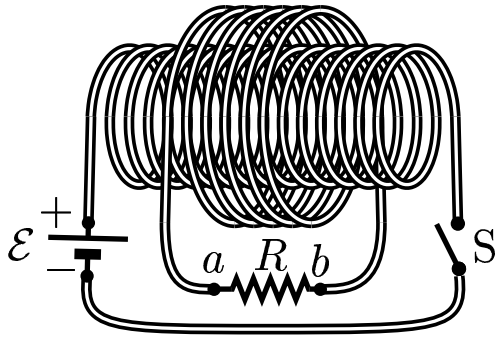
Given: Two coils are suspended around a common central axis as shown in the figure below. One of the coils is connected to a resistor R with ends labeled "a" and "b". The other coil is connected to a battery $\mathcal{E}$ through a switch S.



After switch S has been open for a long period of time, the switch is closed.

What is the direction of the internal induced magnetic field by the larger diameter (secondary) coil and what is the direction of the current through the resistor R just after the switch is closed?

A) ($\Longleftarrow B_{induced}$) right to left and ($I \rightarrow$) from "$a$" through R to "b".
B) ($B_{induced} \Longrightarrow$) left to right and ($I \rightarrow$) from "$a$" through R to "b".
C) ($\Longleftarrow B_{induced}$) right to left and ($I \leftarrow$) from "$b$" through R to "a".
D) ($B_{induced} \Longrightarrow$) left to right and ($I \leftarrow$) from "$b$" through R to "a".

The induced magnetic field depends on whether the flux is increasing or decreasing, since by Lenz's law the induced current will produce flux to oppose a change in flux.

When the switch is open, there is no magnetic field.

At the moment the switch is closed, the magnetic flux through the coils increases.

The induced field through the coil in the circuit with a resistor must produce a magnetic field from left to right ($B_{induced} \Longrightarrow$) to resist any change of flux in the coil (Lenz's law). The larger helical coil is wound counter-clockwise (looking from left-hand end of the coil) from terminal a to terminal b.

Using the right-hand rule, when the induced magnetic field is left to right ($B_{induced} \Longrightarrow$), the induced current through the resistor R flows "from "a" through R to "b" ($I \longrightarrow$).

Answer **B**.

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