## Virtual Investigation into the behavior of L R Circuits

## Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pledge\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Please go to the following webpage - <https://phet.colorado.edu/en/simulation/legacy/circuit-construction-kit-ac>

Run the application and set up the following circuit.



Typically, and inductor is usually a coil of wire wrapped around a piece of iron. Yes, it’s an electromagnet that we do not use for picking stuff up!

1. By right clicking on the inductor, set it to 10 Henries (No, that really is the unit)
2. Ensure that both bulbs are 10 ohms
3. Close the switch. Describe your observations.
4. Describe in your own words what effect the inductor has on the current.
5. Now open the switch. Again, describe your observations.
6. Why do you think a current was able to flow after we effectively removed the battery from the circuit?

A couple of things to consider. When the current through an inductor changes, Lenz’s law gives us a clue as to how the inductor will act.

1. The inductor will generate an EMF which opposes the change taking place.
2. The size of the EMF will be proportional to the rate of change of current (Why?)
3. The constant of proportionality depends on the geometry of the coils and is called the inductance L, measured in Henries

$$ε=-L\frac{dI}{dt}$$



Consider the loop in the diagram above. We can use Kirchoff 2 (loop) to write a differential equation for current I

If ε is the emf of the battery and -$L\frac{dI}{dt}$ is the emf generated in the coil, the sum of these two should equal the p.d across the resistor, IR.

Write down and solve the differential equation, assuming I = 0 when t = 0



Now consider what happens to the bottom loop when we open the switch. There is now only one source of EMF. Write down and solve a differential equation in $I$ for this case, assuming that the current at $t=0$, when the switch was opened, was $I\_{0}$