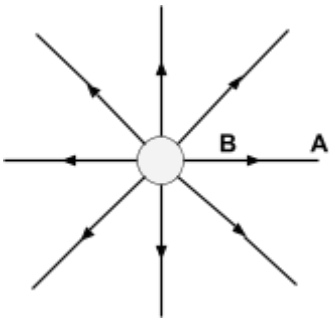
Particles and Waves

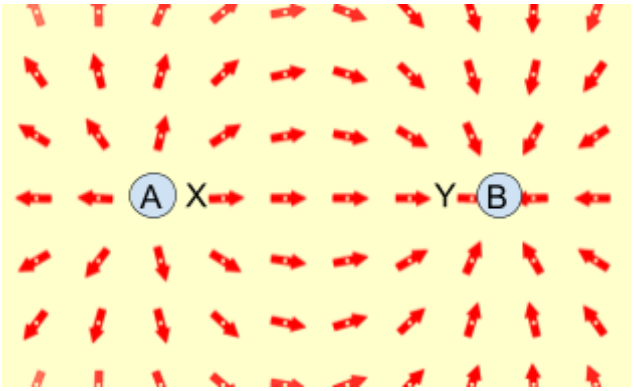
Moving charged particles in an Electric Field

1) The electric field around a charge is shown in the diagram.



   a) State what the lines with arrows indicate.
   b) State the sign of the charge in the diagram.
   c) A small positive charge of 2 coulombs is moved from position A to position B. The work done on the charge is 4 joules.
      Determine the potential difference in volts between position B and A.

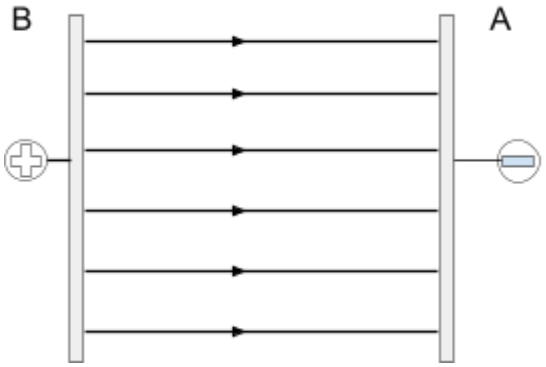
2) The diagram below shows the electric field around two electric charges.



   a) State the sign of charges A and B.
   b) A small positive charge is placed at position X. Describe its motion and direction.
   c) A small negative charge is placed at position Y. Describe its motion and direction.
   d) It requires 9 J of energy to move a +0.5 C charge from position Y to position X. Determine the potential difference between Y and X.
   e) The +0.5 C charge is released from position X. State its kinetic energy at position Y.

3) The potential difference between two points in an electric field is 900 volts.
   How much kinetic energy would an electron gain passing between these two points.
   Electron charge = 1.6 x 10^{-19} C

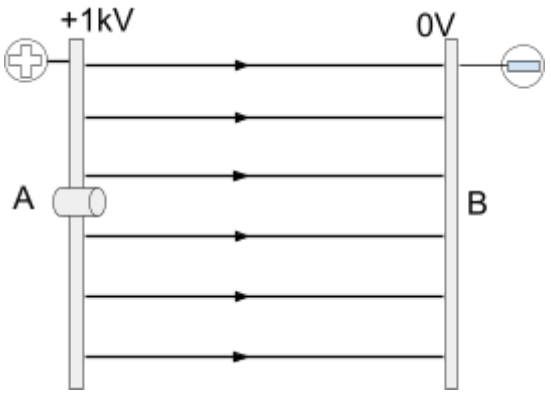
4) An electric field is created between two metal plates as shown below.



A small positive charge of 0.04 C is taken from plate A to B. The potential difference between the plates is 300 V.

a) Calculate the work done on the charge in taking it from plate A to plate B
b) The charge is released at position B. Describe its motion thereafter.
c) Determine the kinetic energy of the particle as it returns to plate A.

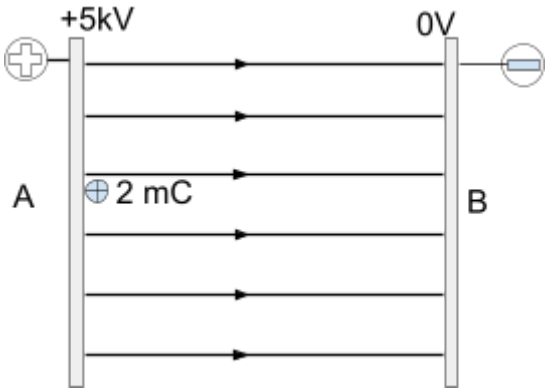
5) An alpha particle (helium nucleus) has a mass of 6.64×10^{-27} kg and an electric charge of 3.2×10^{-19} C.
An alpha particle enters the electric field between two metal plates at position A through a small hole.



The potential difference between the plates is 1000 volts.

a) Describe the motion of the alpha particle when it enters the electric field.
b) Determine the work done on the alpha particle by the electric field.
c) Calculate kinetic energy of the alpha particle when it reaches plate B assuming it was at rest at position A.
d) Find the speed of the alpha particle at plate B.

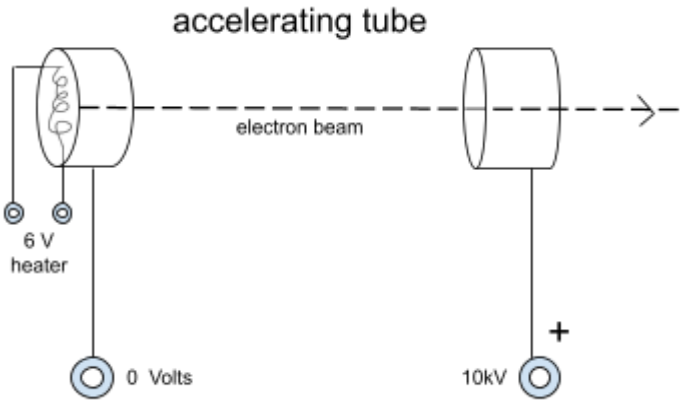
6) A potential difference of 5000 V is applied between two metal plates as shown below.



a) A particle with electric charge of + 2 mC is released from rest at position A. Calculate the work done on the charge by the electric field.

b) State the kinetic energy of the particle at plate B.

7) The diagram below shows a schematic diagram of a particle accelerator.



Electrons are produced at a heater. The electrons are then accelerated along the tube. The potential difference between the ends of the accelerating tube is 200 kV.

a) Determine the kinetic energy gained by an electron as it reaches the end of the accelerating tube.

b) If the electron has mass 9.1×10^{-31} kg determine its speed at the end of the accelerating tube.