Physics 4B

PLC Activity #13: Induction and Inductance

To get credit for this activity, you must show your answers to a PLC tutor and have them initial the sign-out sheet ***before 4:00 pm on Tuesday.***

Show all of your work for each question.

Part 1: Electric Potential Physlets

Go to **Chapter 29: Faraday's Law**. Do the following Physlet Physics exercises and answer the questions listed.

1) Physlet Problem 29.1

Three loops are shown in a region where the magnetic field is changing (position is given in meters and time is given in seconds). Blue indicates the magnetic field is directed into the screen and red indicates it is directed out of the screen. The intensity of the color represents the magnitude of the field. At any instant of time, the red and blue "fields" have the same magnitude.

For each of the following times, is there a current in each loop (A, B, and C) and, if there is a current, is it flowing clockwise or counterclockwise? Explain.

a) t = 0.5 s.

b) t = 3.1 s.

c) t = 4.0 s.

2) Physlet Problem 29.4

A loop, next to a very long current-carrying wire, moves along the path shown (position is given in meters and time is given in seconds). The trail of the loop is marked. The current in the wire is constant and is directed upward as shown by the arrow.

a) For t = 0.5 s, 1.5 s, 2.5 s, 3.5 s, and 4.5 s, is the induced current in the loop clockwise, counterclockwise, or zero?

b) Rank the **magnitudes** of the currents induced in the loop (smallest to greatest, explicitly indicating any ties) at t = 0.5 s, 1.5 s, 2.5 s, and 3.5 s.

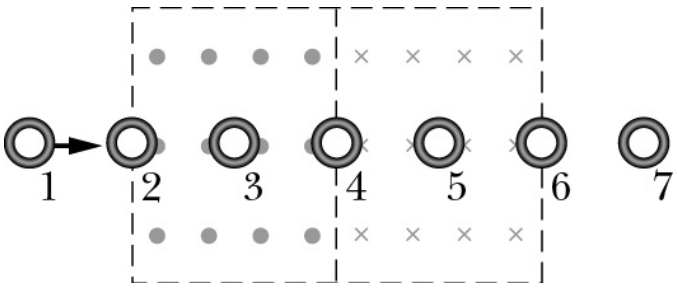
3) Physlet Problem 29.8

The animation shows a top view of four wires and a galvanometer (position is given in meters and time is given in seconds). There is a constant magnetic field passing through the area enclosed by the wires. Current flowing into the + terminal, i.e., counterclockwise, will deflect the meter to the right. You can drag the black bar on the right. The animation runs from 0 to 10s and then repeats.

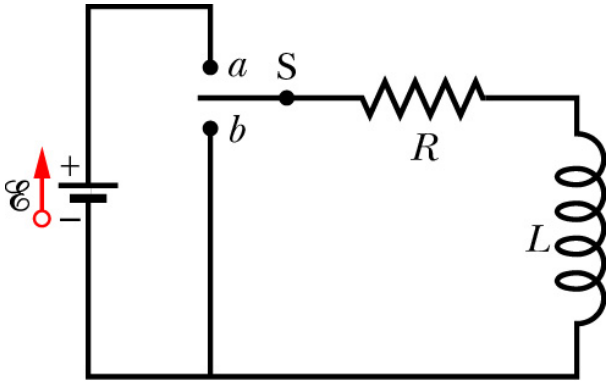
Determine the direction of the magnetic field through the loop.

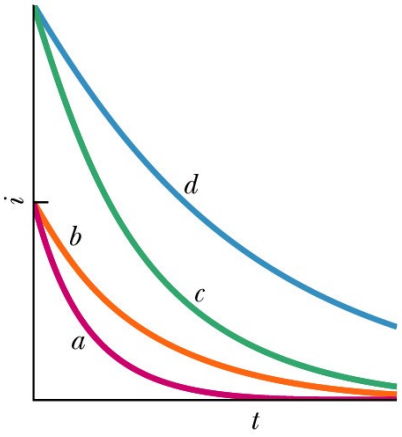
Part 2: Conceptual Questions

4) In the figure below, a circular loop is moved at a constant velocity through regions where uniform magnetic fields of the same magnitude are directed into or out of the page. (The field is zero outside the dashed lines.) At which of the seven indicated loop positions is the emf induced in the loop (a) clockwise, (b) counterclockwise, and (c) zero?



5) The switch in the circuit to the right has been closed on *a* for a very long time when it is then thrown to *b*. The resulting current through the inductor is indicated in the graph below for four sets of values for the resistance R and inductance L: (1) R_0 and L_0, (2) $2R_0$ and L_0, (3) R_0 and $2L_0$, (4) $2R_0$ and $2L_0$. Which set goes with which curve?





6) The figure below gives four situations in which we pull rectangular wire loops out of identical magnetic fields (directed into the page) at the same constant speed. The loops have edge lengths of either L or 2L, as drawn. Rank the situations according to (a) the magnitude of the force required of us and (b) the rate at which energy is transferred from us to thermal energy of the loop, greatest first.