## 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 +2C 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 200m and is found to be directed vertically downwards and to have a strength of 100Vm1. At a height of 300m, the direction of the field is found to be the same, but the field’s strength has decreased to 60Vm1. Use Gauss’ law to determine the amount of charge contained in a cube of side 100m with one face parallel to the earth’s surface located at a height between 200m and 300m. (You may ignore the curvature of the earth.)
4. Four point charges of value 1nC, 2nC, 3nC and 4nC are placed in turn at the corners of a square of side 10cm 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.