Coulomb's law

Introduction

Charges attract or repel each other, that is they exert forces upon each other. This force depends on the magnitude of the charge and on the distance between them. Lets think about how these two quantities affect the force. Complete in the sentences below:

a) The smaller the charges, the (*stronger/weaker*) ..... the forces they exert on each other.

b) The smaller the distance between the charges, the (*stronger/weaker*) ..... the forces they exert on each other.

Task

Go to

https://phet.colorado.edu/sims/html/coulombs-law/latest/coulombs-law_en.html

and choose „Macro Scale".

Tick the boxes for "Force Values" and "Scientific" at the bottom right corner.

Move the blue charge to the left and place its center over the ruler's "0" mark. In the box "Charge 1" set the magnitude to – 1 µC (this is 10^{-6} Coulomb).

Move the red charge to the right and place its center over the ruler's "9 cm" mark. In the box "Charge 2" set the magnitude to – 1 µC.

Investigate the following options and write down the corresponding magnitude of the force:

a) How does the magnitude of the force depend on the amount of each charge?
(r = 9 cm)

Q_1 [µC]	–1	–1	–1	–1
Q_2 [µC]	–1	–2	–3	–4
F [N]				

Look at the values for F and fill in the spaces with a numerical value:

If one of the charges is doubled, the force changes by the factor.....

If one of the charges is tripled, the force changes by the factor.....

If one of the charges is multiplied by four, the force changes by the factor.....

b) How does the magnitude of the force depend on the distance between the charges?
(Q_1 = - 1 µC, Q_1 = - 1 µC)

r [cm]	9 cm	4.5 cm	3 cm
F [N]			

Look at the values for *F* and fill in the spaces with a numerical value:

If the distance between the charges is divided by two, the force changes by the factor.....

If the distance between the charges is divided by three, the force changes by the factor.....

Conclusion

Look up Coulomb's law in your *Formulae, Tables and Concepts* (page 173). In a vacuum, $\varepsilon_r = 1$, therefore $\varepsilon = \varepsilon_0$. Write it in the box:

Coulomb's law

The vacuum permittivity is a constant. Its value is

$$\varepsilon_0 = 8.8542 \cdot 10^{-12} \frac{C^2}{N \cdot m^2}$$