Q- A parallel plate capacitor is having capacitance 50 nF and given a charge of 2μC.
(a) If an electron escapes from the negative plate, how much kinetic energy it will get in reaching positive plate?
(b) How much energy is stored in the electric field between the plates?
(c) If the plates are 1 mm apart, what is the magnitude of the electric field between the plates?

The capacitance of the capacitor C = $50*10^{-9}$ F = $5*10^{-8}$ F
CHARGE ON THE CAPACITOR Q = $2*10^{-6}$ C

(a) The potential difference between the plates of a parallel plate capacitor is related to its capacity and charge on it is given by

Q = CV
0r V = Q/C = $(2*10^{-6})/(50*10^{-9})$ = 40 V

Now when charge Q moves from a point of potential V_1 to V_2 the electrostatic potential energy lost by it is given by

$U = Q*\Delta V$

Thus for an electron going from negative plate to positive plate we get loss in electrostatic potential energy as

$U = e*(V_2 - V_1)$
Or $U = (-1.6*10^{-19})*(-40) = 6.4*10^{-18}$ J

According to law of conservation of energy
Gain in kinetic energy of the electron = loss in electrostatic potential energy
Or Gain in kinetic energy of the electron = $6.4*10^{-18}$ J

(b) The energy stored in a capacitor is the electrostatic energy stored in the field between the plates and is given by

$U = \frac{1}{2} CV^2 = Q^2/2C$

Thus the energy stored in the capacitor will be

$$U = \frac{(2*10^{-6})^2}{2*50*10^{-9}} = 4 * 10^{-5}\ J$$

(c) The distance between the plates is d = 1 mm = 10^{-3} m
As the field is equal to the potential gradient i.e. the change in potential per unit distance and given by

$$E = -\frac{dV}{dr}$$

Here the field is uniform thus the magnitude of the field is given by
E = V/d = $40/(1*10^{-3})$ = 4000 N/C

Negative sign shows that the potential decreases in the direction of field.