Department of Physics
Year 1 Tutorials
Module Phys123
Electricity and Magnetism

Tutorial 2

Issued	Thursday 14th October
Hand in to tutors	Wednesday 20th October 16:00
Tutorials	Friday 22nd October

See the Year 1 Notice Board for tutorial groups, tutors, locations and times of tutorials.

Problems

1. A proton is placed in a uniform electric field at the surface of the earth and the electric field is adjusted until the proton is held stationary in the electric field and the earth's gravitational field. What are the direction and magnitude of the electric field?

2. A positive charge of +2μC is placed at the centre of spherical Gaussian surface. What is the total electric flux out of the surface?
   The same charge is now placed at the centre of a cubical Gaussian surface. What is the total electric flux out of this surface?
   What is the electric flux through each of the faces of the cube?
   Do these results depend on the size of the cube?

3. The earth's electric field is measured at a height of 200 m and is found to be directed vertically downwards and to have a strength of 100 Vm^{-1}. At a height of 300 m, the direction of the field is found to be the same, but the field's strength has decreased to 60 Vm^{-1}. Use Gauss' law to determine the amount of charge contained in a cube of side 100 m with one face parallel to the earth's surface located at a height between 200 m and 300 m. (You may ignore the curvature of the earth.)

4. Four point charges of value 1 nC, 2 nC, 3 nC and 4 nC are placed in turn at the corners of a square of side 10 cm in a clockwise sequence. Determine the direction and magnitude of the electric field and the value of electric potential at the centre of the square.
   Which of these quantities changes if the charges are placed in an anti-clockwise sequence?
   Calculate the potential energy of the system assuming that all charges are brought in from infinite distance. (Hint: the potential energy of a charge q at a point with electric potential V is qV.