

Section 7: Static Electricity

The following maps the videos in this section to the Texas Essential Knowledge and Skills for Physics TAC §112.39(c).

7.01 Electric Charge

- Physics (5)(E)

7.02 Coulomb's Law

Note: This section requires use of trigonometry.

- Physics (5)(C)
- Physics (5)(D)

7.03 Electric Field

Note: This section requires use of trigonometry.

- Physics (5)(C)
- Physics (5)(D)

Note: Unless stated otherwise, any sample data is fictitious and used solely for the purpose of instruction.

7.01

Electric Charge

Electric charge – A characteristic of an object that allows it to interact with other charged objects via the electric force

- The two most important charged particles are _____ and _____.
- Through various physical processes, charge can be transferred between objects. This results in each object having a _____ positive or negative charge.
- Charge is always _____.

Conductor – A type of material that allows charge to move about easily

Insulator – A type of material in which charge cannot move about easily

7.02

Coulomb's Law

Coulomb's Law – Two charged objects exert an **electrostatic force** on one another.

- Charges with the same sign experience a _____ force.
- Charges with opposite signs experience an _____ force.

Coulomb's Law governs the strength of the electrostatic force between two objects with charges q_A and q_B .

$$F = K \frac{q_A q_B}{r^2}$$

$$\text{where } K = 9.0 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2}$$

- Electric charge is measured in units of **coulombs (C)**.
- One coulomb is equivalent to the charge of 6.24×10^{18} electrons or protons.
- The **elementary charge** is the magnitude of the charge of an electron or proton.
- The elementary charge is 1.60×10^{-19} C.

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TIP**

The electrostatic force is stronger with

- larger charge magnitudes or
- less separation between charges.

1. Spheres A and B have charges of $+4.0 \mu\text{C}$ and $-2.0 \mu\text{C}$ respectively. Sphere B is located 5.0 cm to the left of sphere A. Find the electrostatic force of sphere A on sphere B.

2. Spheres A and B have charges of $+4.0 \mu\text{C}$ and $-2.0 \mu\text{C}$ respectively. Sphere B is located 5.0 cm to the left of sphere A. Now, if a third sphere, C, with charge $3.0 \mu\text{C}$ is placed 2.0 cm directly below sphere B, find the net force on sphere B.

7.02

Electric Field

Electric field – The amount of force per unit charge that particles will experience at a particular point in space

- Electric field is a _____ quantity.
- We use **electric field lines** to illustrate the direction of an electric field at a point in space.
- Charged objects both *create* and *experience* electric fields.
 - Electric field lines point _____ objects that have positive charge.
 - Electric field lines point _____ objects that have negative charge.

- The strength of an electric field created *by* an object with charge q , measured at a distance r from the object, is given by $E = k \frac{q}{r^2}$.

- The strength of an electric field *on* a charged object is given by $E = \frac{F_{\text{on } q'}}{q'}$.

1. What is the electric field strength at a point that is 0.4 m to the left of a sphere with a net charge of $-3.0 \mu\text{C}$?

2. If we wish to measure an electric field strength of 300 N/C from an object with a net charge of $15 \mu\text{C}$, how far away from the object must we measure?