Lecture 27 iq24

1. RC circuit: Charging case
2. Comments on selected problems in ch20-h2

   - 008 RC charging case. C1<C2. Compare V1(t) with V2(t).
   - 015,016.
     i. Battery connected: C is fully charged, the equilibrium state is reached, Q on C can be determined.
     ii. Battery disconnected: It corresponds to RC discharging case.

3. Magnetic force: Vector product between the source and the field

   - Qualitative understanding on the direction of the magnetic force
   - Exercises on the direction of qv x B.

4. Circular motion: When a charge is moving perpendicular to a constant magnetic field

Announcement:

Learning module: We are introducing the use of learning modules for this class for the remainder of the semester. From the last two exams, we have seen that the 303L class that is run using these modules has consistently higher exam scores, so we have decided to implement them as well.

The modules are self-explanatory. You will view a number of videotaped lectures on a topic, then answer one or two questions. Afterwards, you will submit feedback informing us of what you find confusing. We will then use that feedback to guide the discussion during the lecture section.

The learning modules will count as part of the homework score: instead of homework accounting for 15%, we now have homework at 12% and leaning modules at 3%.

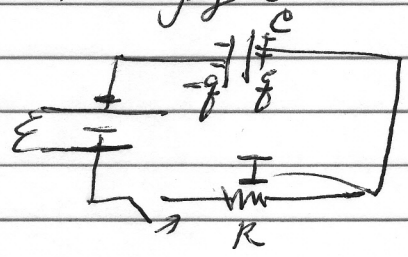
If you have questions on the use of learning model, 303L-LAs Daniel Joh, dkjoh@utexas.edu Alex Rote, aprote22@utexas.edu, who have experience in the use of module, are available to help you. Also do not hesitate to ask Josh for help, who is our head TA and also the TA for our section. . Do keep me informed, especially you think it is important.

Feedback on homework: Changes are afoot! In addition to the learning modules, we will now be soliciting feedback on each homework assignment. This feedback will be used to generate more carefully tailored discussion sessions. In order to encourage participation, we have made HW feedback part of the iq clicker credit:

- iq clicker now counts for 5%,
- while feedback counts for 2%.

The latter is an easy 2%, as all you need to do is tell us which problem you found most confusing on a particular assignment and why. The feedback will be due on the same evening the homework is due, but the due time will be 11:50 to give those last-minute types a chance to enter feedback after completing the homework.

12-008. Charging RC case

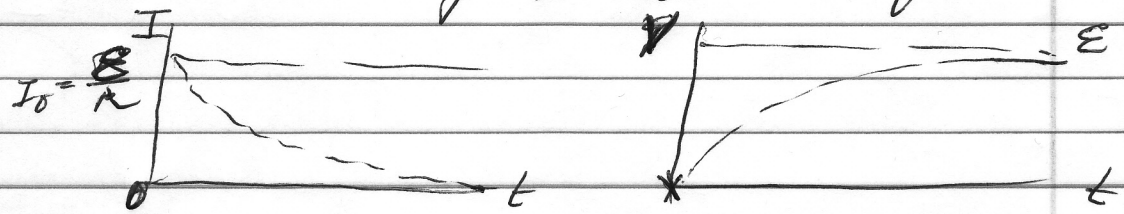


Loop eq: $t=0$,

$\mathcal{E} - \frac{q}{C} - IR = 0$ -(1) $t=0$: $q=0$, $I = I_0 = \frac{\mathcal{E}}{R}$

$\| V$

$t=\infty$ fully charged $\frac{dq}{dt} = I = 0$, $q_\infty = \mathcal{E}C \Rightarrow V = \mathcal{E}$



Analytic solution: Loop eqn has 2 variables - q, ~~I~~

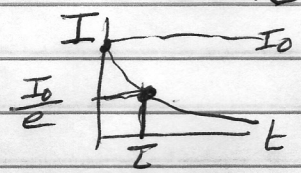
Convenient to work with I. Take $\frac{d}{dt}$(1)

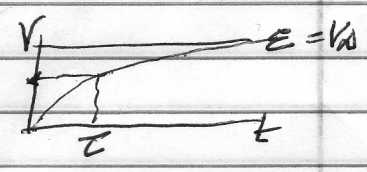
$$\frac{d}{dt}\left(\mathcal{E} - \frac{q}{C} - IR\right) = 0 \Rightarrow -\underbrace{\frac{dq}{dt}}_{I}\cdot\frac{1}{C} - \frac{dI}{dt}R = 0$$

$$\therefore -\frac{I}{C} - \frac{dI}{dt}R = 0$$

Rearrange $\frac{dI}{dt} = -\frac{I}{RC} = -\frac{I}{\tau}$ Solution $I = I_0 e^{\frac{t}{\tau}}$

Check $LHS = -\frac{1}{\tau} I_0 e^{-\frac{t}{\tau}} = -\frac{I}{\tau} = RHS$





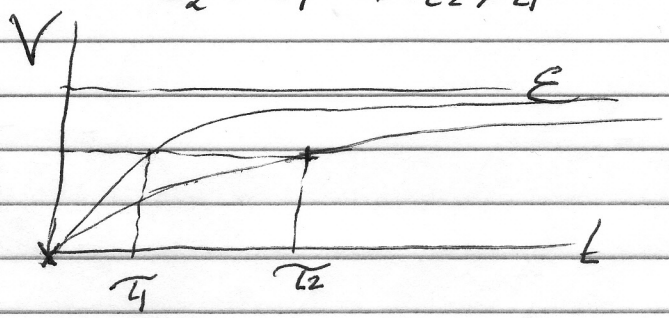
008 Compare 2 cases — Given same $\mathcal{E}$, A, $S_2 < S_1$

Find: $E_2(t)$ compared to $E_1(t)$

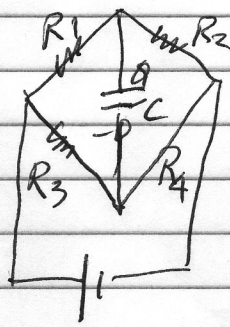
Hint

$\tau_2 = C_2 R$, $\tau_1 = C_1 R$

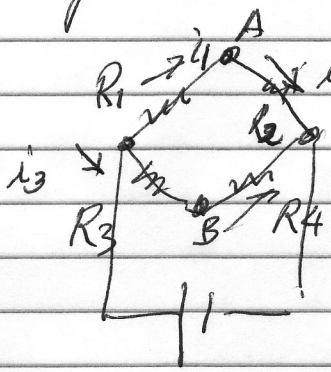
$C_2 > C_1 \Rightarrow \tau_2 > \tau_1$



h2-015,016 4 resistors



Battery connected. at equilibrium no current thru C

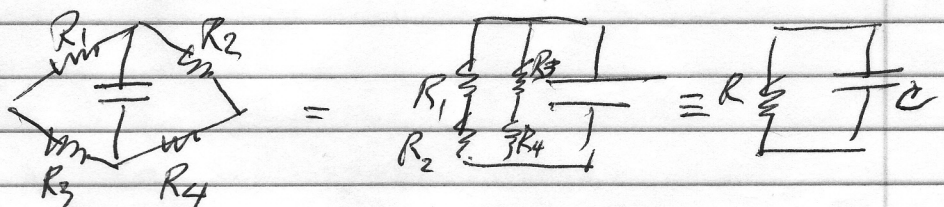


$|V_C| = |V_A - V_B|$

$= |R_1 i_1 - R_3 i_3|$

Can find $Q = |V_C| C$.

Disconnect battery:



$V_C = V_0 e^{-t/\tau}$, $\tau = R_{eff} C$

Magnetic force:

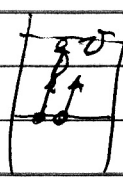
Electric force: $\vec{F}_q^E = q\vec{E}$

Force acted on by $\vec{E}$

Magnetic force:

$$\vec{F}_{q\vec{v}}^{B} = q\vec{v} \times \vec{B}$$

The only way to get the product of 2 vectors to be another vector is $\vec{A} \times \vec{B}$ (vector product)

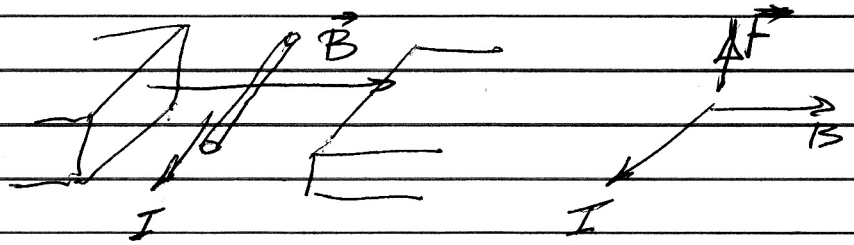


$$\Delta N q\vec{v} = \frac{\Delta N q \Delta l}{\Delta t} = I\Delta\vec{l}$$

$$\therefore \Delta\vec{F}_{I\Delta\vec{l}}^{B} = I\Delta\vec{l} \times \vec{B}.$$

Clicker 26-1 Which direction is the force?

See 29.2.2 in iq-library



Front view:

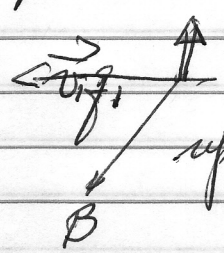
Clicker 26-2 Which pt has larger resultant field? Bottom

Resultant field at bottom is stronger. Stronger field region pushes the wire to weaker region

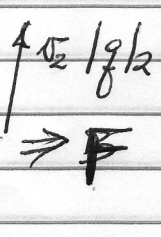
(Intuitively the potential is strong when the field is wrinkled. Natural tendency is to straighten out the wrinkle ⇒ straight up ⇒ upward force.

Read Clicker 26-3

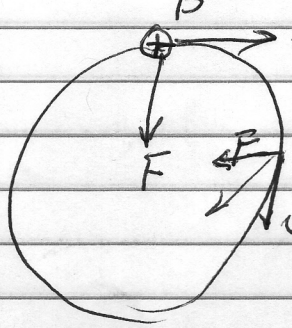
Case 1 $\vec{F}$ on $\vec{v}_1$



Case 2:



Read:



Circular motion