Coulomb Force between Point Charges

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Solution method

Step 1 : Calculate the electric field of a single point charge

A. Write down target equation and given values

- Electric field ➠ $E = \frac{q}{4\pi \cdot r^2 \cdot \epsilon_0}$
- Vacuum permittivity $\epsilon_0 = 8{,}854 \cdot 10^{-12}\ C/Vm$
- Point charge $q = -\,8.01 \cdot 10^{-19}\ C$
- Field strength is evaluated at radius $r = 3 \cdot 10^{-11}\ m$

B. Insert values into target equation

- Inserting given values yields ➠ $E \approx -\,8 \cdot 10^{12}\ V/m$

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Step 2 : Calculate Coulomb force between 2 point charges

C. Write down target equation and given values

- Coulomb force equation ➠ $F_{12} = q_1 \cdot E_2 = \frac{q_1 \cdot q_2}{4\pi \cdot {r_{12}}^2 \cdot \epsilon_0}$
- Sign and amount of charge $q_2 = 1.602 \cdot 10^{-18}\ C$

D. Calculate Coulomb Force

- Inserting given values yields

$$F_{12} = 1.602 \cdot 10^{-18}\ C \cdot (-8) \cdot 10^{-12}\ V/m = -\ 12.8 \cdot 10^{-6}\ N$$

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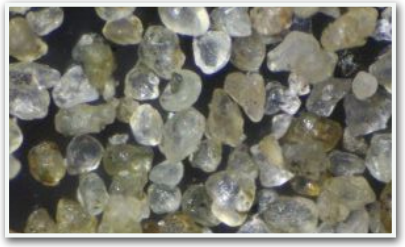
Step 3 : Compare Coulomb force with Tesla 3 acceleration

- A Tesla Model 3 accelerates from 0 to 100km/h in 3 seconds.

- Using $v = a \cdot t$, this results to $a_{Tesla} = 9.27\ m/s^2$.

- Using $m = F/a$, we can calculate how much weight we can accelerate with a_{Tesla} using the force F_{12} :

$$m = \frac{12.8 \cdot 10^{-6}\ N}{9.27 m/s^2} = 1.38 \cdot 10^{-3}\ g$$



a grain of sand
weighs $\approx 0.2 \cdot 10^{-3}\ g$

A Tesla Model 3
weighs $\approx 1.7 \cdot 10^{+6}\ g$