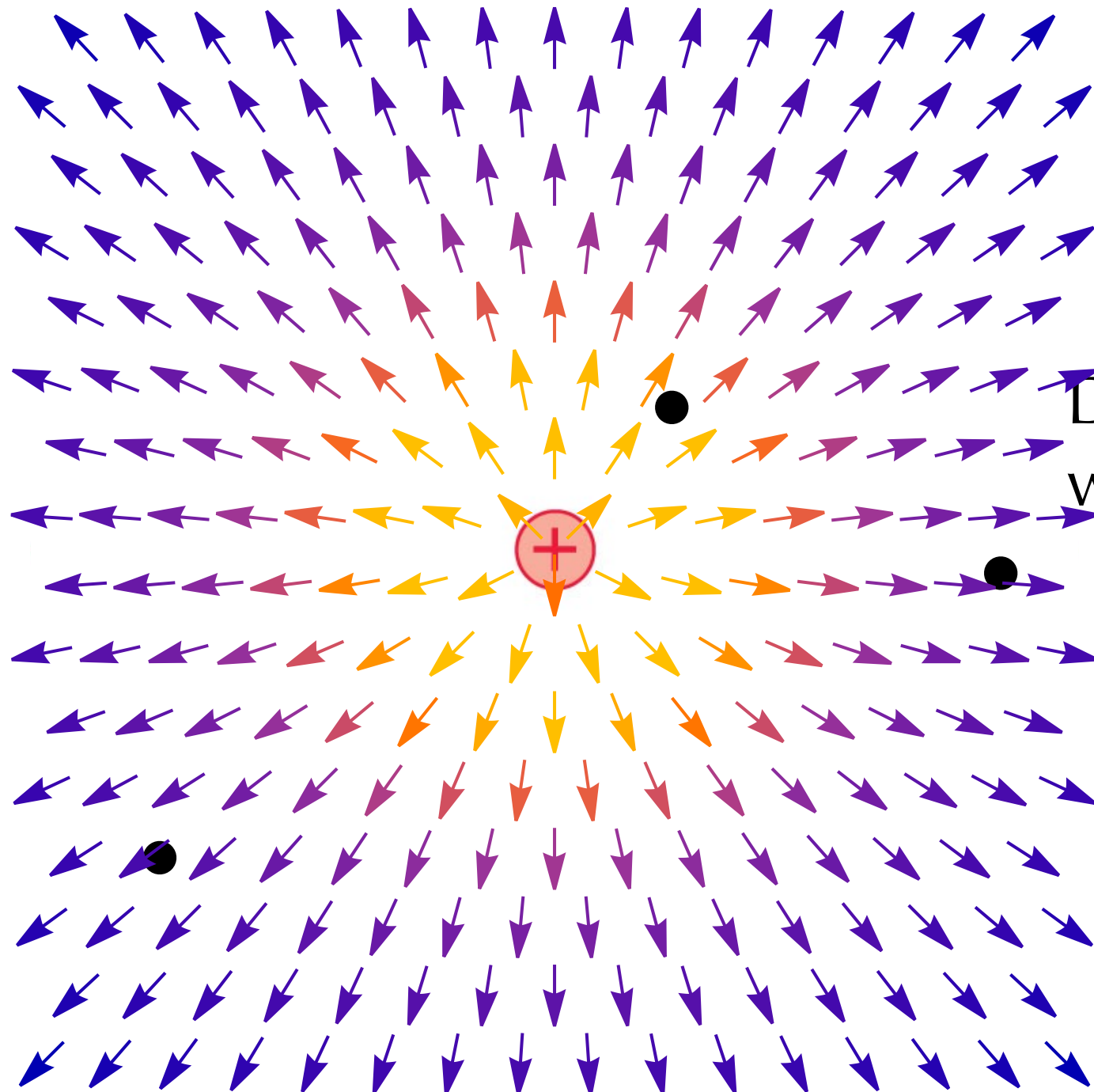
Draw the force vector that a proton would experience if it were there.

$$\vec{E} = \frac{\vec{F}}{q_1} \hat{r}$$

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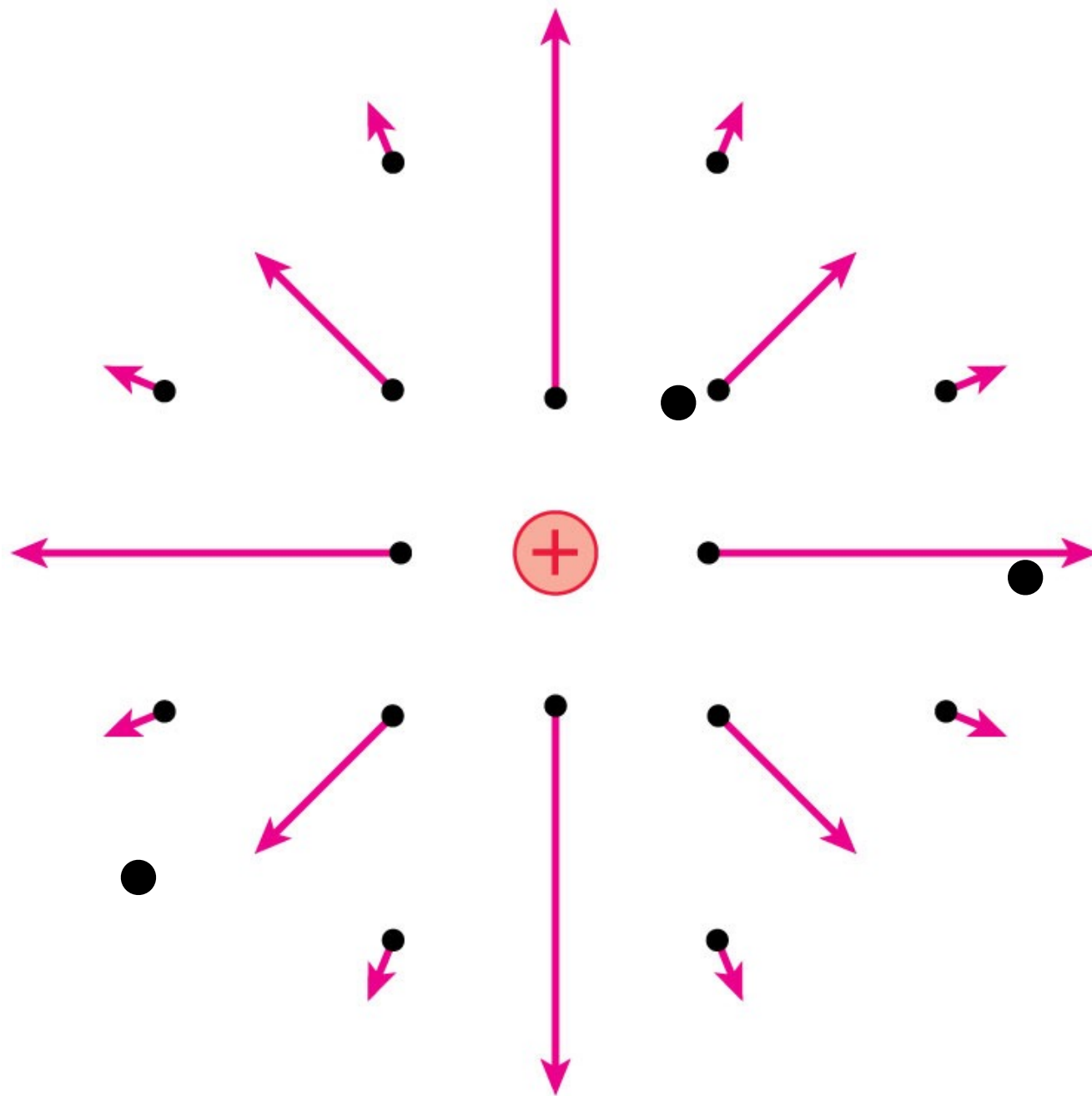
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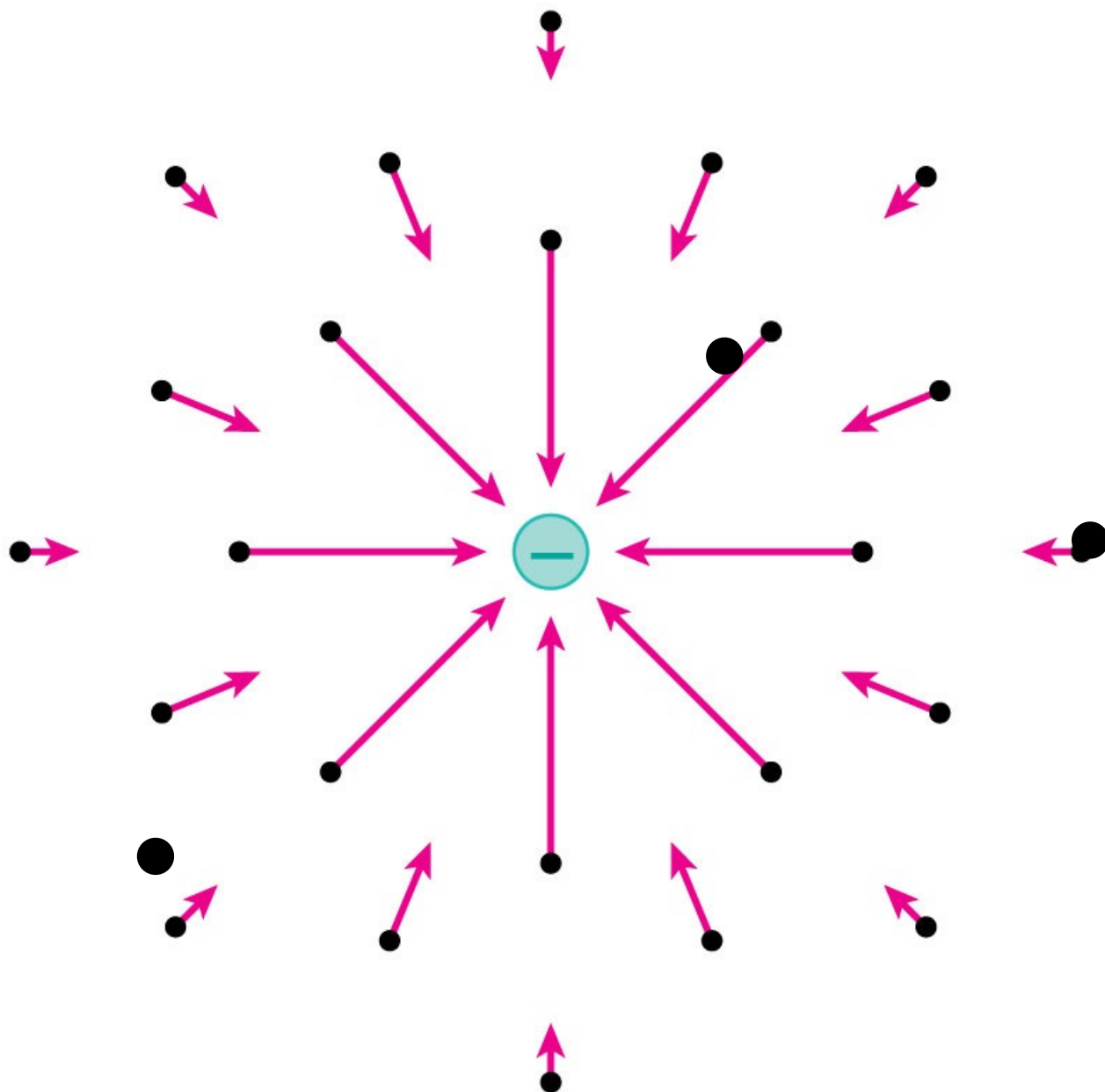


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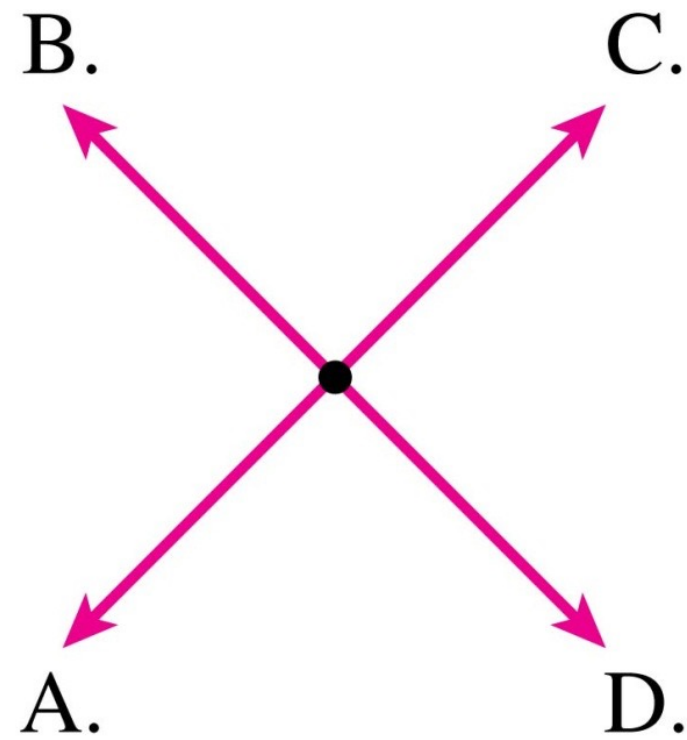


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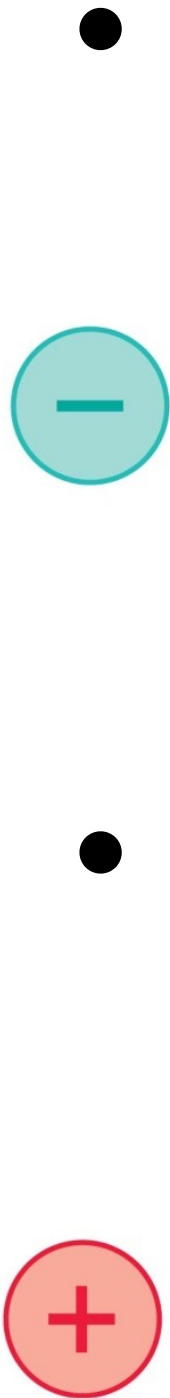
Quiz

Which is the electric field at the dot?



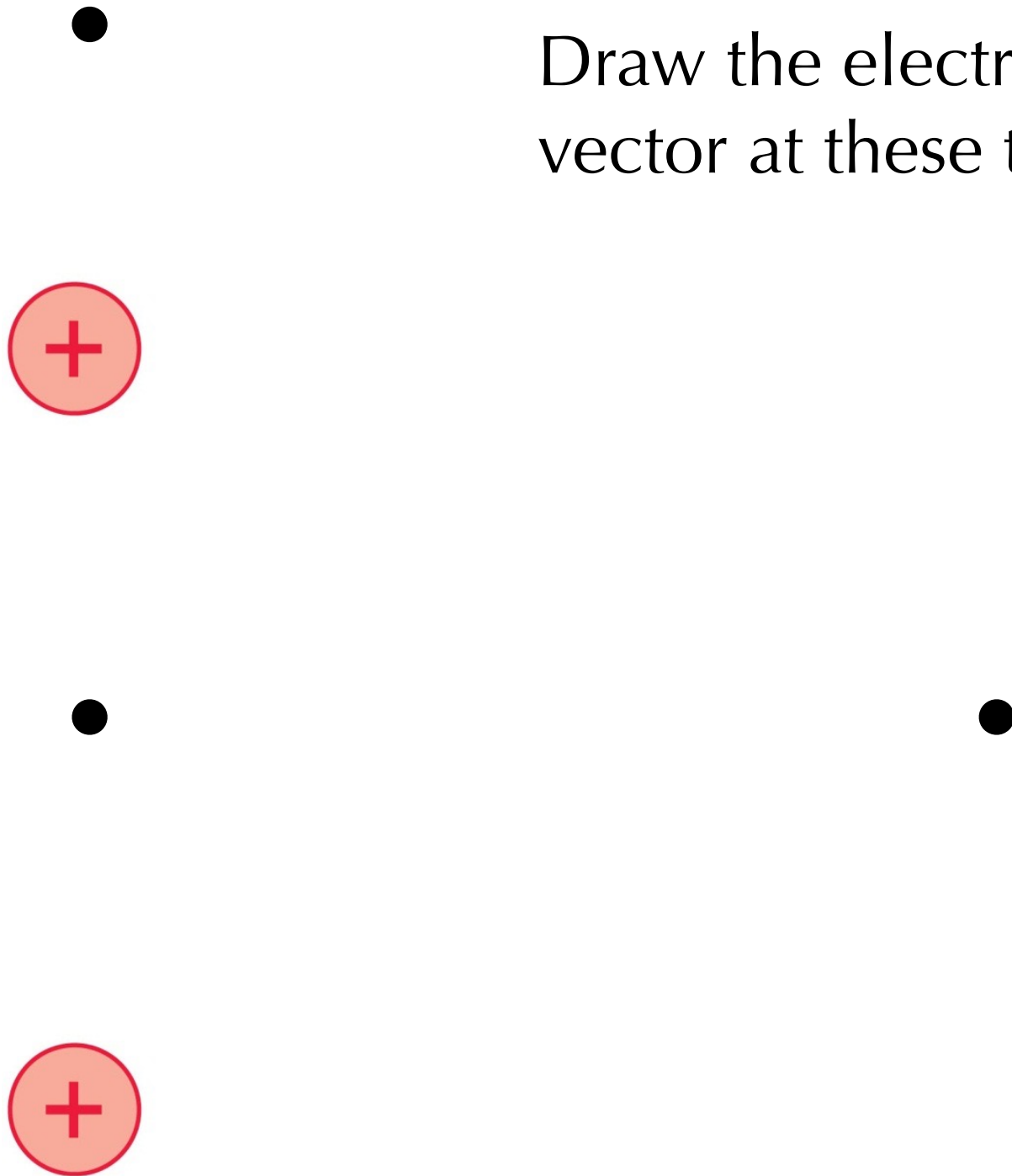
$$\vec{E} = \frac{kQ}{r^2} \hat{r}$$

Draw the electric field vector at these three points.



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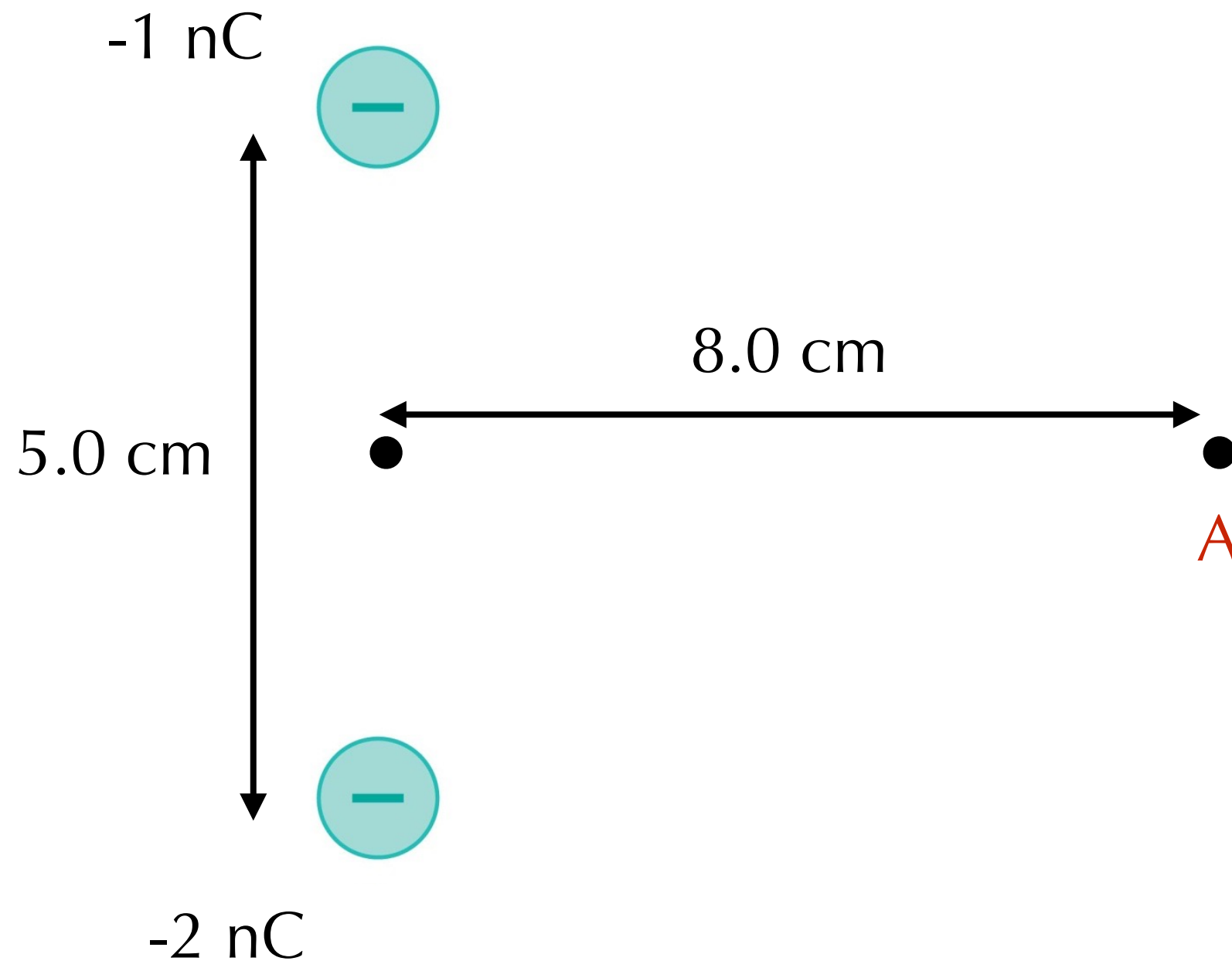


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Draw the electric field vector at these three points.

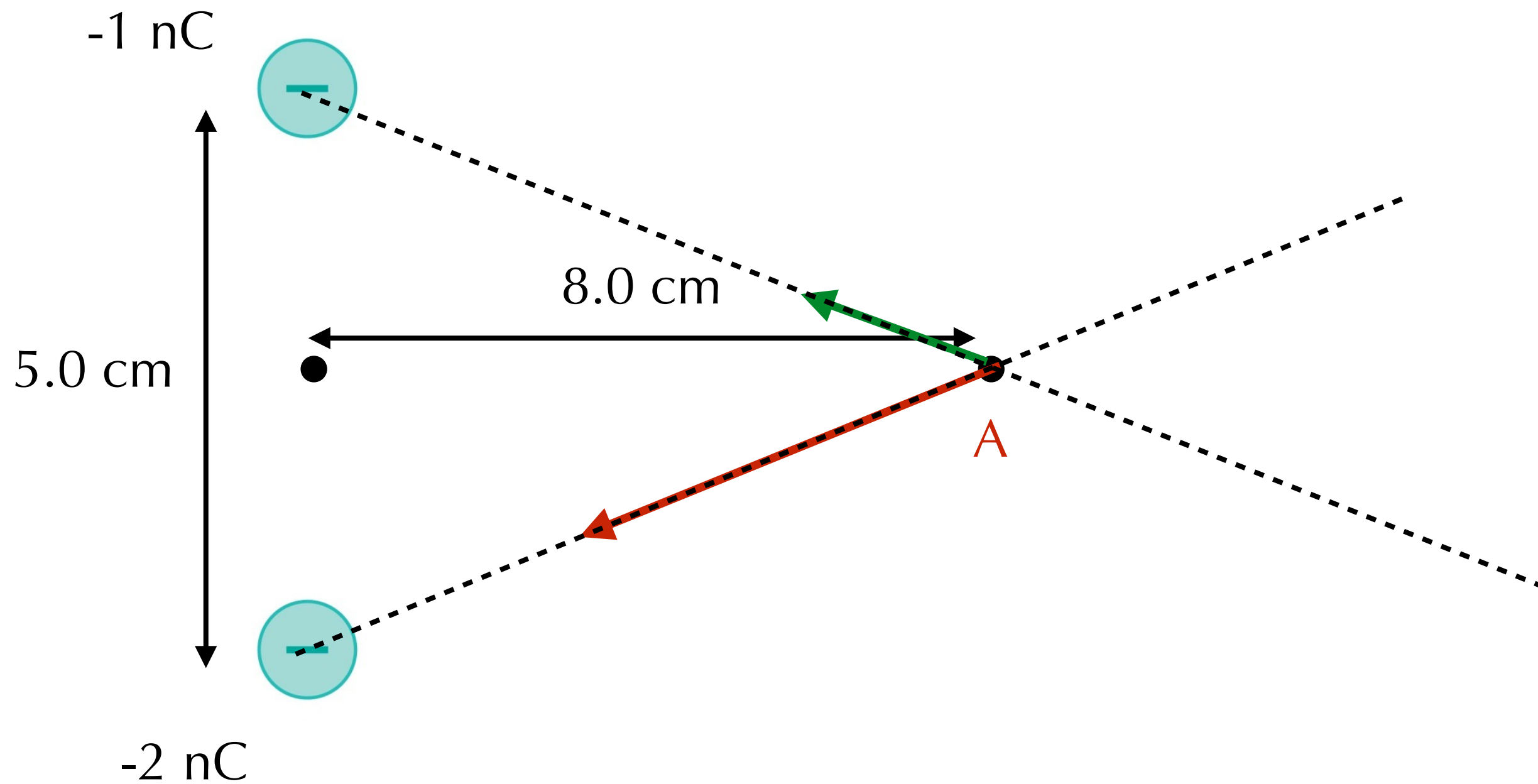


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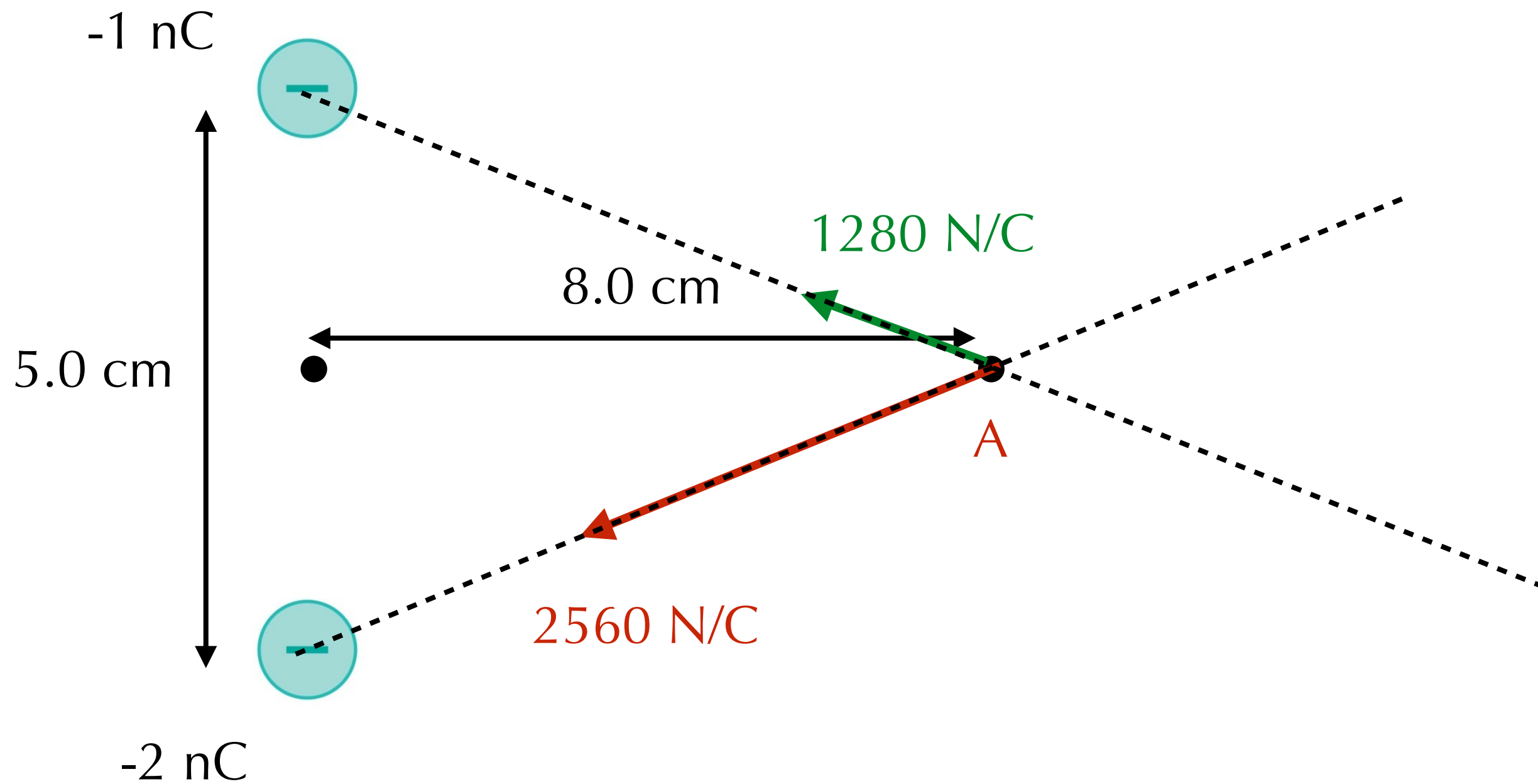
Find the magnitude and direction of the electric field at point A.

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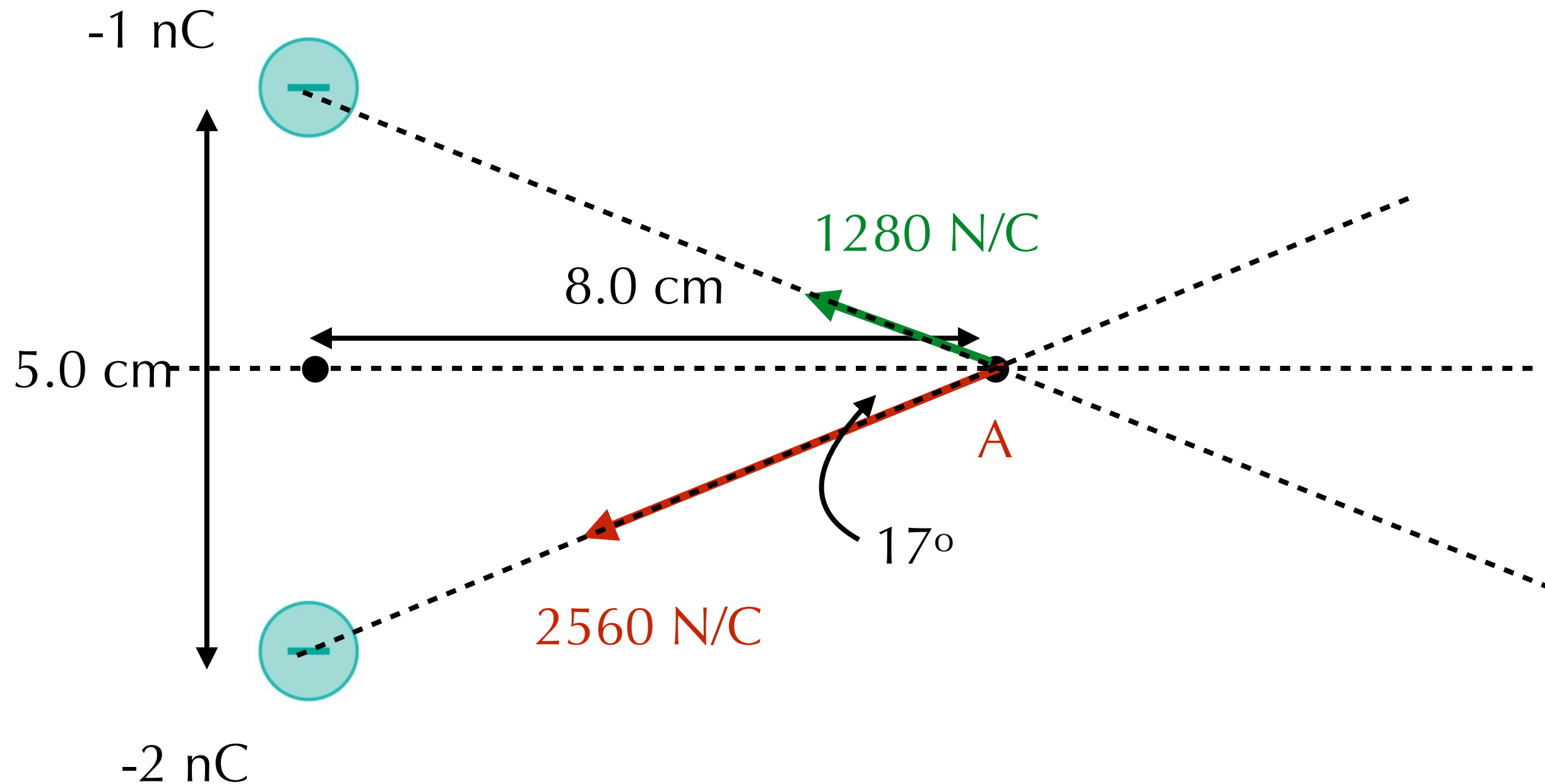
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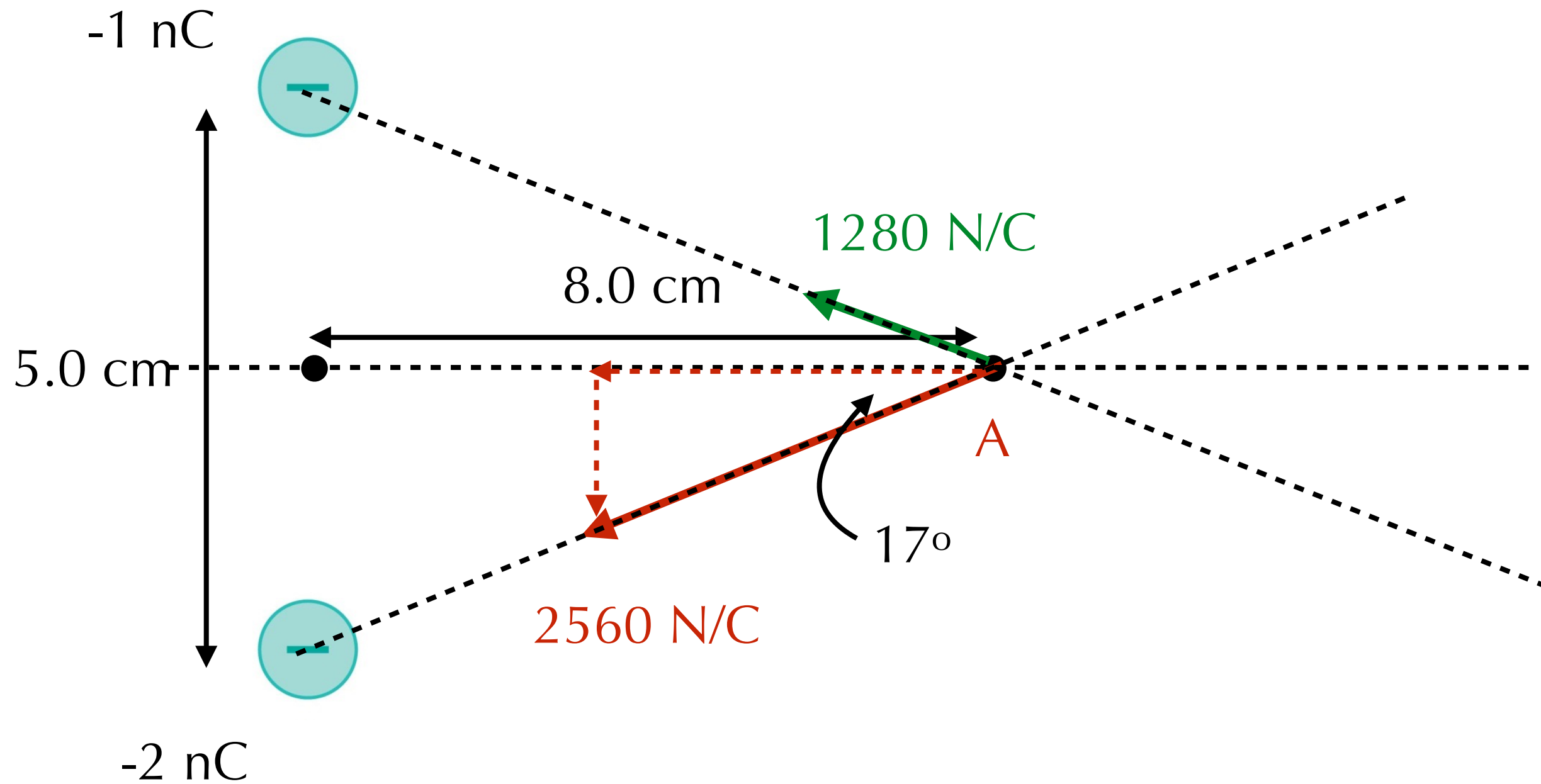
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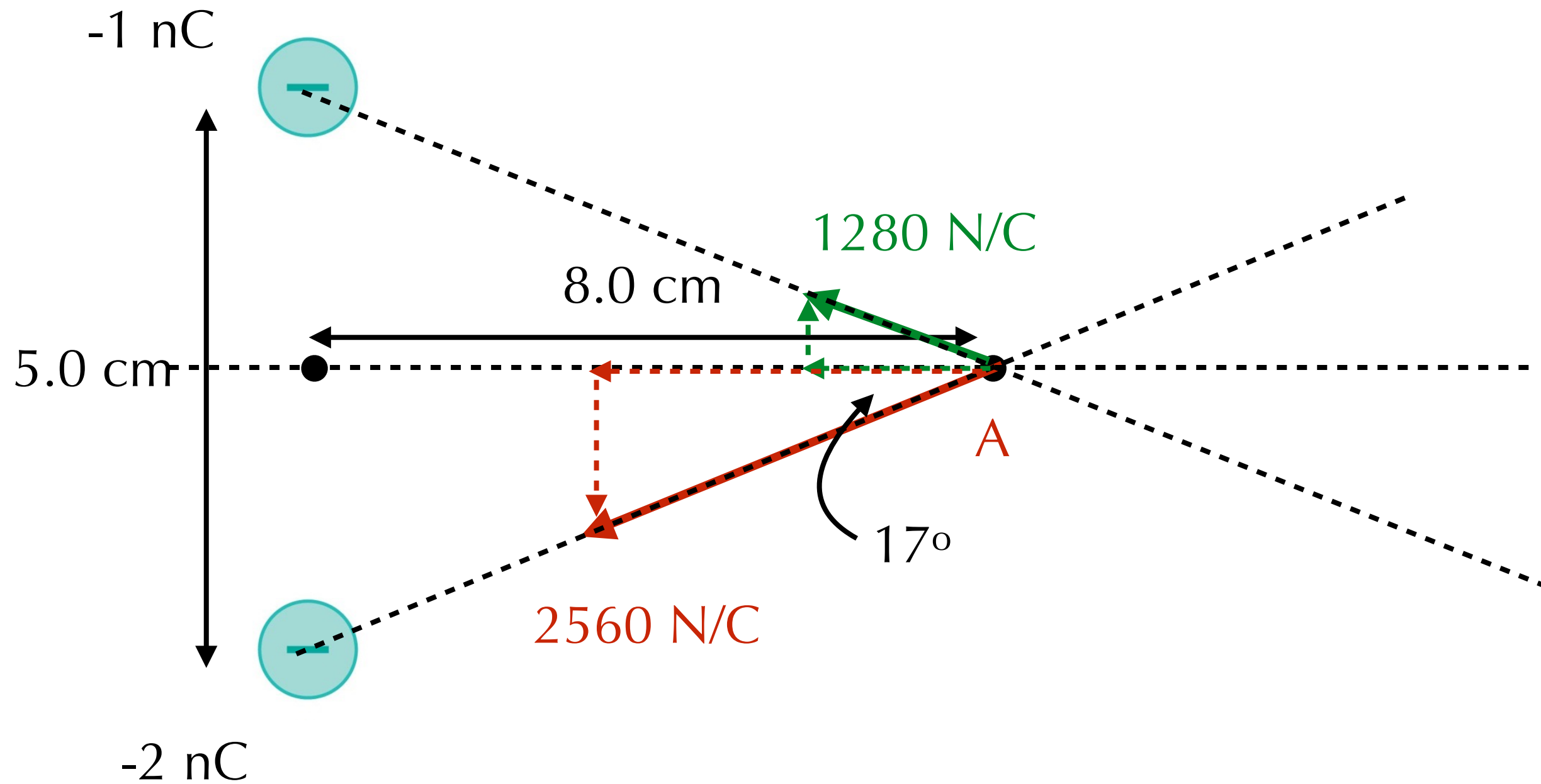
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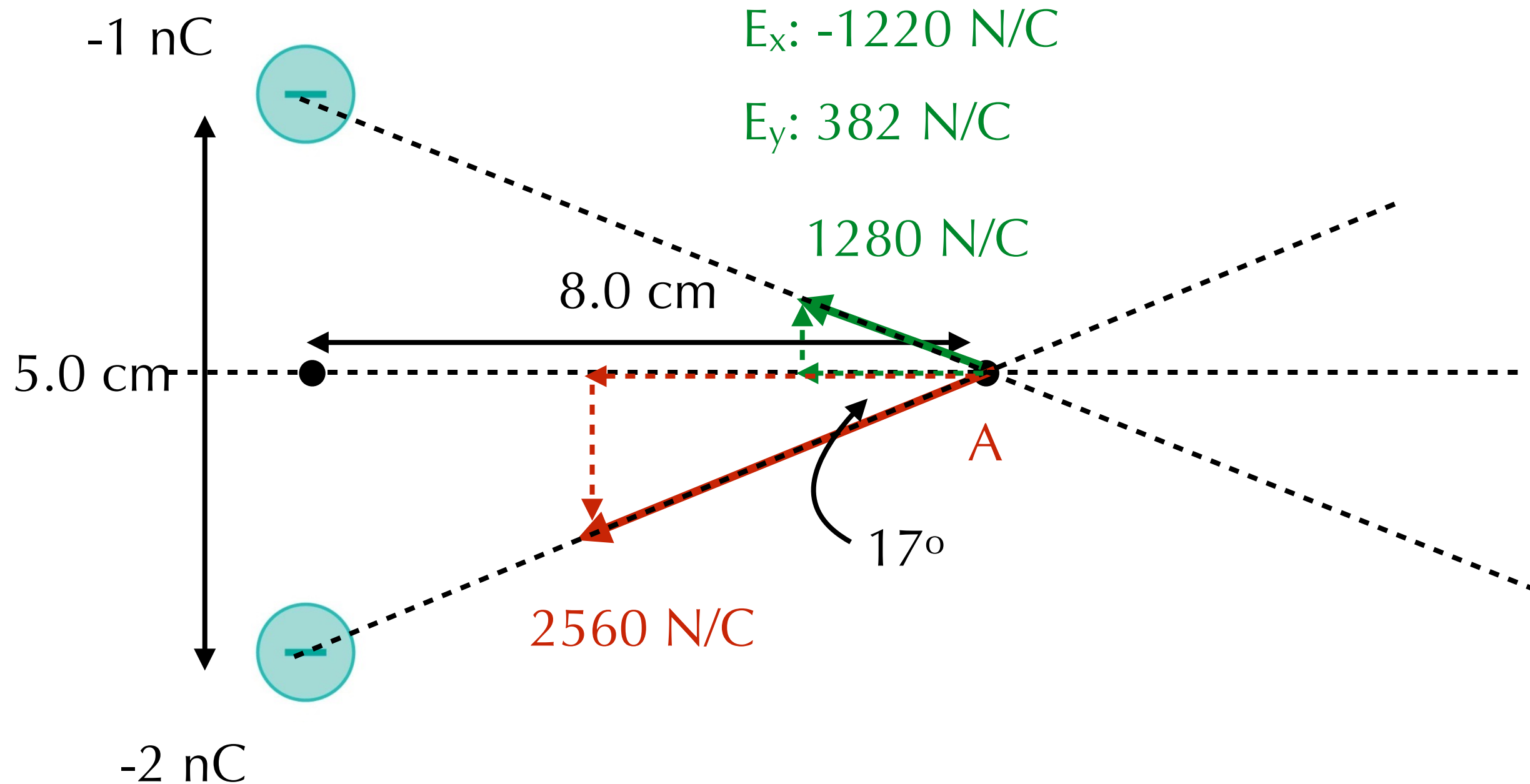
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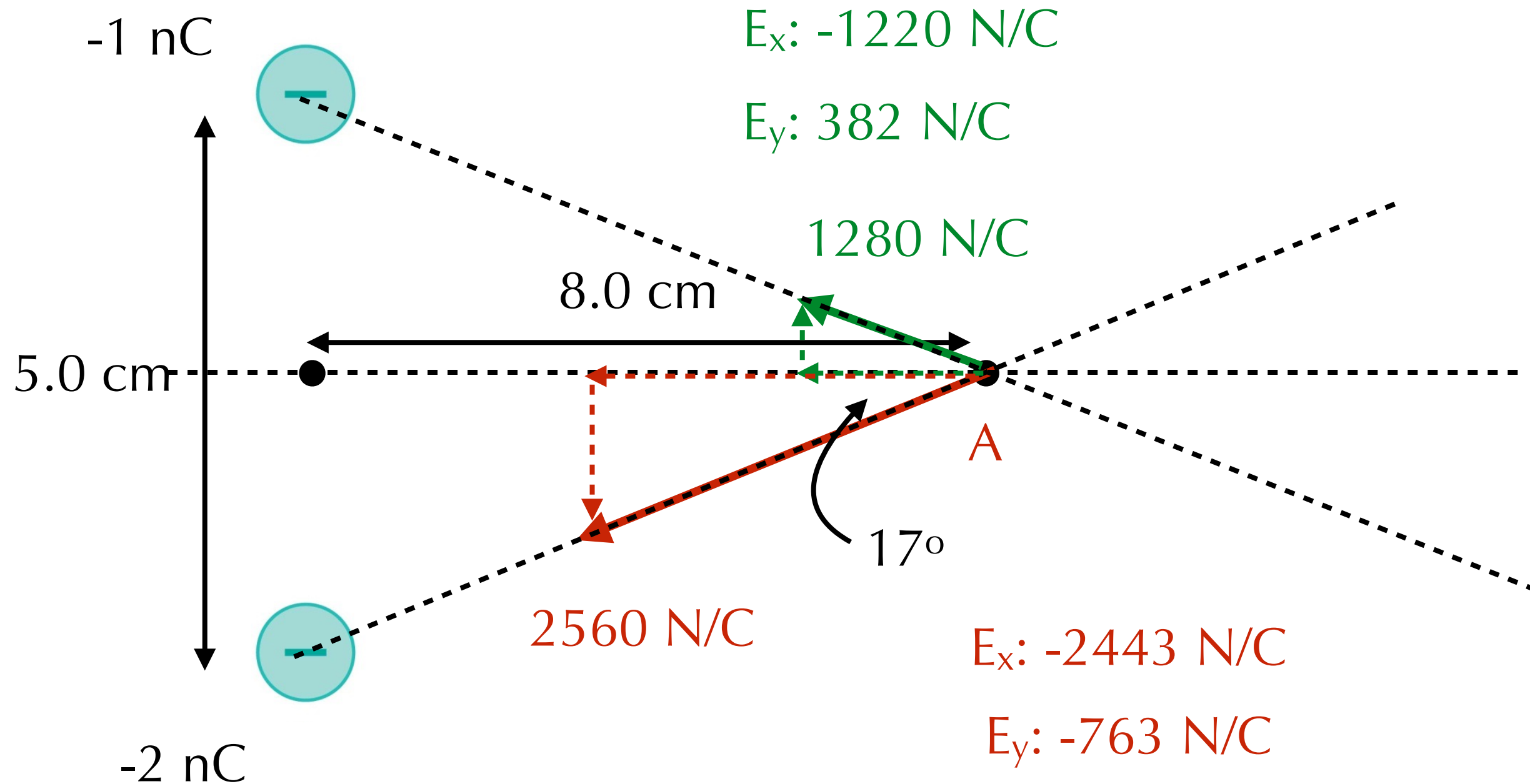
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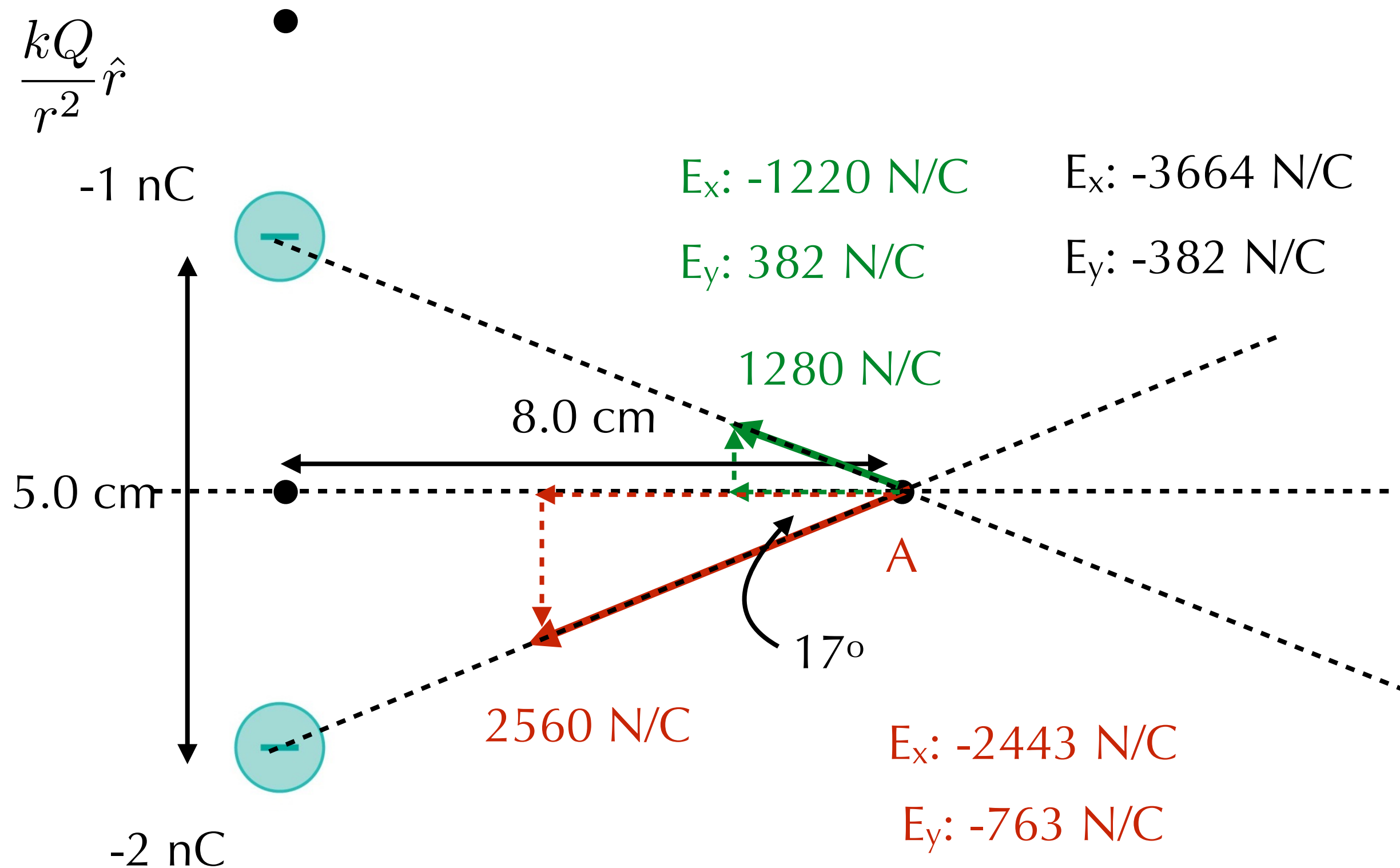
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-1 nC



5.0 cm



2 nC



Modify your code to find
the components of the
electric field!!

6.0 cm



2.0 cm



