SHOCK ABSORBERS

Damped oscillations occur in electronics as well as in mechanics.
The principle of damped oscillations is applied in **SHOCK ABSORBERS**.
Shock absorber is a **mechanical** device designed to smooth out or damp shock impulse, and dissipate kinetic energy.
Shock absorbers are an important part of automobile and motorcycle suspensions, aircraft landing gear, and the supports for many industrial machines. Large shock absorbers have also been used in structural engineering to reduce the susceptibility of structures to earthquake damage and resonance.

Bose known for its innovations in acoustic technologies has invented a new suspension system

Photo courtesy BOSE
Bose® Suspension Front Module

The Bose system uses a **linear electromagnetic motor** (LEM) at each wheel in lieu of a conventional shock-and-spring setup. **Amplifiers** provide electricity to the motors in such a way that their power is regenerated with each compression of the system. The main benefit of the motors is that they are not limited by the inertia inherent in conventional fluid-based dampers. As a result, an LEM can extend and compress at a much greater speed, virtually eliminating all vibrations in the passenger cabin. The wheel's motion can be so finely controlled that the body of the car remains level regardless of what's happening at the wheel. The LEM can also counteract the body motion of the car while accelerating, braking and cornering, giving the driver a greater sense of control.

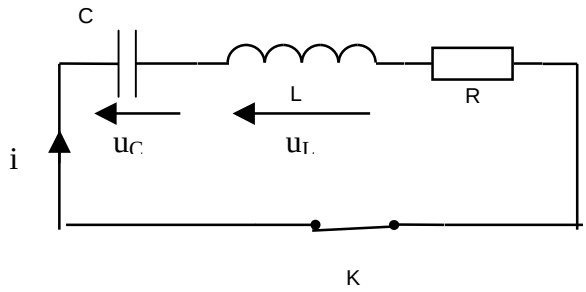
PART 1

Make an exposé on shock absorbers and the following can be helpful.

- What are shock absorbers? Tell what principle of physics is used in them.
- Give some uses of shock absorbers.
- Explain briefly the functioning of the Bose shock absorber system.
- What analogy can you make on free oscillations in RLC circuit ?

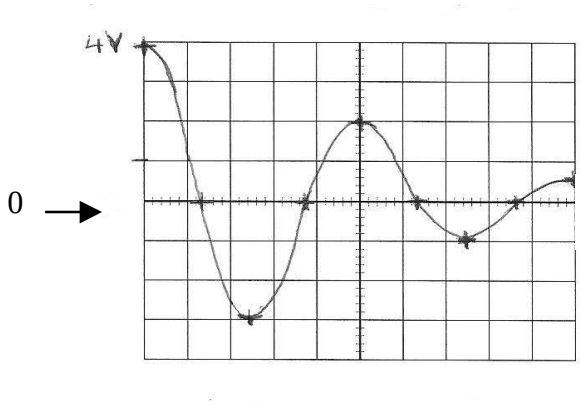
PART 2

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 resistance 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 resistance R we s hall 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