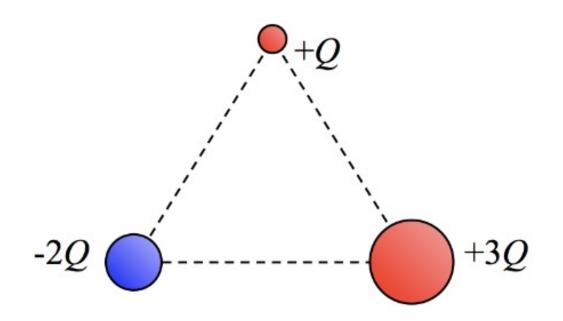
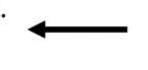
## Physics: 3D Field Simulation



a.



d.



e.



**Question:** Three point charges, of charge +Q, -2Q, and +3Q, are placed equidistant as shown. Which vector best describes the net direction of the electric force acting on the +Q charge?

## **GPT-40 with CoT:**

- 1. Forces Due to the Charges:
  - The -2Q charge attracts the +Q charge. (Force points downward-left).



- The +3Q charge repels the +Q charge. (Force points downward-right).
- 2. Force Magnitudes (Coulomb's Law):
  - Force due to -2Q:  $F_{-2Q}=rac{2kQ^2}{r^2}$ .
  - Force due to +3Q:  $F_{+3Q} = \frac{3kQ^2}{r^2}$ .
- 3. Force Directions:
  - -2Q: Downward-left.
  - +3Q: Downward-right.
- 4. Force Components (at  $60^{\circ}$ ):
  - Horizontal:  $F_{-2Q,x}=-rac{kQ^2}{r^2}$  ,  $F_{+3Q,x}=+rac{3kQ^2}{2r^2}$  .

Vertical:

$$F_{-2Q,y}=-rac{\sqrt{3}kQ^2}{r^2}$$
 ,  $F_{+3Q,y}=-rac{3\sqrt{3}kQ^2}{2r^2}$ 

- 5. Net Force Components:
  - Horizontal:  $F_x = \frac{kQ^2}{2r^2}$ .
  - Vertical:  $F_{y}=-rac{5\sqrt{3}kQ^{2}}{2r^{2}}$ .
- 6. Net Force Direction:

The net force is determined by

$$an^{-1}\left(rac{F_y}{F_x}
ight).$$

 $F_x>0$  and  $F_y<0$  indicate the direction is downward-right.

Final Answer: |e|.

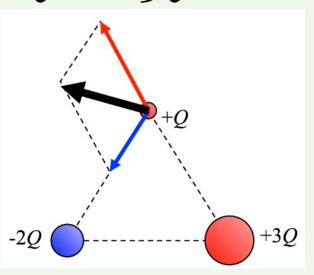
## Direct GPT-40: b.



**Error Analysis:** Misunderstand the net force's direction during vector addition. The issue arose from not correctly identifying the force direction from +3Q to +Q (longer red arrow in vector graphic on the right), which causes the net force to point \, not downward-right **\** in **⊗** .

## **Human Reasoning (Ground Truth):**

The direction of the electric force due to -2Q and +3Q can be visualized with a



quick free-body sketch of the electric forces:

