Physics 2401 Summer 2, 2008
Exam II

$e = 1.60\times10^{-19}$ C, m(electron) $= 9.11\times10^{-31}$ kg, $\varepsilon_0 = 8.845\times10^{-12}$ C^2/Nm^2,
$k_e = 9.0\times10^{9}$ Nm^2/C^2, m(proton) $= 1.67\times10^{-27}$ kg. n = nano $= 10^{-9}$, μ = micro $= 10^{-6}$, m = milli $= 10^{-3}$
Put your answers on the orange scantron which you brought. There is only one correct answer for each questions. All questions are weighted equally.

C_1

1. A 30-μF capacitor is charged to 80 V and then connected across an initially uncharged capacitor of unknown capacitance C. If the final potential difference across the 30-μF capacitor is 20 V, determine C. $\searrow C_2$

a. 60 μF
b. 75 μF
c. 45 μF
d. 90 μF
e. 24 μF

d

$Q_{tot} = C_1(80V) = 2.4\,mC$

Divides to Q_1, Q_2 such that final $V_1 = V_2$

or $\frac{Q_1}{C_1} = \frac{Q_2}{C_2} = 20V$ Also $Q_1 + Q_2 = Q_{tot}$

$Q_1 = C_1(20V) = 0.60\,mC$ so $Q_2 = 1.8\,mC = C_2(20V)$

$C_2 = 90\,mF$

2. A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. It is then disconnected from the battery and the plates are pulled apart to a separation $2d$ without discharging them. After the plates are $2d$ apart, the magnitude of the charge on the plates and the potential difference between them are

a. $\frac{1}{2}Q_0, \frac{1}{2}V_0$
b. $Q_0, \frac{1}{2}V_0$
c. Q_0, V_0
d. $Q_0, 2V_0$
e. $2Q_0, 2V_0$

d

Q constant. So $\sigma = \varepsilon_0 E$ also constant.

$V' = 2V_0$ since $V = Ed$

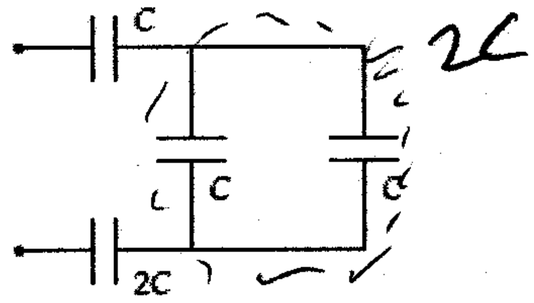
and $d' = 2d$

3. A parallel plate capacitor is connected to a battery and charged. It remains connected to the battery as a piece of dielectric material with dielectric constant K is inserted between the plates. When the material is inserted, the stored energy in the capacitor
a) stays the same b) increases c) decreases

b

$U = \frac{1}{2}CV^2 = \frac{1}{2}KC_0V^2$ $K > 1$

4. Determine the equivalent capacitance of the combination shown when C = 12 pF.



d

$C_{eq} = \left(\frac{1}{C} + \frac{1}{2C} + \frac{1}{2C}\right)^{-1} = \left(\frac{2}{2C}\right)^{-1} = C/2$

a. 48 pF
b. 12 pF
c. 24 pF
d. 6.0 pF
e. 59 pF