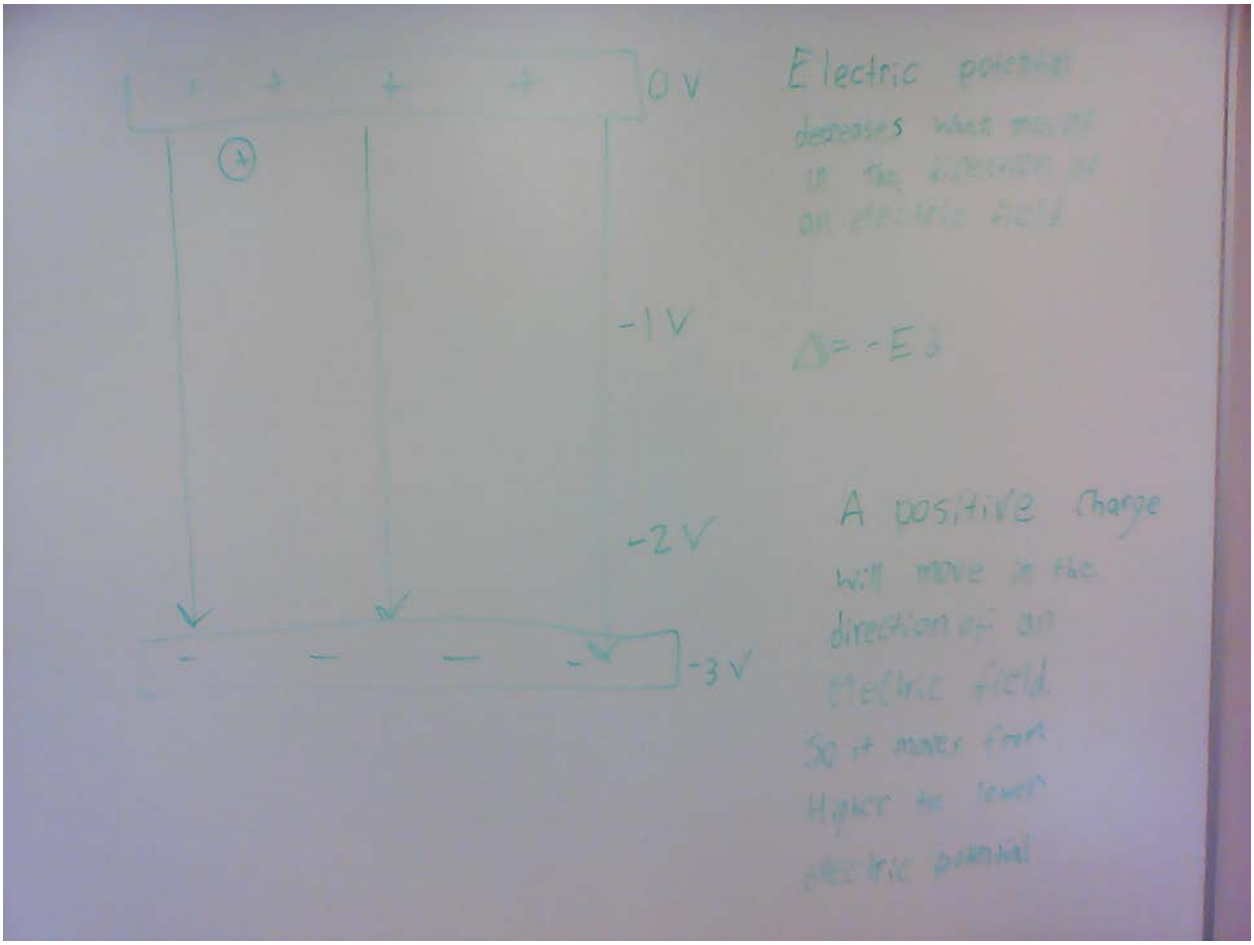
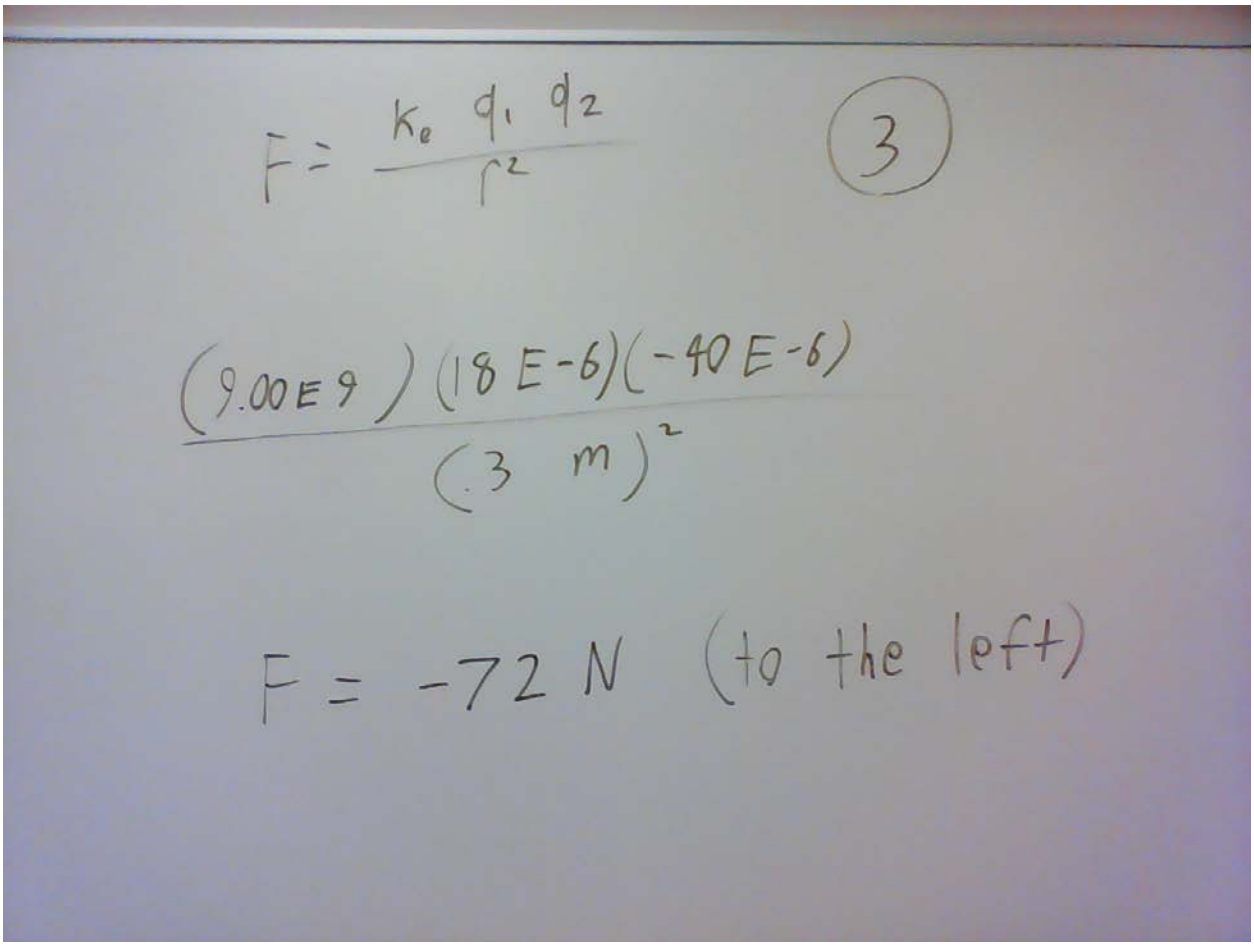
1. Opposite charges, Quantized and conserved.

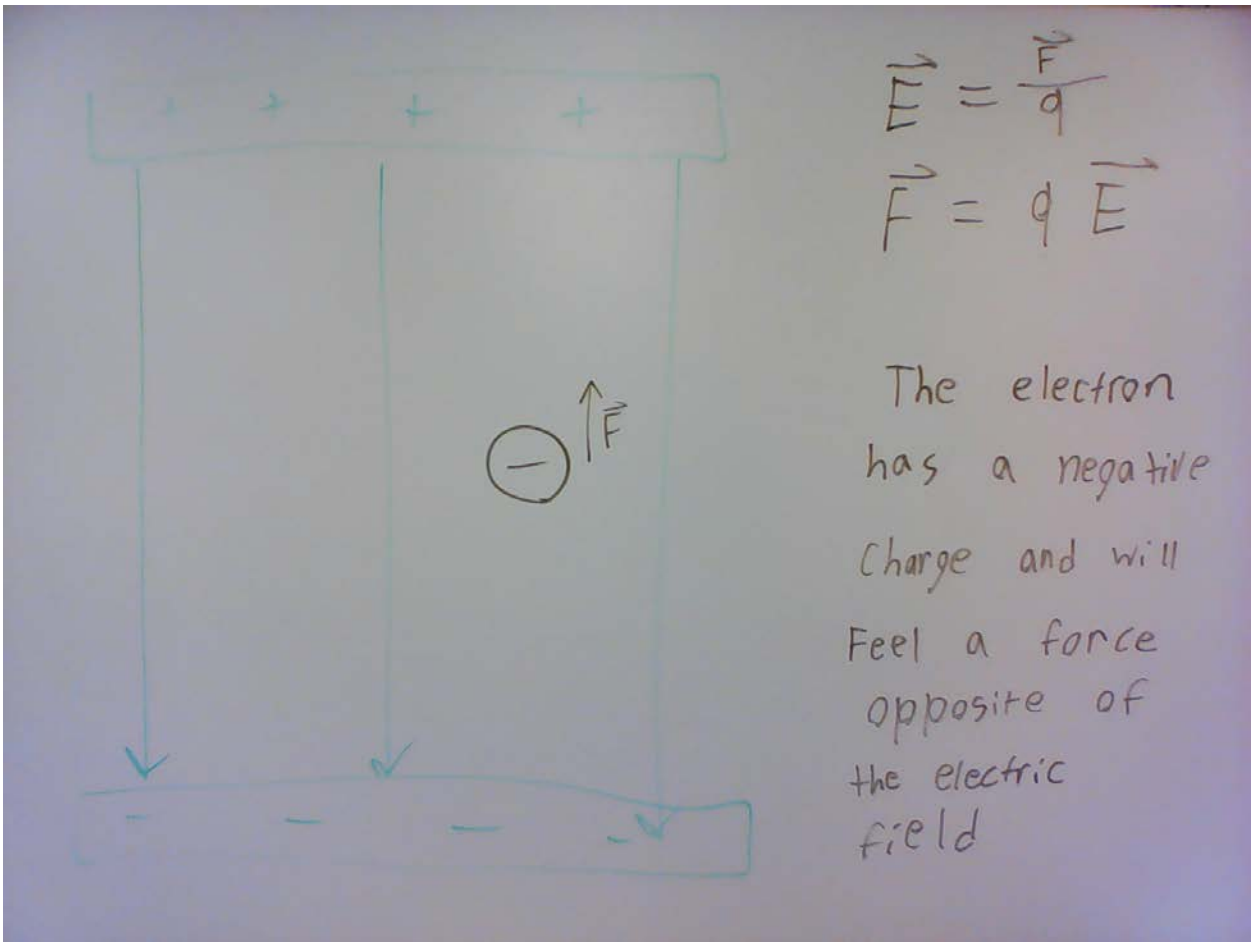
2.



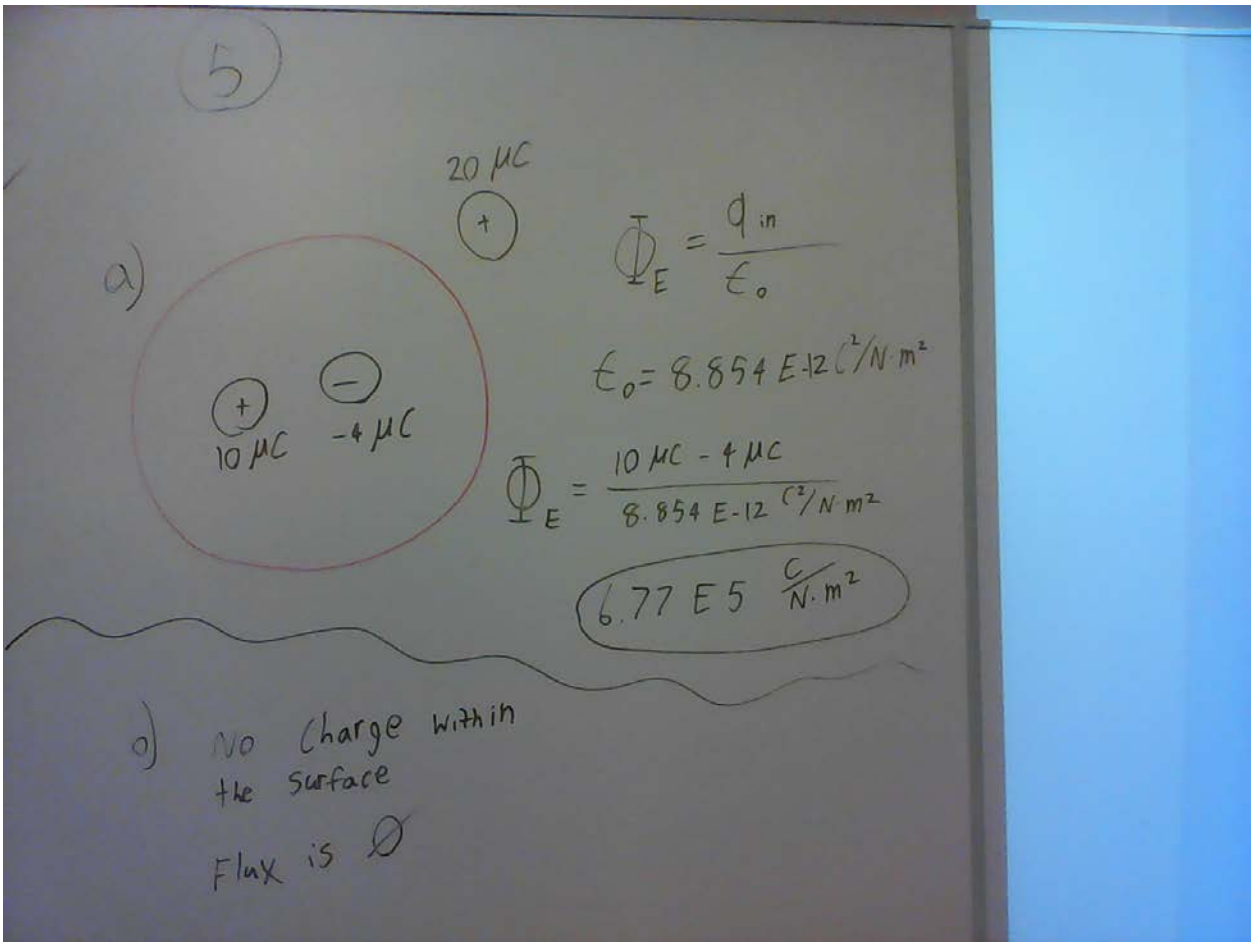
3.



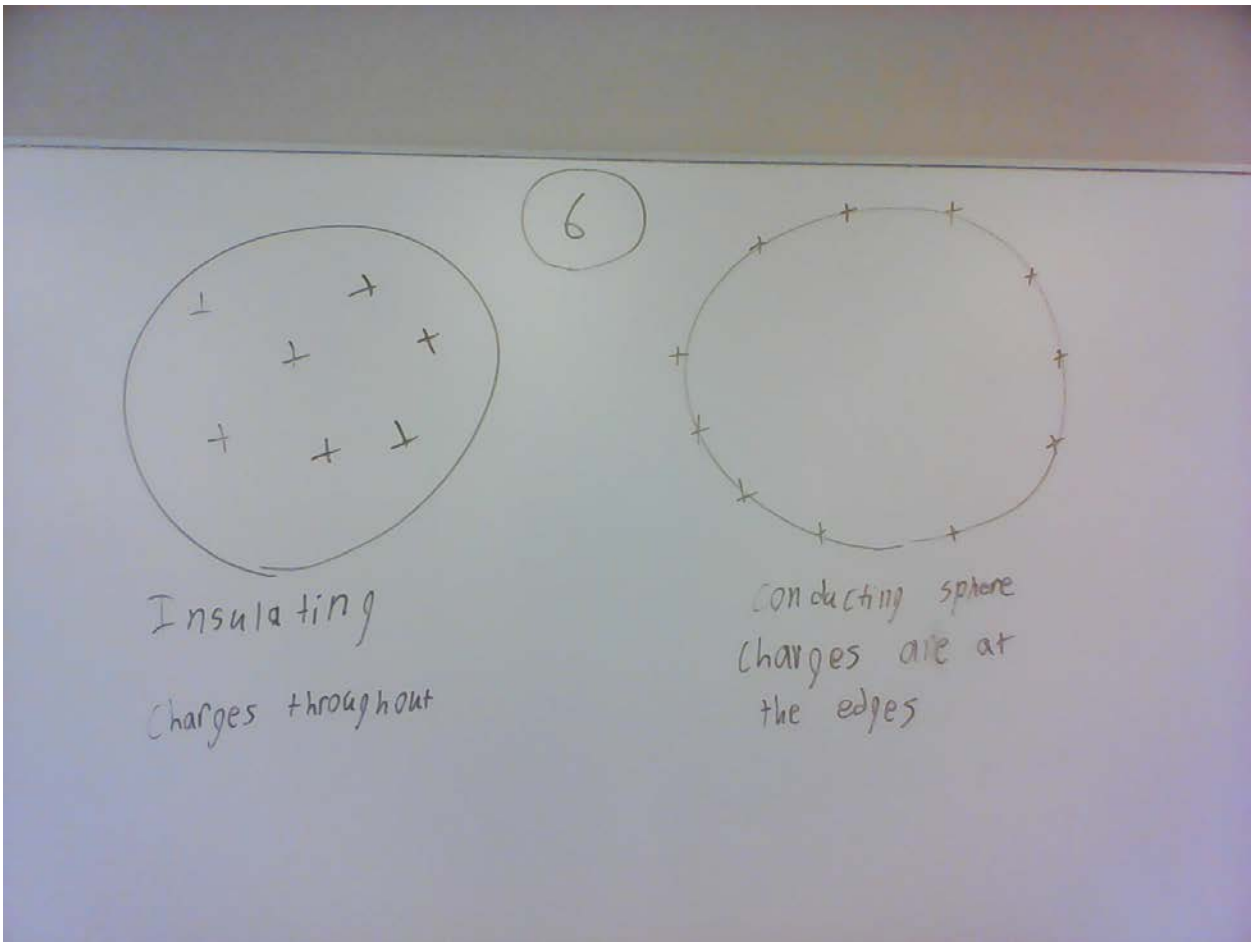
4.


$\vec{E} = \frac{\vec{F}}{q}$
$\vec{F} = q\vec{E}$
$\vec{F}$
The electron has a negative charge and will Feel a force opposite of the electric field

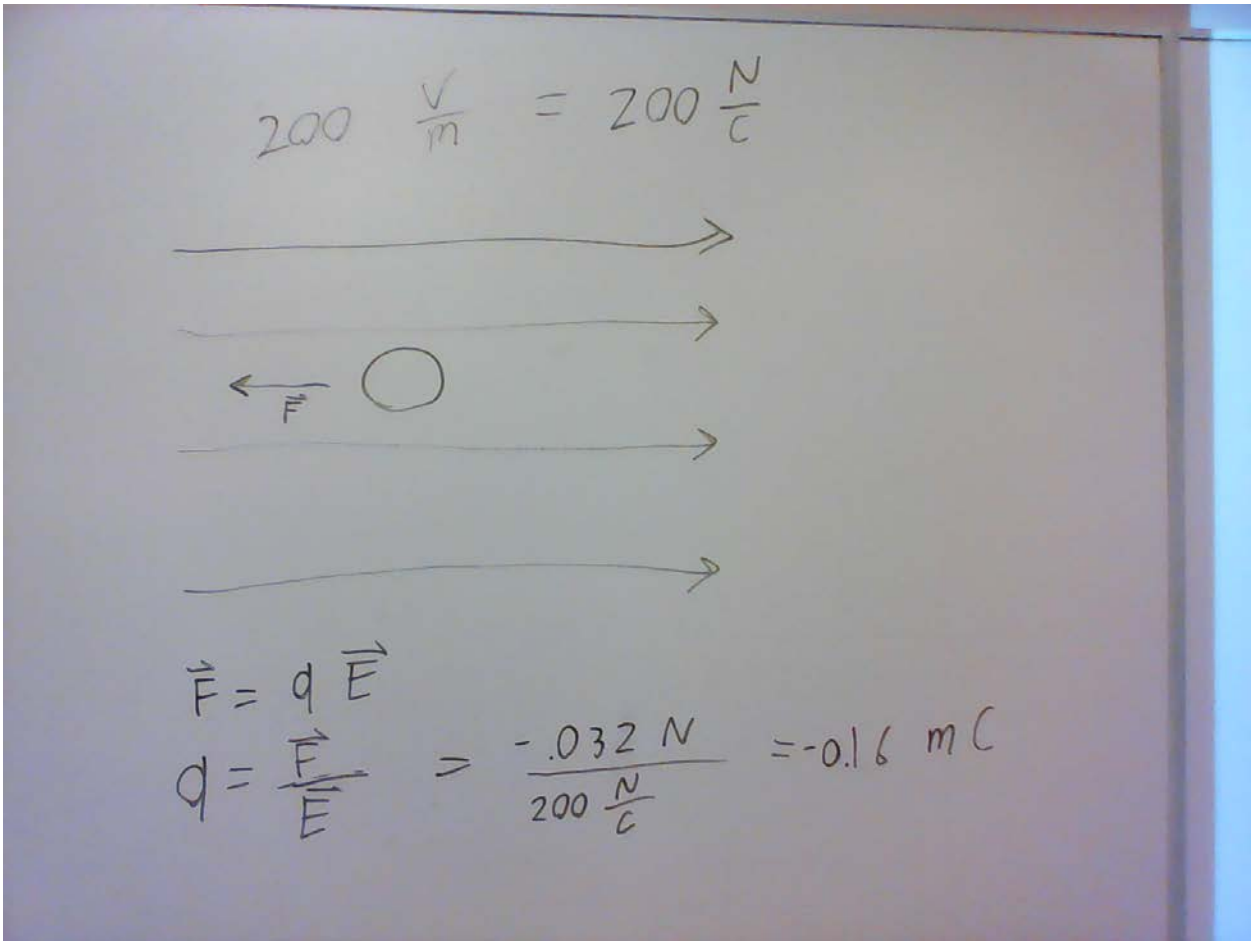
5.


5
20 μC
+
a)
+
10 μC
−
−4 μC
$\Phi_E = \frac{q_{in}}{\epsilon_0}$
$\epsilon_0 = 8.854\ E\text{-}12\ C^2/N \cdot m^2$
$\Phi_E = \frac{10\ \mu C - 4\ \mu C}{8.854\ E\text{-}12\ C^2/N \cdot m^2}$
$6.77\ E5\ \frac{C}{N \cdot m^2}$
c) No Charge within the surface
Flux is Ø

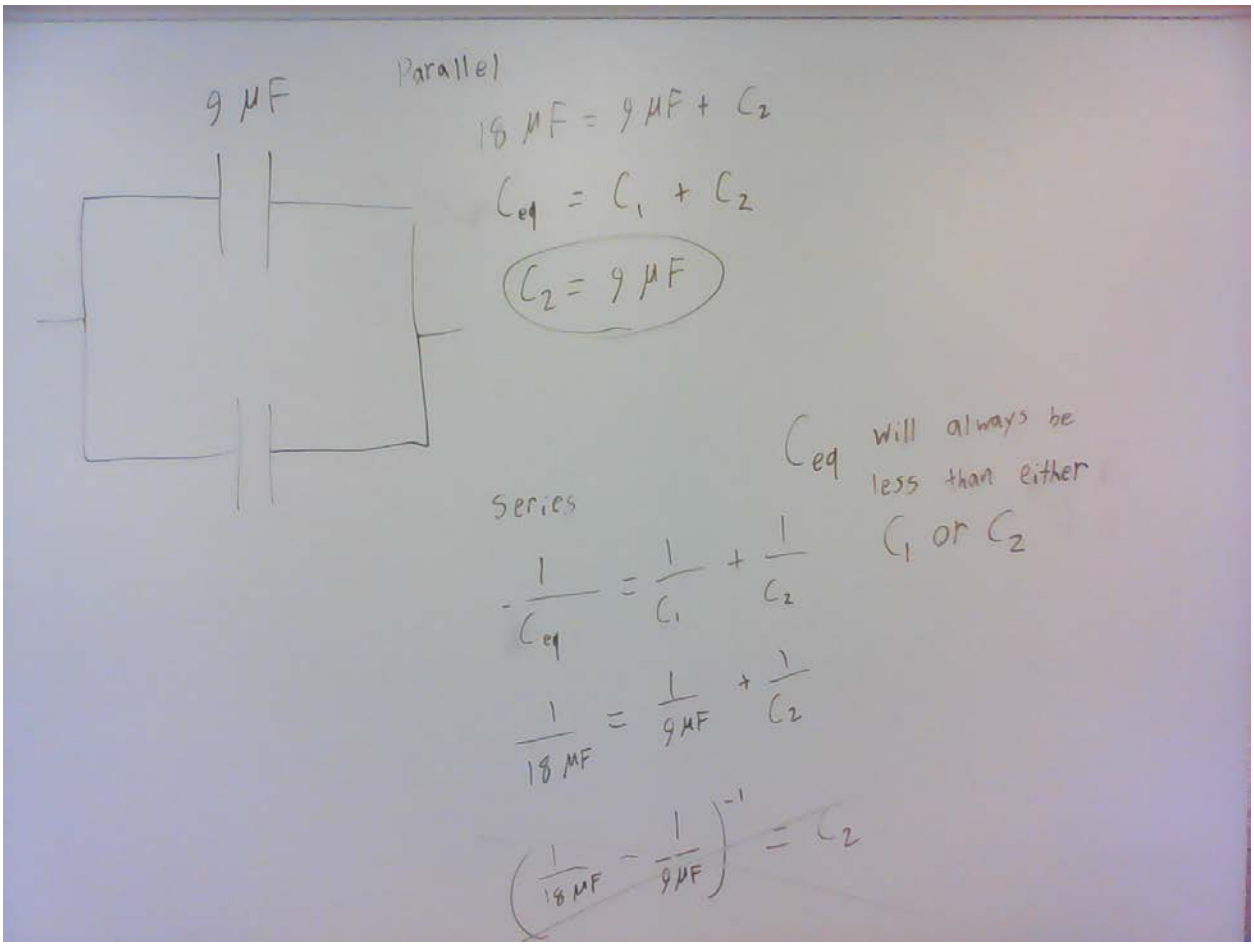
6.


6
Insulating
Charges throughout
Conducting sphere
Charges are at
the edges

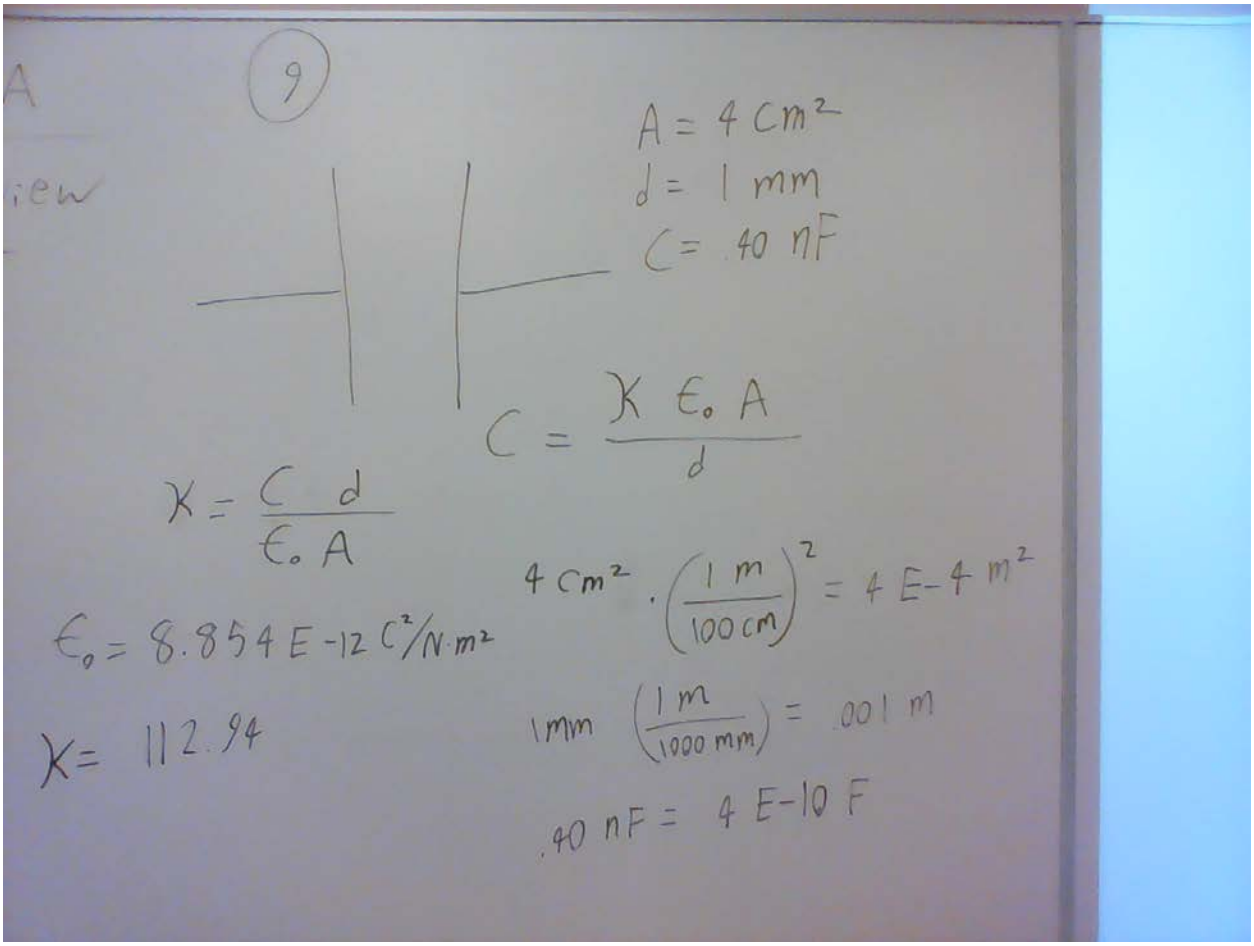
7.



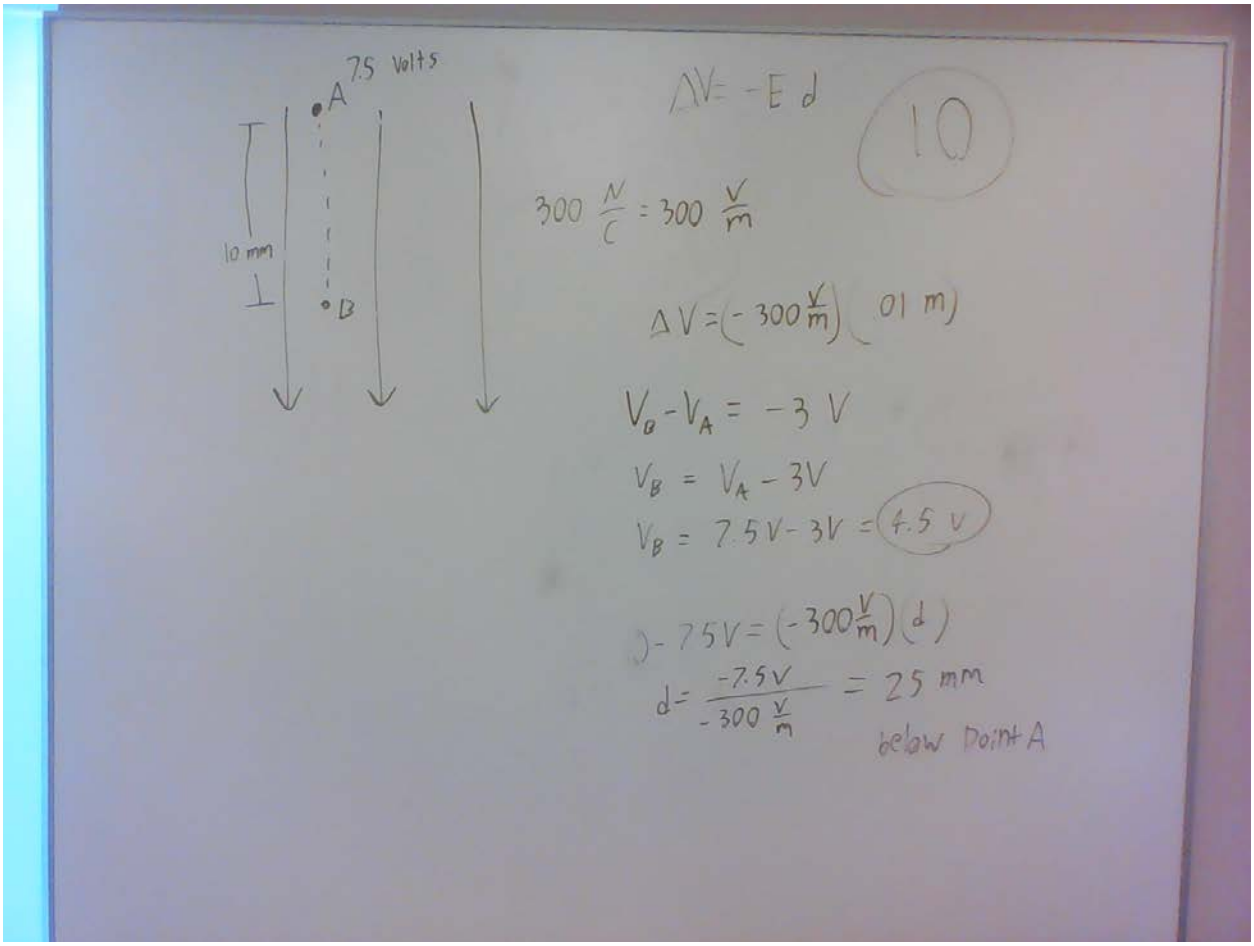
8.


9 μF
Parallel
18 μF = 9 μF + C2
Ceq = C1 + C2
C2 = 9 μF
Ceq will always be less than either C1 or C2
Series
1/Ceq = 1/C1 + 1/C2
1/18 μF = 1/9 μF + 1/C2
(1/18 μF − 1/9 μF)^-1 = C2

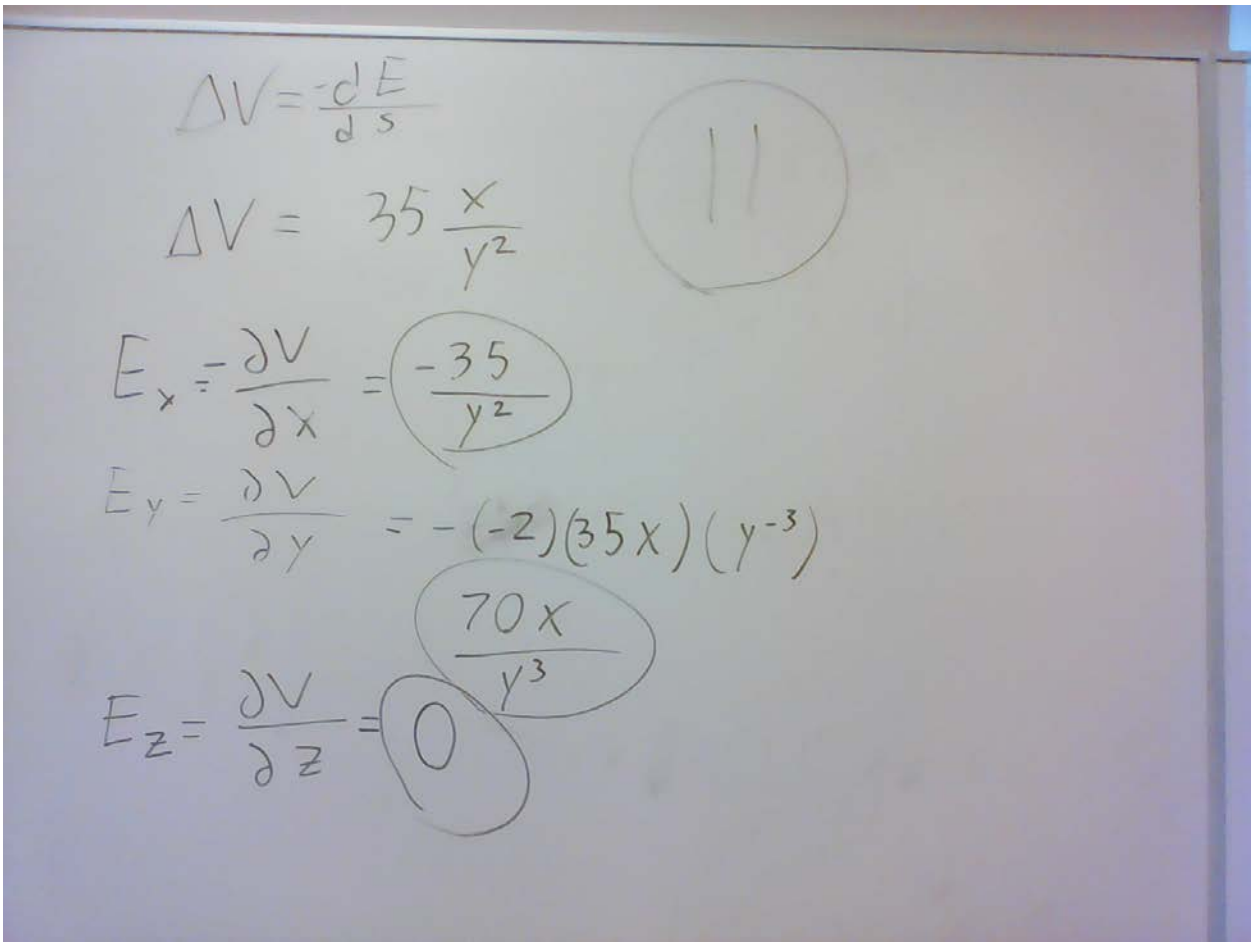
9.


9
A = 4 cm²
d = 1 mm
C = 40 nF
C = K ε₀ A / d
K = C d / ε₀ A
4 cm² · (1 m / 100 cm)² = 4 E-4 m²
ε₀ = 8.854 E-12 C²/N·m²
1 mm (1 m / 1000 mm) = .001 m
K = 112.94
.40 nF = 4 E-10 F

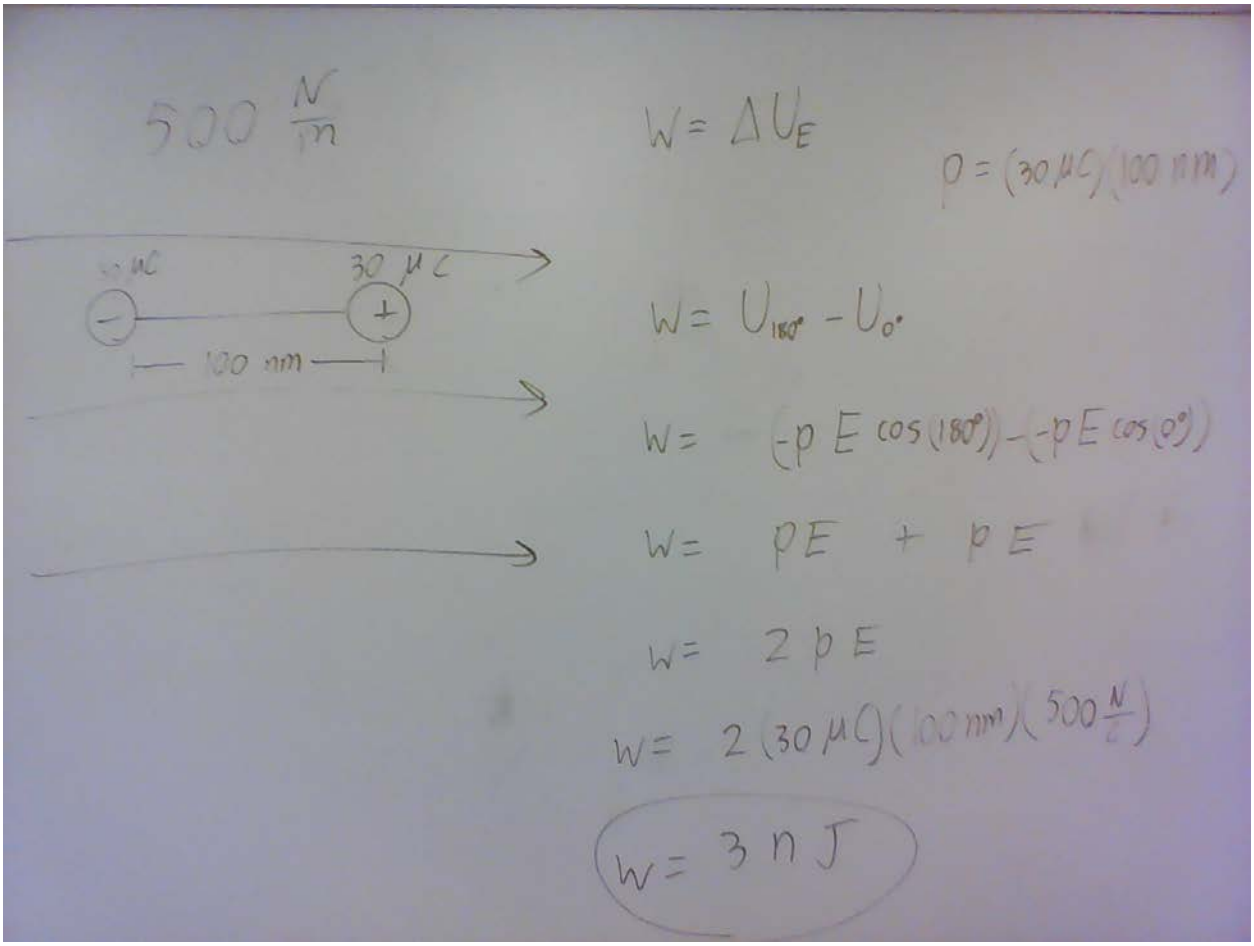
10.


7.5 Volts
A
B
10 mm
$\Delta V = -E\,d$
10
$300\ \frac{N}{C} = 300\ \frac{V}{m}$
$\Delta V = (-300\ \frac{V}{m})(.01\ m)$
$V_B - V_A = -3\ V$
$V_B = V_A - 3V$
$V_B = 7.5V - 3V = 4.5\ V$
$-7.5V = (-300\ \frac{V}{m})(d)$
$d = \frac{-7.5V}{-300\ \frac{V}{m}} = 25\ mm$
below Point A

11.


$\Delta V = -\frac{dE}{ds}$
$\Delta V = 35\frac{x}{y^2}$
11
$E_x = -\frac{\partial V}{\partial x} = \frac{-35}{y^2}$
$E_y = \frac{\partial V}{\partial y} = -(-2)(35x)(y^{-3})$
$\frac{70x}{y^3}$
$E_z = \frac{\partial V}{\partial z} = 0$

12.


500 N/m
W = ΔU_E
p = (30 μC)(100 mm)
30 μC
100 mm
W = U_180° − U_0°
W = (−pE cos(180°)) − (−pE cos(0°))
W = pE + pE
W = 2pE
W = 2(30 μC)(100 mm)(500 N/C)
W = 3 nJ