= KEY =

Welcome to the homework page test1. If this isn't you then please go back to the homework login page.

HW4

You may log out and return later if you wish without losing any saved data. You will have **TEN** attempts for each assigned problem. Every unsuccessful attempt will lower that part of the problem's value by 5%.

For example, if you get it right on the first try, then you will receive 100% for that problem. If you are twice incorrect and submit the correct on the third try, then you will receive a 90% for that part of the problem. You will not recieve any points for that part of the problem after 10 attempts.

You do not have to answer all the problems during a single session or in any particular order. To answer a problem simply type the numerical value in the box provided, check the box to the right of the part(s) you want to answer, and then click the submit button. You can freely log in and out of the homework page without losing any submitted information so feel free to take breaks if necessary.

LET'S BEGIN!

Problem #1

$U = \frac{1}{2}CV^2$

A capacitor with a capacitance value of 55.0μF is connected in series to a battery. What is the energy stored in the capacitor when the electric potential of the battery is (a) 10.0V and (b) 5.00V?

a) $U = \frac{1}{2}(55\times10^{-6})(10)^2 = 0.00275$

(a) [2.75] mJ ☑ Answer part (a)

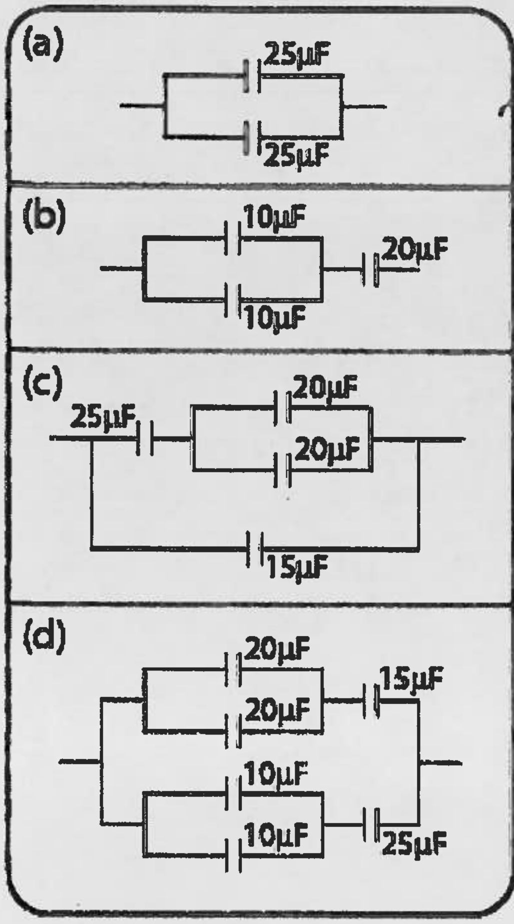
b) $U = \frac{1}{2}(55\times10^{-6})(5)^2 = 0.000687$

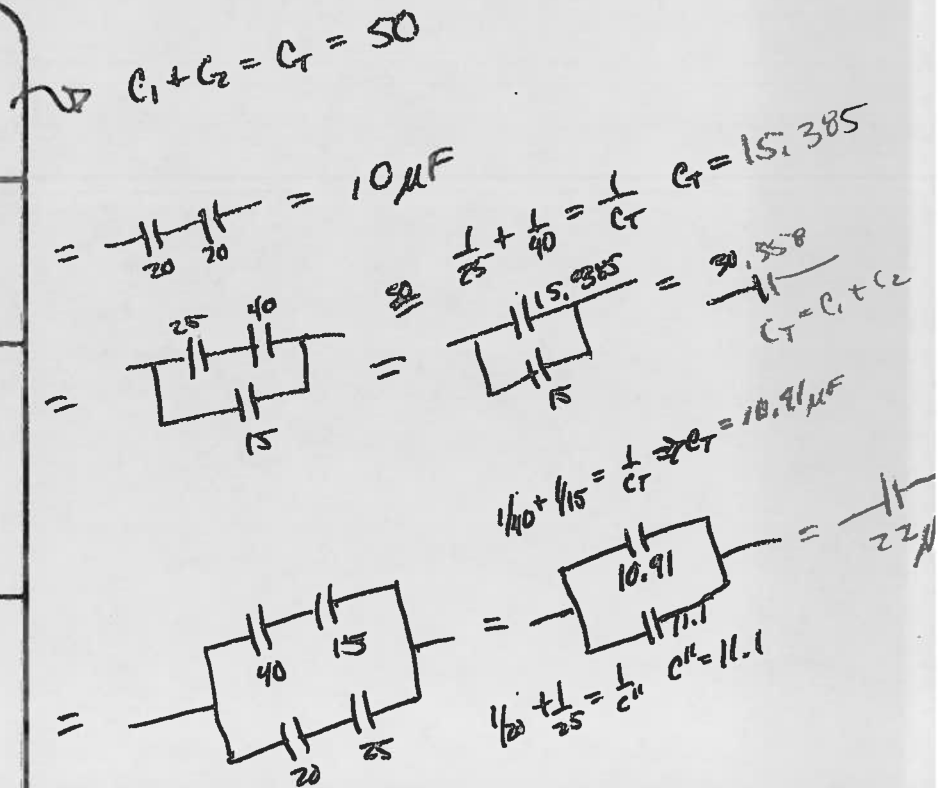
(b) [0.6875] mJ ☑ Answer part (b)

Submit

Attempted part (a) times and part (b) times.

Problem #2





For the circuits shown in the above diagram, calculate the equivalent capacitance.

(a) 50 µF ☑ Answer part (a)

(b) 10 µF ☑ Answer part (b)

(c) 30.385 µF ☑ Answer part (c)

(d) 22.0 µF ☑ Answer part (d)

Submit

Attempted part (a) times, part (b) times, part (c) times, and part (d) times.

Problem #3

An air-filled parallel-plate capacitor has plates of area $8.10 cm^2$ separated by a distance of 0.120cm. (a) What is the capacitance? (b) If the capacitor is hooked to a 14.0V battery, then what is the charge of the capacitor?

(a) 5.97 pF Answer part (a)

(b) 83.6 pC Answer part (b)

Submit

Attempted part (a) times and part (b) times.

Problem #4

Air has a dielectric strength of $3.00\times10^6 V/m$ and a dielectric constant of 1.00 while Teflon has a dielectric strength of $6.00\times10^7 V/m$ and a value of 2.10 for the dielectric constant. (a) How much charge can be placed on a parallel plate capacitor with air between the plates before it breaks down when the area of each plate is $2.40 cm^2$? (b) How much charge can be placed on the capacitor when Teflon is used as a dielectric medium?

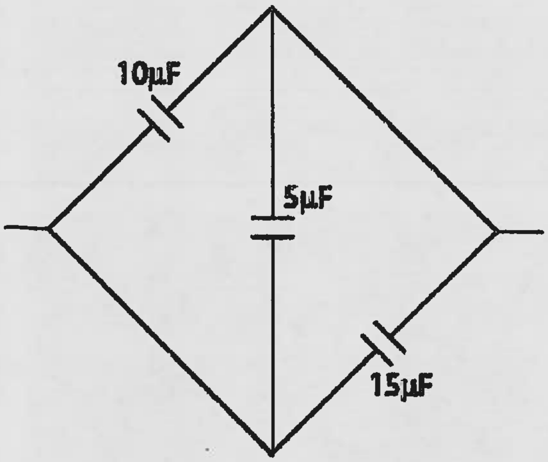
(a) 6.37 nC Answer part (a)

(b) 267.6 nC Answer part (b)

Submit

Attempted part (a) times and part (b) times.

Problem #5



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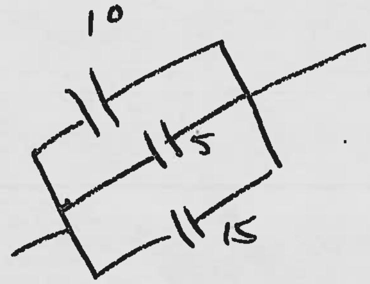


$C_{tot} = 30 = C_1 + C_2 + C_3$

In the above diagram, find the equivalent capacitance.

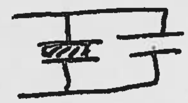
30 μF ☑ Answer the question

Submit

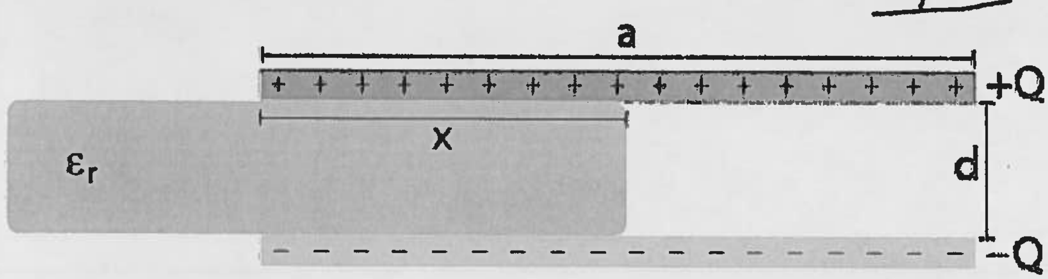
Attempted the problem times.

Problem #6

* IDEA IS: THINK OF THIS AS TWO CAPACITOR CONNECTED IN PARALLEL... ONE W/ DIELECTRIC & ONE WITHOUT.



So $C = C_1 + C_2$



$C = \frac{K\epsilon A}{d}$

$C_1 = \frac{(2.2)(8.85\times10^{-12})(.0\ldots)(.0\ldots)}{0.12\times10^{-2}}$

$C_1 = 3.93\times10^{-12}F$

$C_2 = \frac{1\cdot(8.85\times10^{-12})(.022)(.0\ldots)}{.12\times10^{-2}}$

$= 1.78\times10^{-12}$

A capacitor is constructed from two square, metallic plates of sides a = 2.20cm and separated by a distance d = 0.120cm. A material of dielectric constant κ_r = 2.20 is inserted a distance x into the capacitor and charges Q = 13.0nC are placed on the plates as shown in the above diagram. When x = a/2, find (a) the equivalent capacitance and (b) the energy stored in the device. When x = 3a/4, find (c) the equivalent capacitance and (d) the energy stored in the device.

a) $C_1 + C_2 = 5.715\times10^{-12} f = C_{TOT}$

b) $U = \frac{1}{2} Q^2/C_{TOT} = 1.478\times10^{-5} J$

(a) 5.715 pF ☑ Answer part (a)

(b) 14.78 μJ ☑ Answer part (b)

c) Now x = 3/4 a

(c) 6.78 pF Answer part (c)

$C_1 = \frac{(2.2)(8.85\times10^{-12})(.022)(.022/4)}{0.12\times10^{-2}}$

(d) 12.46 μJ Answer part (d)

$C_2 = \frac{1(8.85\times10^{-12})(.022)(.022/4)}{0.12\times10^{-2}}$

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c) $C_{TOT} = C_1 + C_2 = 6.78\times10^{-12}$ f (d) $u = \frac{1}{2}\frac{Q^2}{C_{TOT}} = 1.246\times10$

Attempted part (a) times, part (b) times, part (c) times, and part (d) times.

Problem #7

A parallel-plate capacitor is constructed using a dielectric material whose dielectric constant is 3.10 and whose dielectric strength is 1.50×10^8V/m. The desired capacitance is 0.240μF and must withstand a maximum electric potential difference of 3.60kV. What is the minimum area of the capacitor plates?

0.21 m^2 Answer the question

$C = \frac{K\epsilon_0 A}{d}$ BUT $V = \vec{E}\cdot\vec{d} = E/d$

$d = \frac{V}{E} = \frac{1.5\times10^8}{3600} \Rightarrow d = 2.4\times10$

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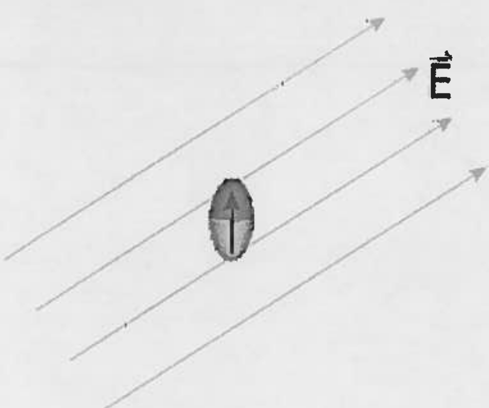
$A = \frac{dC}{K\epsilon_0} = \frac{(2.4\times10^{-5})(0.24\times10^{-6})}{(3.1)(8.85\times10^{-12})} = 0.21\ m^2$

Attempted the problem times.

Problem #8



THIS ONE FOR EXTRA CREDIT ONLY>>>> as we didn't quite get to the idea of dipoles in the class...no time....

A system of perfectly aligned molecules that all have a permanent dipole moment p = 2.20×10^{-28}Cm are subject to a constant applied electric field of magnitude $|\mathbf{E}| = 5.40\times10^{6}$V/m. There are 1.00×10^{23} molecules in the perfectly aligned system and the electric field makes an angle of $\theta = 49.0^{\circ}$ with respect to the direction of the dipolar alignment. (a) What is the magnitude of the sum of all torques that the field exerts on the molecules? (b) What is the potential energy of the system of dipoles in the applied electric field?

(a) 89.66 kg m^2/s^2 Answer part (a)

(b) 77.94 J Answer part (b)

Submit

Attempted part (a) times and part (b) times.

$\tau_{max} = \Sigma E p = E p N$

$= (5.4\times10^6)(2.2\times10^{-28}\,Cm)(1.0\times10^{23})$

$\tau_{max} = 118.8$ N-m

$\tau_\theta = \tau_{max} \cdot .550$

$\tau_{49^\circ} = 89.66$ N-m

$U = \vec{E}\cdot\vec{P} = N|E||P|\cos\theta$

$= (118.8)\cos(49)$

$U = 77.94$ J