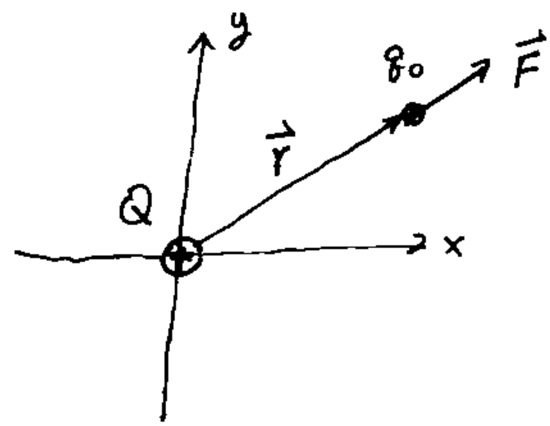
- The electric field of a point charge. Q.
  ← size → 0.

Let's put Q at the origin. (Let Q — positive)

the test charge q_0 is at $\vec{r}\ (x, y, z)$.



The electric force due to Q acting on q_0 is:

$$\vec{F} = k \frac{Q q_0}{r^2} \cdot \frac{\vec{r}}{r}$$

the electric field at location $\vec{r}$ is:

$$\boxed{\vec{E} = \frac{\vec{F}}{q_0} = k \frac{Q}{r^2} \cdot \frac{\vec{r}}{r}.}$$

This is correct even when Q is negative.

(the sign of Q will indicate the correct direction of $\vec{E}$)

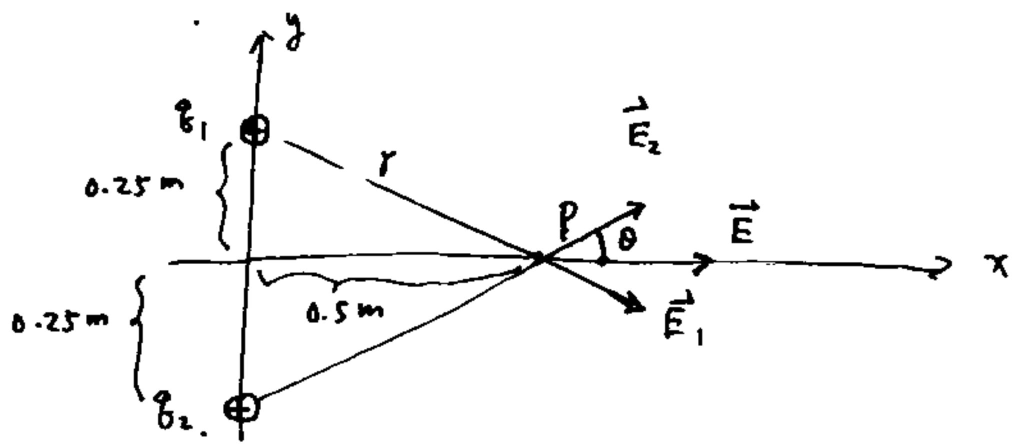
Magnitude : $E = k \frac{|Q|}{r^2}$. $\left(\propto \frac{Q}{r^2}\right)$

- Superposition.

The net field due to two charges is equal to the sum of the fields due to individual charges.
↖ vector sum.

i.e., $$\underbrace{\vec{E}_{Total}}_{\text{due to } (Q_1,\, Q_2)} = \underbrace{\vec{E}_1}_{\text{due to } Q_1} + \underbrace{\vec{E}_2}_{\text{due to } Q_2}$$

e.g. Two charges, each equal to $2.90 \mu C$.



find the electric field at point P. (P — on x-axis)

$$\vec{E} = \vec{E}_1 + \vec{E}_2 .$$

at $\vec{P}$:

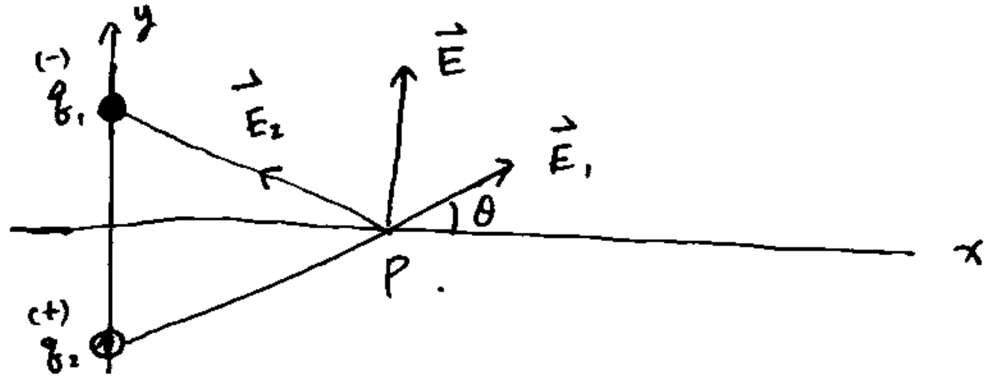
$$E_x = E_{1x} + E_{2x} = 2 E_1 \cos\theta =$$

$$E_y = E_{1y} + E_{2y} = 0. \quad (\because \ E_{1y} = -E_{2y}).$$

$$\therefore \quad \vec{E} = 2 E_1 \cdot \cos\theta \cdot \hat{x} . \qquad \left(E_1 = k \frac{q_1}{(0.25^2 + 0.5^2)} = \right)$$

e.g: Two charges. $q_1 = -2.9\,\mu C$.

$q_2 = 2.9\,\mu C$.



$$\vec{E} = \vec{E}_1 + \vec{E}_2$$

at P:

$$E_x = E_{1x} + E_{2x} = 0 \qquad (E_{1x} = -E_{2x})$$

$$E_y = 2\,E_1 \sin\theta .$$

$$\therefore\ \vec{E} = 2E_1 \cdot \sin\theta\ \hat{y}. \qquad (\text{when } P \text{ is on } x\text{-axis})$$

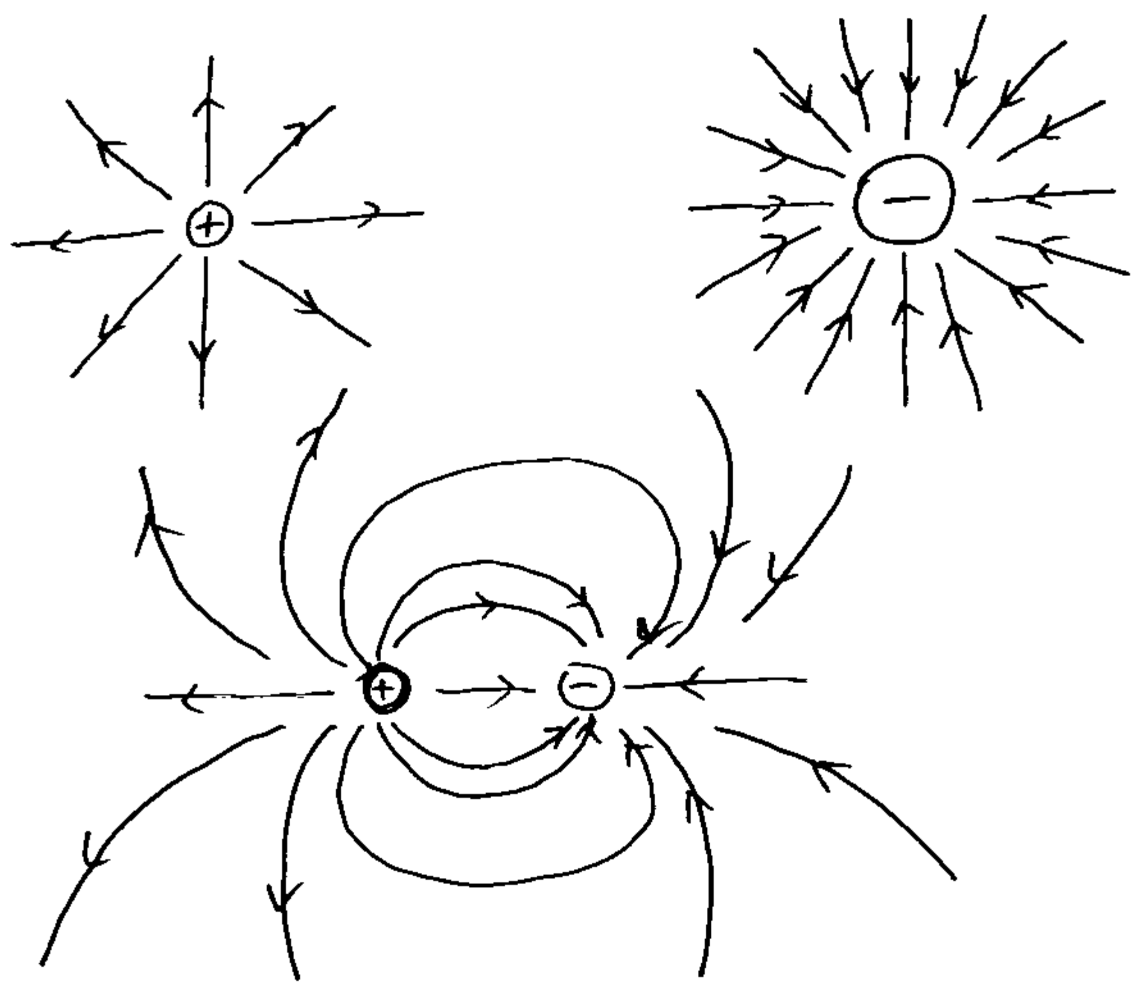
- Electric Field Lines

— A Pictorial representation of the electric field.

Rules for drawing the field lines:

1. Point in the direction of $\vec{E}$ at every point.
2. Start at positive charges or ∞.
3. End at negative charges or ∞.
4. The greater the E, the more dense the lines.

e.g.:



See p. 628