Test Questions - [Left Overs from 1]

1 Prob 3-12

2. Prob 3-13

3. Which $\underline{E}$-field is larger: $\underline{E}$ which is at a point 3m away from a charge of 9μC or one which is 1m away from a charge of -1μC? Why?

4 If $\underline{E} = (100\,N/C)\hat{x}$ what is the flux of $\underline{E}$ through an area of $1\,m^2$ if the area is in (i) YZ-plane (ii) xz-plane, (iii) XY-plane? Why?

5. The electron and proton carry the charges -1.6×10^{-19} C and $+1.6\times10^{-19}$ C. Which force is larger (i) force between an electron and a proton or a force between two electrons when the separation is the same in both cases? Why?

Test Questions - Exam II

1. In the Bohr model of the hydrogen atom, an electron moves at constant speed in a circular orbit with the proton located at the center. Show that the kinetic energy (+ive) of the Electron is One half of its potential energy (-ive).

2. Prob 4-5.

3. Show that when a dipole of dipole moment $\vec{p} = q\vec{L}$ is placed in an $\vec{E}$-field it experiences a torque given by

$$\vec{\tau} = [\vec{p} \times \vec{E}]$$

4. Prob 4-7

5. Prob 4-8

6. Prob 4-9

7. Write down Gauss's Law in your own words.

8. For a dipole (two equal and opposite charges separated by some length ℓ) the total flux of $\underline{E}$ through many surfaces surrounding the dipole is zero. Why does a dipole have a non-zero $\underline{E}$-field?

9. Under stationary conditions if you place a charge on a conductor where will the charge reside? Why?

10. In prob 9, what is the direction of the $\underline{E}$-field on the surface of the conductor? Why?

11. Prob 4-13.

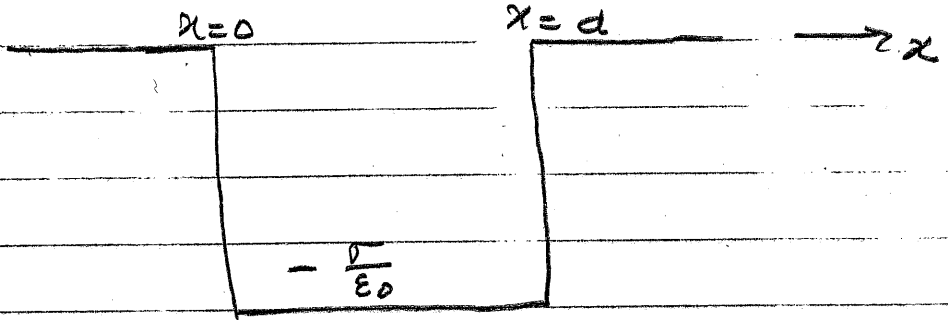
12. An insulating sphere of radius R has a charge Q uniformly distributed in it. Prove that the $\underline{E}$ field produced by it is

$$\underline{E}(r) = \frac{\rho r}{3\epsilon_0}\hat{r} \quad \text{if } r < R$$

and $$\underline{E}(r) = \frac{Q}{4\pi\epsilon_0 r^2}\hat{r} \quad \text{if } r > R$$

where r is the distance from the center and $\rho = Q/\frac{4\pi}{3}R^3$ is the uniform charge density.

13 How would you create the E-field shown below



14 Prob 4-15

15 Prob 5-1

16 Show that the Coulomb Force is a Conservative force.

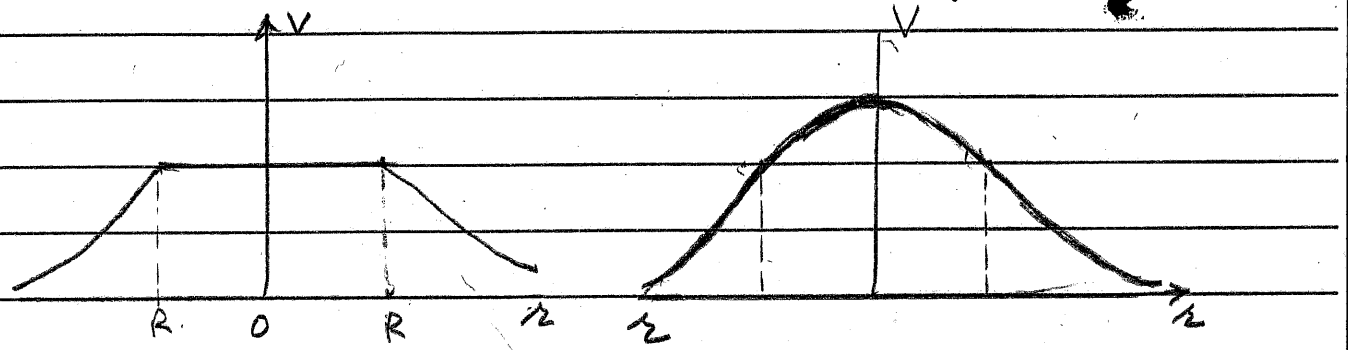
17 Prob 5-2

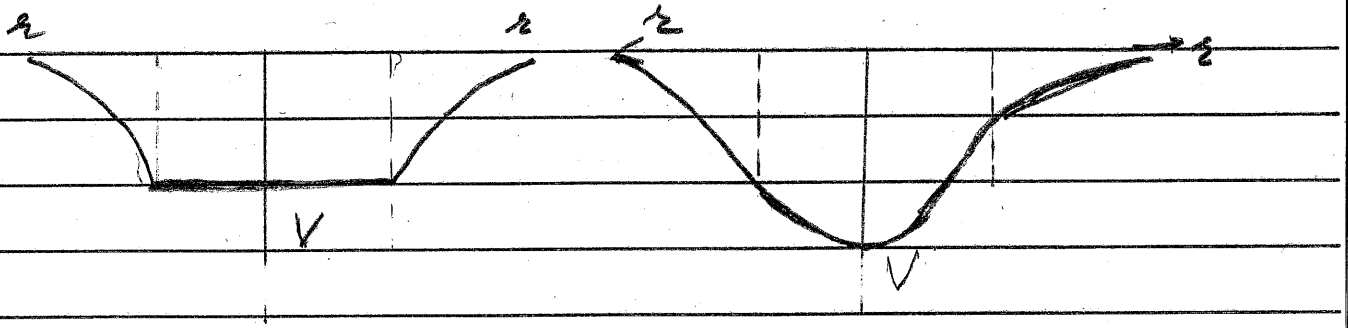
18 Prob 5-8

19. Which potential is larger: 0.1m away from a charge of 10μC or 0.2m away from a charge of 30μC? Why?

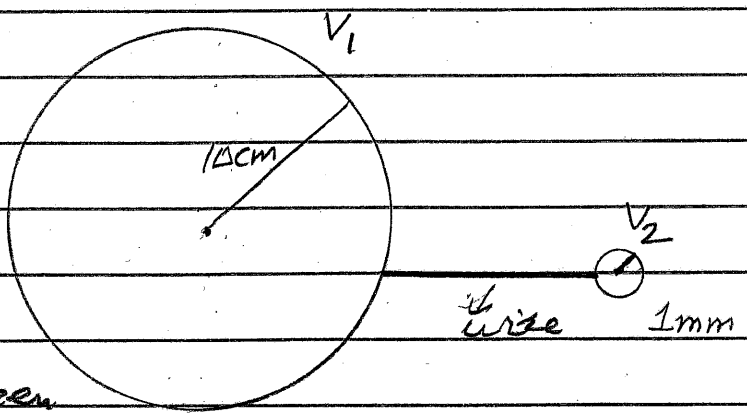
19' How would your answer to 19 change if the charges were negative? Why?

20. The figures show the variation, with r, of the potential due to a spherical distribution of charge (of radius R) centered at $r=0$. Which of the spheres is a conductor and which of the charges is negative? Why?



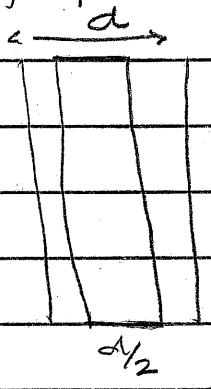


21. Two conducting spheres (radii 10 cm and 1 mm) are connected by a copper wire. If you place some charge on this system what is the relationship between (i) the potentials V_1, V_2 and (ii) the $\vec{E}$-fields E_1, E_2 on the surfaces of the spheres.



22 Consider a parallel plate capacitor filled with air, plate area A and separation d. If you put charges $\pm Q$ on the plates (i) what is the $\vec{E}$-field between the plates, (ii) What is the potential difference between the plates? Why?

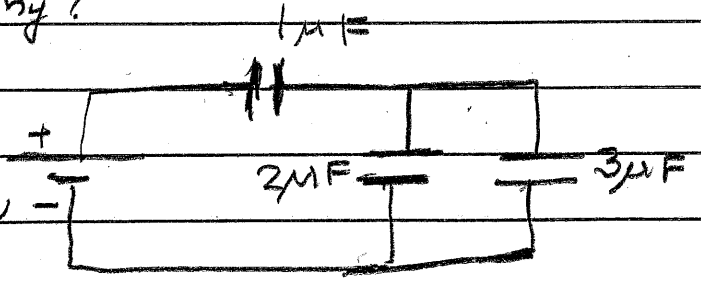
23 Starting with the capacitor of prob 22, if you put a conductor of area A and thickness $\frac{d}{2}$ in the middle, what is the potential difference between the plates? Why?



If the conductor is not in the middle but touching one plate will the potential change? Why?

24 Next experiment, replace conductor by a dielectric of dielectric const $k = 2$ and thickness equal to d. What is the potential difference now? Why?

25 In the circuit shown



which capacitor has (i) highest (ii) lowest charge? Why?

26 Prob 6-2

27 Prob 6-3

28 Silver has an atomic mass of 0.108 kg and each silver atom contributes one mobile electron, Calculate the number of mobile electrons per m^3 in silver. Density of silver is 10.5×10^3 kg/m^3. Avogadro's number is 6×10^{23} per mol.

29. Use the result of Prob 28 to calculate the drift speed of electrons in a silver wire of radius 1mm when there is a current of 1 ampere in it. [$e = -1.6 \times 10^{-19}$ C]

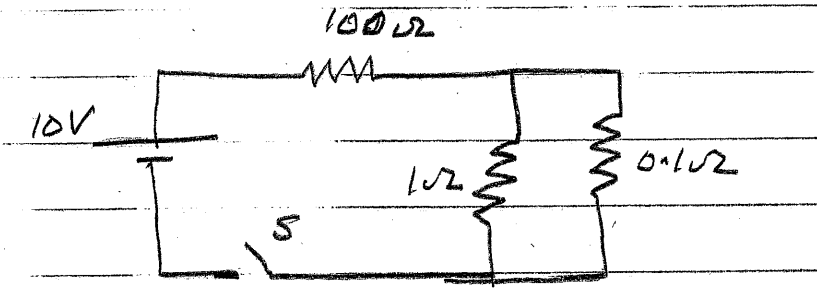
30 The thermal speed of particles is given by $v_{th} = \sqrt{\frac{3k_B T}{m}}$. Calculate the thermal speed electrons at T = 300 K. $k_B = 1.38 \times 10^{-23}$ J/k, $m_e = 9 \times 10^{-31}$ kg

31 Why is v_D in problem 29 so much smaller than v_{th} of problem 30?

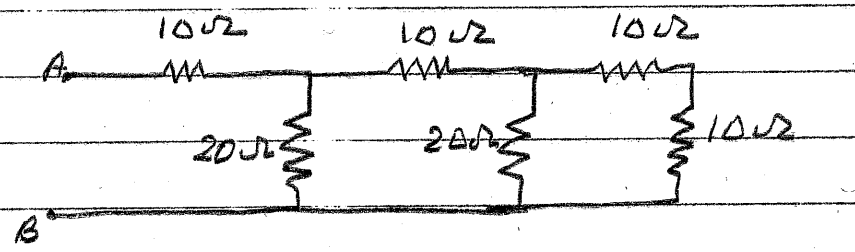
32 Show that if you apply an $\vec{E}$-field to a conductor it responds by setting up a current density

$$\vec{J} = \sigma \vec{E}$$

33 In the circuit shown, when you close the switch which resistor has (i) the highest (ii) the lowest current? Why?



34. What is R_{AB}? Why?



35. If you apply 10V across AB what are the currents in the resistors? Why?

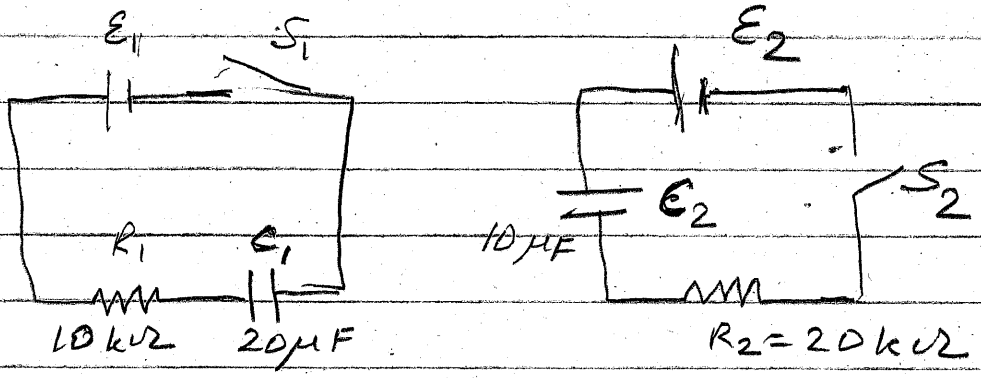
36. Show that RC has the dimensions of time.

37. Why does the time constant for an RC circuit depend on both R and C?

38 Prob 7-1

39 Prob 7-10

40 Shown are two circuits.



Which capacitor will reach 6 Volts first if both switches are closed at $t=0$ and a) $\mathcal{E}_1 = \mathcal{E}_2 = 12$ Volts or b) $\mathcal{E}_1 = 12$ Volts, $\mathcal{E}_2 = 9$ Volts.? Why?

41. In class we did an experiment using the circuit shown. First, we connected $1 \to 2$ and charged the capacitor. a) During this process, what is the direction of the current (CW or CCW) in the wires. b) within the capacitor. After the capacitor was fully charged we connected $1 \to 3$. Now what is the direction of the current? Justify your answers.