Name: ________________________________

Physics 117

Quiz 8 (5/1/2003)

Use as far as possible formula and try to explain your reasoning.

A) In ordinary salt (NaCl) an electron is transferred from one atom to the other (initially they are both neutral so one atom gets negatively charged and the other positively charged). If the atoms are separated by a distance of 0.1 nm, how strong is the electric force between them?

($k_e=9\cdot10^9$ Nm^2/C^2 , charge electron $Q_e=-1.6\cdot10^{-19}$ C)

After the exchange of the electron we have on one side a negative charge equal to that of one electron. On the other side an equal and positive charge.

$$F_e = k_e \frac{-Q_e \cdot Q_e}{r^2} = -9\cdot 10^9 \ \frac{Nm^2}{C^2}\frac{(1.6\cdot 10^{-19}\ C)^2}{\left(0.1\cdot 10^{-9} m\right)^2} = -2.304\cdot 10^{-8}\ N$$

B) What is the electric field at 2 cm from a negative charge Q=-4 mC=$-4\cdot10^{-3}$ C.

($k_e=9\cdot10^9$ Nm^2/C^2)

The electric field is the force excert on a test charge q divided by the test charge q

$$E_e = k_e \frac{Q}{r^2} = -9\cdot 10^9 \ \frac{Nm^2}{C^2}\frac{4\cdot 10^{-3}\ C}{\left(2\cdot 10^{-2} m\right)^2} = -9\cdot 10^{10}\frac{N}{C}$$

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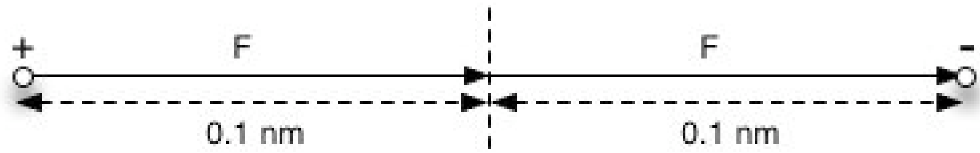
C) What is the electric field midway between an electron and a proton separated by 0.2 nm? (n.b. 1 nm=10^{-9} m)

($k_e=9\cdot10^9$ Nm^2/C^2 , $Q_e=-1.6\cdot10^{-19}$ C=$-Q_p$)



The electric field is the net force excert on a test charge q divided by the test charge q
Note that in this case the contributions from each charge add up in the center.
The charges would pull in opposite directions if they would be equal, but in this case they push in the same direction (that of the electron, look at the figure) because the charges are opposite.

$$E_e = \frac{F_{e,net}}{q} = \frac{F_e(Q_e) - F_e(Q_p)}{q} = k_e \frac{Q_e - Q_p}{r^2} = -9\cdot10^9 \ \frac{Nm^2}{C^2} \frac{2\cdot1.6\cdot10^{-19} \ C}{\left(10^{-10} m\right)^2} = -28.8\cdot10^{10}\frac{N}{C}$$

D) The difference in electric potential from a point A to a point B is +6 V.
How much work is required to take 2 mC of charge from A to B?

$$V = \frac{W}{q} \quad \Rightarrow \quad W = q\cdot V = 2\cdot10^{-3} \ C\cdot6 \ V = 12\cdot10^{-3} \ J$$