Figure shows three particles with charges $q_1 = +2Q$, $q_2 = -2Q$ and $q_3 = -4Q$, each a distance d from the origin. Find the net electric field $\vec{E}$ at the origin.

Solution:

Electric field is defined as the electric force per unit charge. The direction of the field is taken to be the direction of the force it would exert on a positive test charge. The electric field is radially outward from a positive charge and radially in toward a negative point charge.

$$\vec{E} = \frac{\vec{F}}{q} = \frac{q}{4\pi\varepsilon_0 d}$$
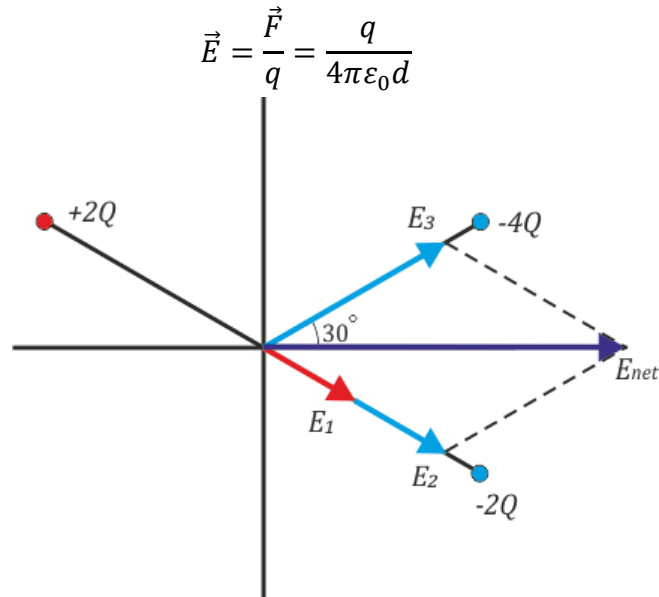
The net field is

$$\vec{E}_{net} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3$$

$$E_{net} = 2E_3 \cos 30° = \frac{2 \cdot 4Q}{4\pi\varepsilon_0 d} \cos 30° = \frac{8Q}{4\pi\varepsilon_0 d}\frac{\sqrt{3}}{2} = \frac{6.93Q}{4\pi\varepsilon_0 d}$$

Answer: (b) $E_{net} = \frac{6.93Q}{4\pi\varepsilon_0 d}$ towards +ve x-axis.