

Physics

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(Chapter 1) (Electric Charges and Fields)
(Class 12)

Question 1.1:

What is the force between two small charged spheres having charges of $2 \times 10^{-7}\text{C}$ and $3 \times 10^{-7}\text{C}$ placed 30 cm apart in air?

Answer 1.1:

Repulsive force of magnitude $6 \times 10^{-3}\text{N}$

Charge on the first sphere, $q_1 = 2 \times 10^{-7}\text{C}$

Charge on the second sphere, $q_2 = 3 \times 10^{-7}\text{C}$

Distance between the spheres, $r = 30\text{cm} = 0.3\text{m}$

Electrostatic force between the spheres is given by the relation $F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$

Where, ϵ_0 = Permittivity of free space and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{Nm}^2\text{C}^{-2}$

Therefore, force $F = \frac{9 \times 10^9 \times 2 \times 10^{-7}}{(0.3)^2} = 6 \times 10^{-3}\text{N}$

Hence, force between the two small charged spheres is $6 \times 10^{-3}\text{N}$. The charges are of same nature. Hence, force between them will be repulsive.

Question 1.2:

The electrostatic force on a small sphere of charge $0.4\mu\text{C}$ due to another small sphere of charge $-0.8\mu\text{C}$ in air is 0.2N .

(a) What is the distance between the two spheres?

(b) What is the force on the second sphere due to the first?

Answer 1.2:

(a) Electrostatic force on the first sphere, $F = 0.2\text{N}$

Charge on this sphere, $q_1 = 0.4\mu\text{C} = 0.4 \times 10^{-6}\text{C}$

Charge on the second sphere, $q_2 = -0.8\mu\text{C} = -0.8 \times 10^{-6}\text{C}$

Electrostatic force between the spheres is given by

$$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$$

Where, ϵ_0 = Permittivity of free space and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{Nm}^2\text{C}^{-2}$

Therefore,

$$r^2 = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{F} = \frac{0.4 \times 10^{-6} \times 8 \times 10^{-6} \times 9 \times 10^9}{0.2} = 144 \times 10^{-4}$$

$$\Rightarrow r = \sqrt{144 \times 10^{-4}}$$

$$= 12 \times 10^{-2}$$

$$= 0.12\text{m}$$

The distance between the two spheres is 0.12m .

(b) Both the spheres attract each other with the same force. Therefore, the force on the second sphere due to the first is 0.2N .

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