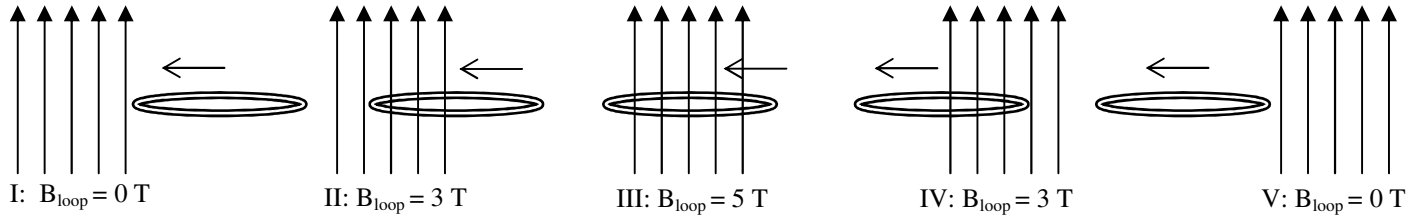


PreAP Magnetism 8

Lenz's Law states: "A change of magnetic field causes an induced current whose induced magnetic field opposes the change."
Let's see if I can make this clearer.

1. A loop of wire passes through the magnetic field, moving left, as seen below. Let's pretend that each vertical arrow represents 1 Tesla of magnetic field strength. Since they are pointing up, we'll call B positive. The amount of B in each loop (# of arrows) is notated below each stage of the diagram. The direction of the induced current (I_{induced}) is as viewed from above. Instructions are given below the diagrams.



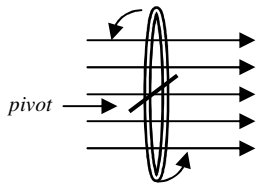
- | | | | | |
|---------|---|---|---|---|
| Step A: | $\Delta B_{\text{loop}} = +3 \text{ T}$ | $\Delta B_{\text{loop}} = \underline{\hspace{2cm}}$ | $\Delta B_{\text{loop}} = -2 \text{ T}$ | $\Delta B_{\text{loop}} = \underline{\hspace{2cm}}$ |
| Step B: | $B_{\text{induced}} = + \text{ or } -$ | $B_{\text{induced}} = + \text{ or } -$ | $B_{\text{induced}} = \text{+ or -}$ | $B_{\text{induced}} = + \text{ or } -$ |
| Step C: | $I_{\text{induced}} = \text{CW or CCW}$ | $I_{\text{induced}} = \text{CW or CCW}$ | $I_{\text{induced}} = \text{CW or CCW}$ | $I_{\text{induced}} = \text{CW or CCW}$ |

Step A: Between each of the stages, write the ΔB_{loop} in the given blanks. Two of them are given for you already.

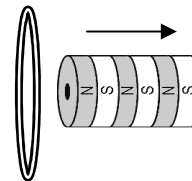
Step B: B_{induced} must always be opposite the change of magnetism in the loop. Two of them, again, have been given for you.

Notice that as the loop passes into the field, the ΔB_{loop} (Stages I–III), the magnetic field is becoming more positive, so the induced field must be negative. As the loop passes out of the field (Stages III–V), the magnetic field is decreasingly positive, so the change is negative. Therefore, the induced magnetic field must be positive, restrengthening the positive B.

Step C: Using the circular right hand rule, use the direction of the induced magnetic field in the loop to determine the direction of the induced current in the loop (as viewed from above). The first one has been given for you.



2. A wire loop is rotated CCW in a magnetic field.

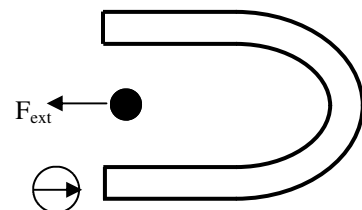


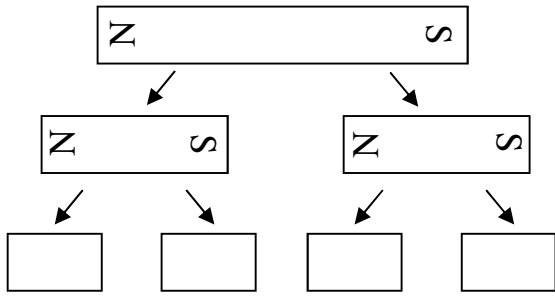
3. A stack of magnets is moved out of a wire loop.

- * When it is vertical, are the ends of the loop moving parallel or perpendicular to the field?
- Is the emf (induced voltage) a max or a min at this position?
- As it turns CCW from vertical to horizontal, is B increasing or decreasing in the loop?
- From the left, determine the direction of I_{induced} in the loop as it rotates from this position to horizontal.

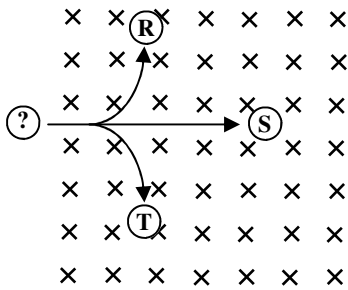
- To resist the magnet's motion, the loop will make a magnet with the north pointing left or right?
- From the left, which direction is I_{induced} flowing in the loop?

4. Remember that the point of the arrow is the N pole of a compass.
- Use the compass at the left to decide which side is N and S. The wire is pulled to the left by an external force.
 - Is the magnet moving the wire?
 - So, what part of the right hand rule (RHR) is the moving wire?
 - Which direction does the magnetic field point?
 - Which direction will the magnetic force be in the wire?
 - Which direction will the induced current be?





5. A bar magnet is split in half. Each of the two halves is also halved.
- Label each of the bars.
 - So, how small would one of the bars have to be to have just a single North or single South pole?



6. When scientists need to determine the charge of a particle, they project it (shoot it) into a magnetic field, as seen at the left. By watching the path, they can easily determine its charge.
- Which path would prove it is negatively charged?
 - Which path would prove it has no charge?
 - Which path would prove it is positively charged?

This is one way that scientists can determine the charge of a particle. The picture at the lower left is that of “pair production”, when an electron and a positron (an anti-electron) are formed in a nuclear accelerator. (I don’t know which is which because I don’t know the direction of the magnetic field.) The two particles have equal mass (more mass would be a much larger spiral path), but you can see by the opposite paths that they have opposite charges. The positron is the antimatter particle of an electron.



2A) parallel