

Electricity Summary

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We have studied two theories of electricity.

- ▶ Coulomb's little (18th century, old) theory
- ▶ Faraday and Maxwell's big (19th century, new) theory

Coulomb's little theory

- ▶ Two equations

$$F = k \frac{|qQ|}{r^2}, \text{ like charges repel, unlike charges attract}$$

$$\text{PE} = k \frac{qQ}{r}$$

- ▶ Coulomb's little theory has only one aspect (compared with the two aspects of Faraday and Maxwell's big theory).
- ▶ A particle produces a force on another particle.
- ▶ Two or more particles have a potential energy.
- ▶ Point charges q and Q have an equal footing.
- ▶ This theory has no electric field, no electric potential.
- ▶ There are only point charges (particles) in this theory. There are no planes or plates of charge.

Faraday and Maxwell's big theory

- ▶ Faraday and Maxwell's big theory has two aspects.
 - ▶ Aspect 1: Charge creates electric field and electric potential.
 - ▶ A point charge Q creates an electric field. $E = k \frac{|Q|}{r^2}$
 - ▶ A point charge Q creates an electric potential. $V = k \frac{Q}{r}$
 - ▶ A plate σ creates an electric field. $E = 2\pi k |\sigma|$
 - ▶ A plate σ creates an electric potential. $V = -2\pi k \sigma |x|$
 - ▶ Aspect 2: Electric field exerts force on charge. Electric potential invests charge with potential energy.
 - ▶ Electric field \vec{E} exerts force on point charge q . $\vec{F} = q\vec{E}$
 - ▶ Electric potential V gives potential energy to q . $PE = qV$
- ▶ Charges Q and σ create the electric field and electric potential (aspect 1).
- ▶ Charge q feels the effect of electric field and electric potential by feeling a force and having potential energy (aspect 2).
- ▶ This theory deals with both point charges and plates of charge.