Name: Key

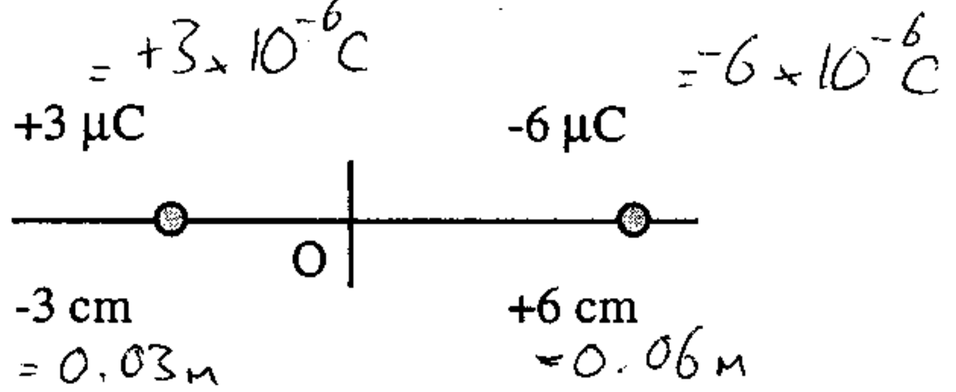
Physics 2020 – Fall 2001

Quiz #1

$e = 1.602 \times 10^{-19}\,C$ $\quad \varepsilon_0 = 8.85 \times 10\text{-}12\ C^2/(m^2\,N)$ $\quad k = 8.99 \times 10^9\ N\,m^2/C^2$

You must show your working and/or explain your answers to receive full credit.

1. Two point charges are placed on the x-axis as shown: a -6 μC charge is placed at x = +6 cm, and a +3 μC charge is placed at x = -3 cm. (A μC is 10^{-6} C.)



a) At the origin O (x = 0 cm) what is the direction of the total electric field. (You do not need to do a calculation to determine this!) Explain your answer. (4 points)

E-fields always point from + to − so at the origin the field will point from left to right.

b) Now calculate the magnitude of the total electric field at the origin. (3 points)

$$E_1 = \frac{kq_1}{r_1^2} = \frac{(8.99\times10^9\ N\,m^2/C^2)(3\times10^{-6})C}{(0.03\,m)^2} = 3.00\times10^7\ N/C$$ to the right

$$E_2 = \frac{kq_2}{r_2^2} = \frac{(8.99\times10^9\ N\,m^2/C^2)(6\times10^{-6}\,C)}{(0.06\,m)^2} = 1.50\times10^7\ N/C$$ to the right

$$E_{TOTAL} = E_1 + E_2 = 4.50\times10^7\ N/C$$

c) What would be the magnitude and direction of the electric force on a single electron placed at the origin? (3 points)

$$E = \frac{F}{q_0} \Rightarrow F = q_0 E = 1.602\times10^{-19}\,C \cdot 4.50\times10^7\ N/C$$

$$= 7.21\times10^{-12}\ N$$

Direction is to the left because the charge of an electron is negative so it feels a force in the opposite direction to E.