

Two infinite parallel plates of charge are $1\mu\text{m}$ and $2\mu\text{m}$ thick, and are $1\mu\text{m}$ apart. The total charge of the system is zero and individual charge densities inside the plates are uniform. The charge density of the thinner plate is positive $50\text{C}/\text{m}^3$. The relative permittivity of the medium is

1. What amount of work is required to move an electron (charge $-1.6 \times 10^{-19}\text{C}$) from the outside of the positive plate to the outside of the negative plate?

2. The three vertices of an equilateral triangle of 10^{-10}m side are occupied by three charges: $-4.6 \times 10^{-19}\text{C}$, $-1.6 \times 10^{-19}\text{C}$ and $+3.2 \times 10^{-19}\text{C}$. Determine the magnitude and the direction of the electric field and of the force acting on one of the negative charges.

3. An electric current of 75A flows north-east in an infinite, straight, horizontal line located 15m above ground. The return current flows in a line 5m directly below the first line. The local value of the terrestrial magnetic field is $2 \times 10^{-6}\text{ Tesla}$ and points north. By what angle and in what direction will the line currents deflect the needle of a magnetic compass located on the ground directly below the wire?

4. What current flowing in a horizontal circular loop of 10cm radius will produce a field of 10^{-4} Tesla on the vertical axis of the loop, 17.3cm from its center? Relate the direction of the magnetic field to that of the current.

5. What is the energy stored in a circular, parallel plate capacitor of 5cm diameter, 1mm plate separation, with a 0.5 mm thick layer of dielectric of relative permittivity 2.5 glued to the inside face of one of the plates? The potential between the plates is 10 Volt .

6. The terminals of a current loop are A and B. A 2A current is flowing initially through the loop, entering at A and leaving at B. When the magnitude of the current is changed by external sources at a uniform rate of $20\text{A}/\text{sec}$ in an unknown direction, the induced voltage at the terminal A is positive with respect to the terminal B. What is the current in the loop after one tenth of the second?