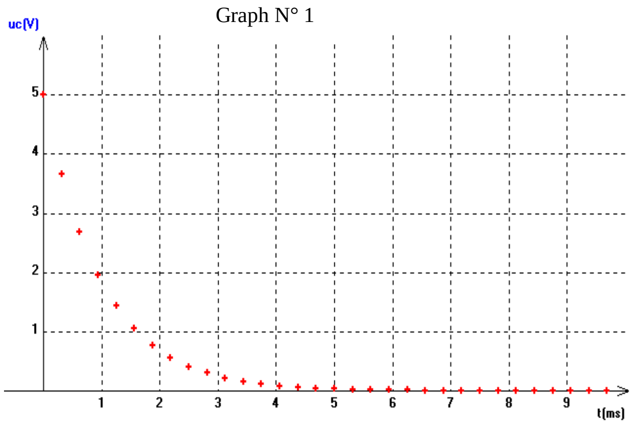
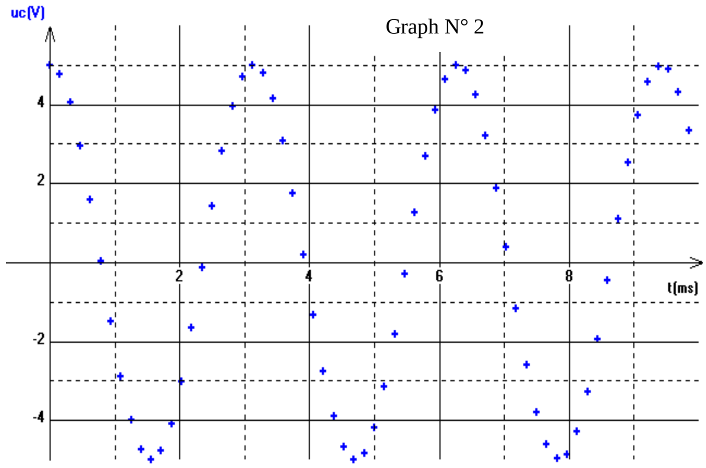
ORAL WORK ON RLC CIRCUIT : PART 1

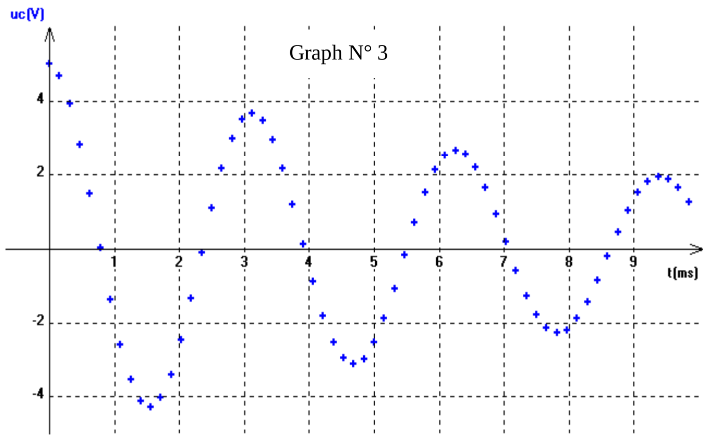
A capacitor C = 1 µF is charged at constant voltage E.
3 different circuits can be connected to the charged capacitor :

- ☞ an inductor L of negligible resistance (r= 0 Ω)
- ☞ an inductor L with a resitance r
- ☞ a resistor of resistance R

The following 3 graphs showing the variation of voltage uC across the capacitor against time t are given :



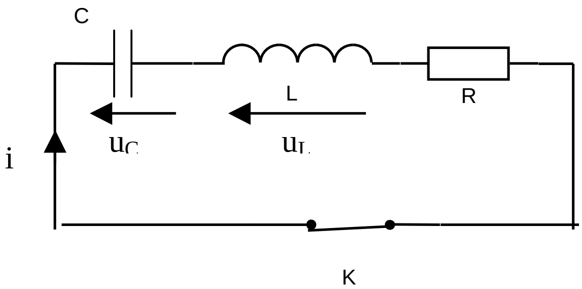




a) Associate each graph to each circuit. Give each time the reason of your choice.
b) Which graph will enable us to calculate time constant τ ? Calculate τ and hence calculate the value of R.
c) Which graph will enable us to calculate period T of oscillations ? Calculate T and hence caculate the value of L.
d) Draw the circuit which correspond to each graph. Voltages and current i must appear on each circuit.
e) Write down the differential equation for each circuit.
f) Examine the case when the capacitor discharges in the inductor L of negligible resistance. Calculate the energy of the system at t = 0 and explain energy exchange between the capacitor and the inductor.
g) Examine the case when the capacitor discharges in the inductor L of resistance r. Explain energy exchange between the capacitor and the inductor.

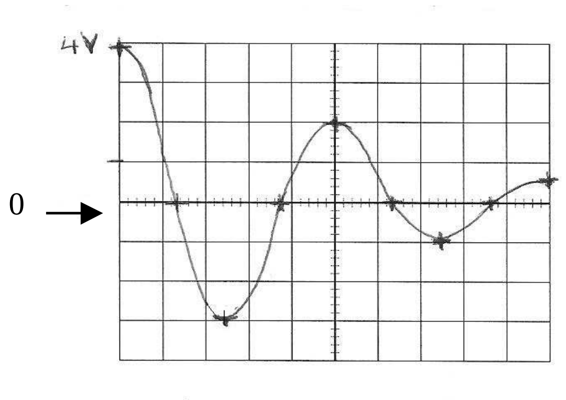
ORAL WORK ON RLC CIRCUIT (Extract BAC 2006): PART 2

We study free oscillations at a frequency f_0 = 40 kHz in the following circuit:



The capacitor C is initially charged at 4 V, L = 1 mH and the total resitance of the circuit is R

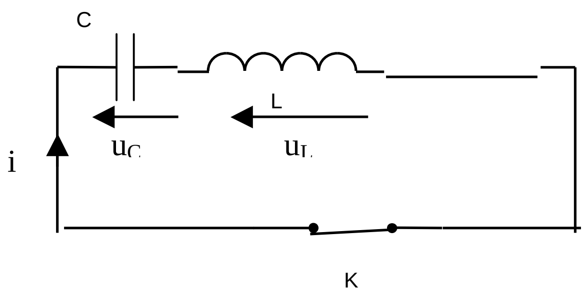
At t = 0 K is closed and a memory oscilloscope gives the following u_C against time graph :



Horizontal sensibility : 5 µs/div

a) What type of oscillations do we observe on the oscilloscope ?
b) Discuss energy exchange in the circuit and explain why the oscillations are damped.
c) How can we avoid damped oscillations knowing that R can never be 0 ?
d) Say whether the following affirmations are true or false. Justify each time your answer.
☞ Affirmation N° 1 : If we increase resitance R we shall always observe damped oscillations.
☞ Affirmation N° 2 : Period T_0 of oscillations depend on initial value of u_C.
e) Calculate T_0 from the graph and hence calculate the value of capacitance C of the capacitor.

We are going to consider now that R = 0 and the following circuit is obtained :



f) Show that the differential equation is : $\frac{d^2u_C}{dt^2} + \frac{1}{LC}u_C = 0$