tutorial #2 [electric potential, potential energy & capacitors] .quiz

Name:

1) Pieter van Musschenbroek tries to accelerate electrons using two plates connected to a voltage $\Delta V = 10$ kV. Consider an electron released from rest at the negative plate and accelerates to the positive plate as shown in fig. 1.

a) What is the potential energy of the electron at the negative plate? How about total energy?
b) What is the potential energy of the electron when reaches the positive plate?
c) Find the kinetic energy of the electron when reaches the positive plate. Calculate this energy in terms of eV.

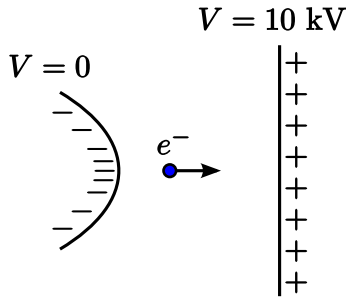

Figure 1: An electron between equipotential surfaces.

a) $U_1 = -eV = 0$, $v = 0 \Rightarrow$ kinetic energy $= K_1 = 0$

total energy $= 0$

b) $U_2 = -eV = -1.6 \times 10^{-19} C \times 10\,kV = -1.6 \times 10^{-15}$ J

c) Conservation of energy $K_2 + U_2 = K_1 + U_1 = 0$

$\hookrightarrow K_2 = 1.6 \times 10^{-15}$ J $= 10$ keV.

2) Robert A. Millikan slowly brings three same charges $q = 1.0$ nC from infinity and put them on three vortices of an equilateral triangle with edges $l = 1.0$ μm.
a) Find the potential energy of the configuration. How much work he did?
b) Answer part 'a' again if he brings four charges and put them on the vortices of a square with each side of $l = 1.0$ μm.

a) $U = 3k\frac{q^2}{l} = 2.7 \times 10^{-2}$ J

b) $U = 4k\frac{q^2}{l} + 2k\frac{q^2}{l\sqrt{2}} = 4.9 \times 10^{-2}$ J