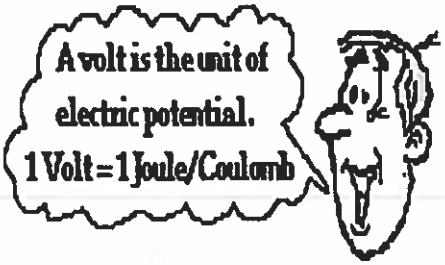
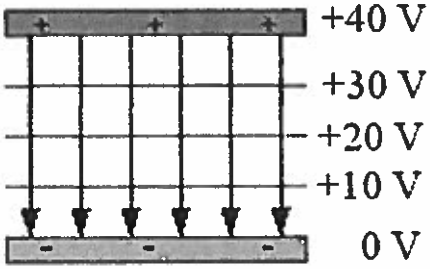
PHYSICS 12

Examples Connecting Electric force and Energy





Field and equipotential lines between plates

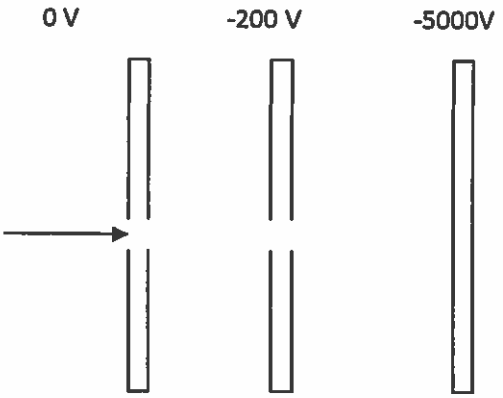
1. Recall that eV is a unit of energy and it is defined as work done by electric force on one electron by moving it through a potential difference equal to exactly 1 V.

$1eV = 1.6 \times 10^{-19} J$

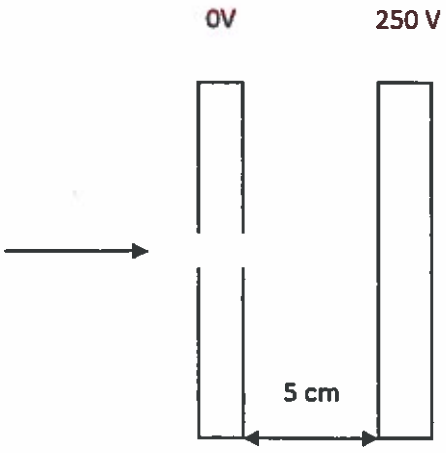
a) Calculate the speed of a proton with 100eV of kinetic energy.

b) What would be the speed of an electron with the same amount of kinetic energy?

2. A proton moving at 5.0×10^5 m/s enters a series of charged parallel plates as shown below. What is the impact speed on the last plate? **Note: this speed cannot exceed the speed of light in vacuum.**

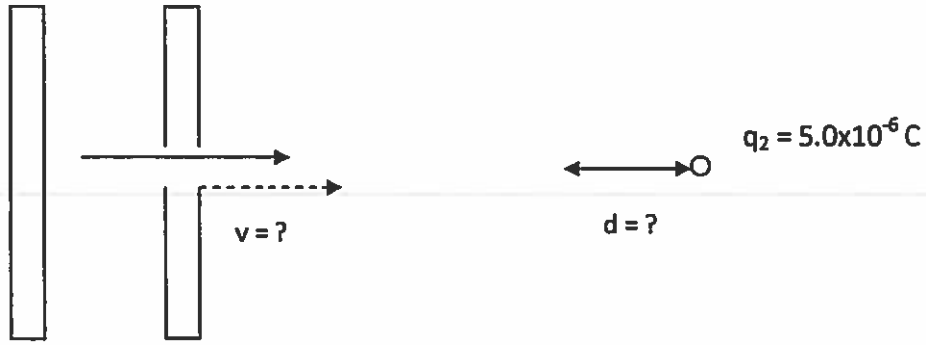


3. An electron moving at 2.5×10^6 m/s enters a region of electric field between parallel plates by passing through a small hole in the plates as shown. What is the impact speed of the electron on the second plate?



4. A proton is accelerated from rest through a potential difference of 1.2×10^4V is directed at a fixed charge of $+5.0 \times 10^{-6}$C.

a) What is the speed of the proton as it leaves the last plate?



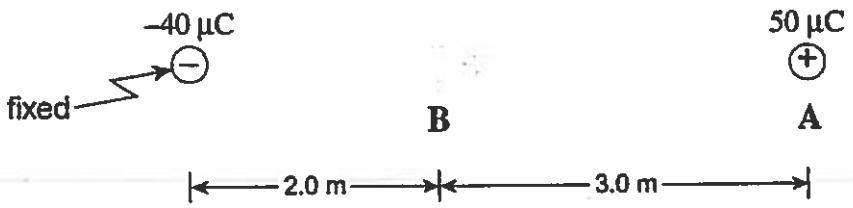
b) What is the distance of the proton from q_2 when proton stops?

5. Alpha particles with a mass of 6.6×10^{-27} kg and a charge of 3.2×10^{-19} C are fired towards each other from a great distance.

a) If they each have a speed of 2.5×10^{6} m/s to start with, what will be their minimum separation distance?

b) Using energy principles, explain why the particles do not come any closer than this minimum separation distance.

6. A 1.0×10^{-3} kg styrofoam ball carrying 50 μC of charge is released from rest from position A as shown in the diagram below. $(1\,\mu C = 1\times10^{-6}\ \text{C})$



a) Determine the change in electric potential energy, ΔE_p, of the ball as it moves from position A to position B.

b) What is the speed of the ball as it reaches position B? $(v_i = 0 \text{ at A})$