

Answer ALL SIX questions from Section A and THREE questions from Section B.

The numbers in square brackets in the right-hand margin indicate the provisional allocation of maximum marks per sub-section of a question.

### SECTION A

[Part marks]

1. (a) Write down an expression for the electric potential generated at a point P by a point charge  $q$  at the origin. [2]  
(b) Write down an expression for the electric potential generated at a point P by a discrete collection of charges  $q_1, q_2, \dots, q_n$ . [2]  
(c) Define the electric field  $E$ . [2]  
(d) Write down an expression for the electric field generated at a point P by a point-like charge  $q$ . Define the constants appearing in the expression. [2]
2. Sketch the electric field lines for  
(a) a positive point charge. [2]  
(b) an electric dipole. [2]  
(c) two identical positive point charges separated by a distance  $d$ . [2]
3. (a) Define the flux of the electric field. [2]  
(b) State Gauss' law for electrostatics in integral form. [2]  
(c) Write down an expression for the electrostatic energy  $U$  of two charges  $q_1, q_2$  separated by a distance  $d$ . [2]
4. (a) Describe briefly what is meant by "conductor". [1]  
(b) What is the magnitude of the electric field inside a conductor at electrostatic equilibrium? [1]  
(c) If an isolated conductor at electrostatic equilibrium carries a charge, where does it reside? [2]  
(d) What is the direction of the electric field just outside a charged conductor at electrostatic equilibrium? Assume the charge on the conductor to be positive. [2]