Electrostatics – Part 6

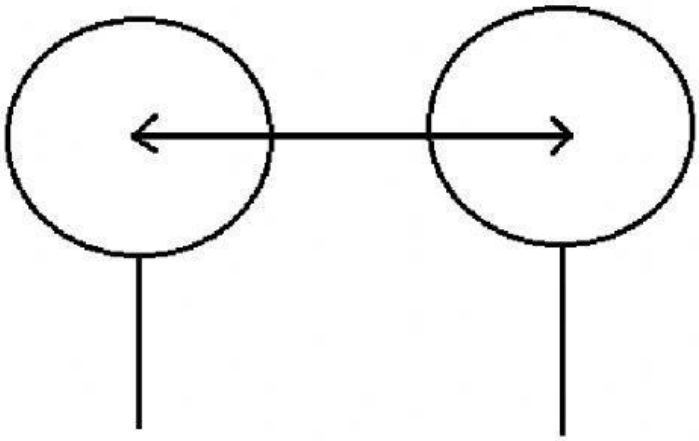
Electrostatic Force

When 2 charged objects are brought close to each other they will exert a **force** of attraction or repulsion on each other, even if they are not touching. The area in which they experience a force is called a field.

It is possible to calculate the strength of the force that these 2 objects exert on each other.

First let's look at what factors will affect this force:

1. Distance between the objects:



The further apart / greater the distance between the spheres, the weaker the force that they will exert on each other.

Thus the force is indirectly proportional to the distance: $F \propto \frac{1}{r^2}$

2. The magnitude of the charges

The bigger the charge on the spheres, the greater the force that they will exert on each other.

$$F \propto Q$$

The unit for force is the Newton (N) and the size of the electrostatic force can be calculated using Coulomb's Law:

Coulomb's Law

The electrostatic force between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them.

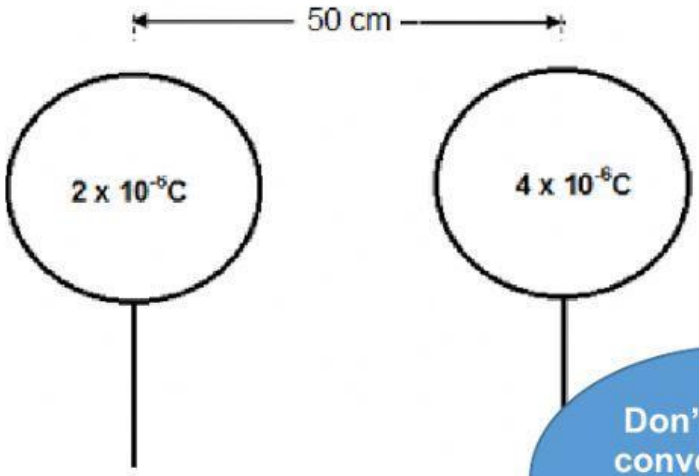
$$F = \frac{kQ_1Q_2}{r^2}$$

The constant, $k = 9 \times 10^9$

	Symbol	Unit
charge	Q	C
Electrostatic force	F	N
Distance between 2 spheres	r	m

To calculate the electrostatic force between 2 objects:

Example 1



Don't forget to convert all your units before you start!

$$F = \frac{kQ_1Q_2}{r^2}$$

$$= \frac{9 \times 10^9 (2 \times 10^{-6}) (4 \times 10^{-6})}{(0{,}50)^2}$$

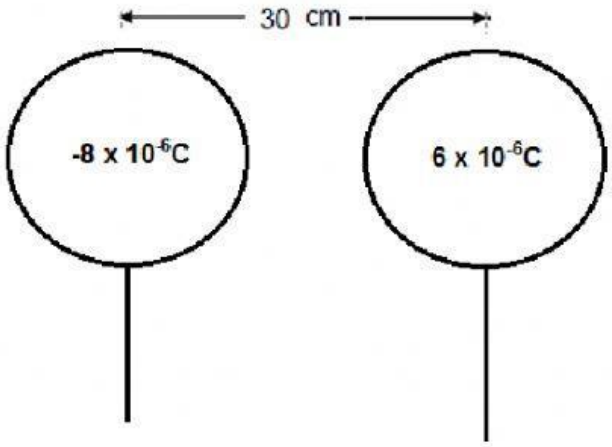
= 0,29 N repulsive

You need to specify whether the force is attractive or repulsive – you can work this out from the signs on the original charges.

Exercise 5

Calculate the electrostatic force between the following

1



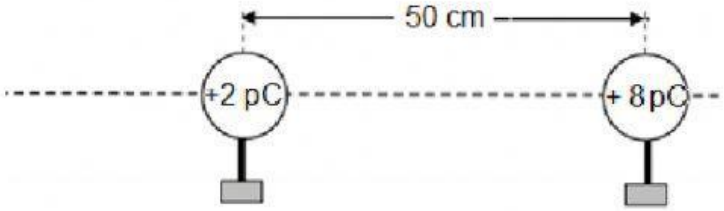
$F = \frac{kQ_1Q_2}{r^2}$

$= \frac{9 \times 10^9 \times \quad \times}{(\quad)^2}$

= N attractive / repulsive

Note that we DO NOT use signs for the charges for force calculations. F must be positive and we use the original signs to determine if it is attraction/repulsion.

2



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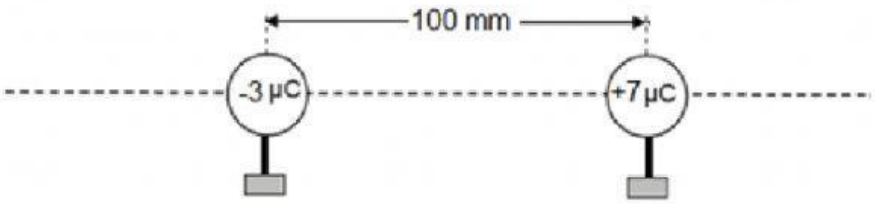

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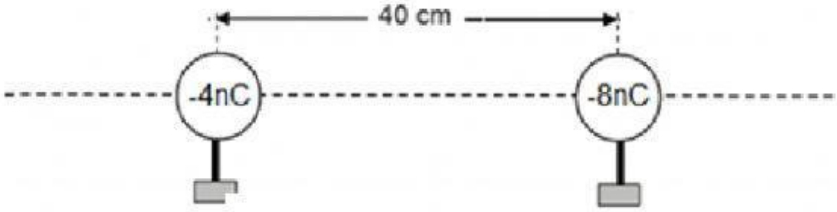

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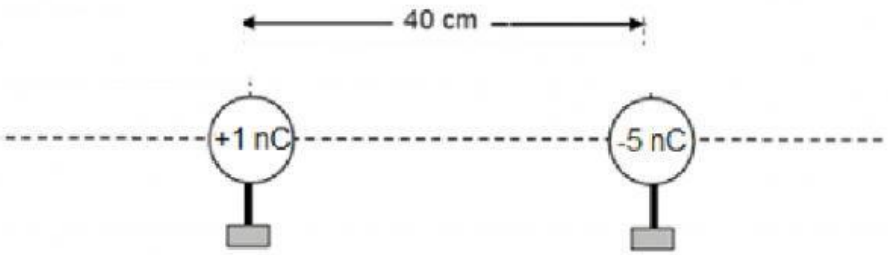

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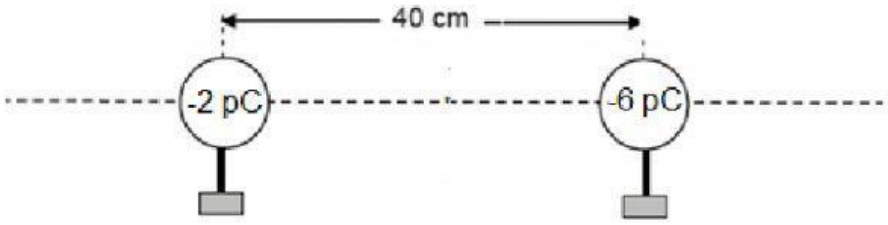

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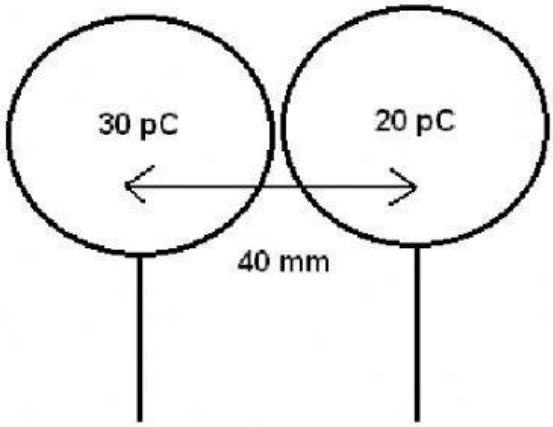

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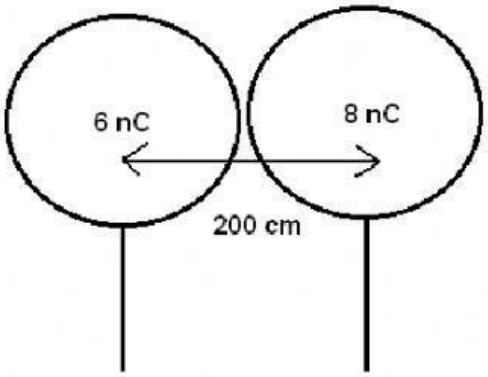

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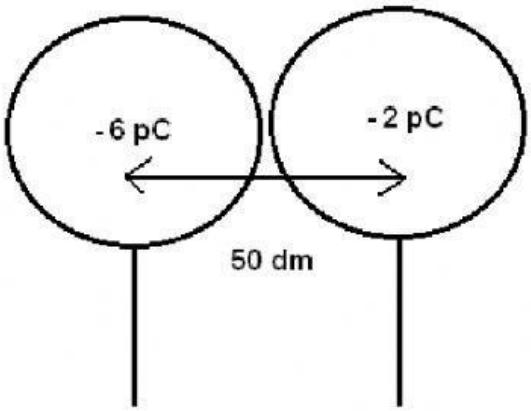

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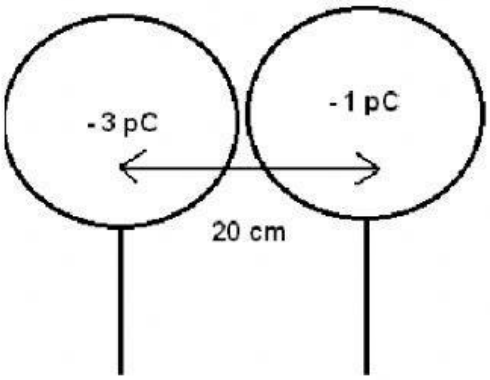

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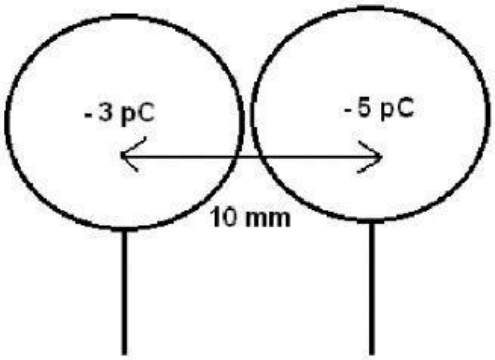

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