On Electric fields

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Warm-up problems

1. Describe in your own words what a field is in physics, and give 3 examples of physical fields.

2. Draw two diagrams with field lines to show

   (a) the electric field around an electron

   (b) the electric field around a positron

   (c) the electric field around a proton

3. Write down the formulæ which can be used to work out the force between two charges in a vacuum, and the magnitude of the electric field strength in a radial field (such as that from a point charge). Make sure you write down what physical quantity each of the symbols you use represents, and what unit is usually used to measure it.

Regular problems

4. In Rutherford's nuclear model, the nucleus was supposed to have a radius of around 10^{-15} m and the electrons were supposed to orbit in a sphere of radius 10^{-10} m.

   (a) In a hydrogen atom, what is the attraction force in Rutherford's model due to

      i. the electrostatic attraction?

      ii. the gravitational attraction?

   (b) Which force will play the dominanty role in the model?

5. There is evidence that the nucleus of a helium atom is very stable.

   (a) What is this evidence?

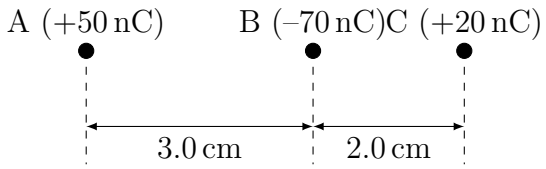
   (b) Estimate the electrostatic force between the two protons in a helium nucleus.

   (c) Now do the same for the gravitational force between these two protons.

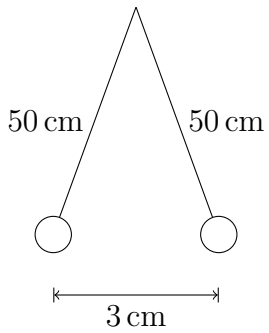
   (d) From your calculations what ought to happen to the two protons?

   (e) Give the name of the new force which had to be potulated to explain why this does not happen, and outline briefly its characteristics.

6. Three point charges, A, B, and C, are positioned in a line as shown. Calculate the resulting force acting on C.



7. Two light conducting spheres, each 6 mm in diameter and having a mass of 10 mg, are suspended from the same point by fine insulating fibres 50 cm long. Due to electrostatic repulsion, the spheres are in equilibrium when the centres of the spheres are 3 cm apart.



   (a) What is the force of repulsion between the spheres (you need to work out the horizontal force which is equal to the horizontal component of the tension in the wire)?

   (b) What is the charge on each sphere?