Electromagnetic Induction
Sound Examples
emf

Nada Saab-Ismail, Ph.D.
www.nhsaab.weebly.com

Items

1. LENZ'S LAW
2. Electromagnetic Force (emf) Produced by a Moving Magnet
3. Applications of Electromagnetic Induction to the Reproduction of Sound

LENZ'S LAW

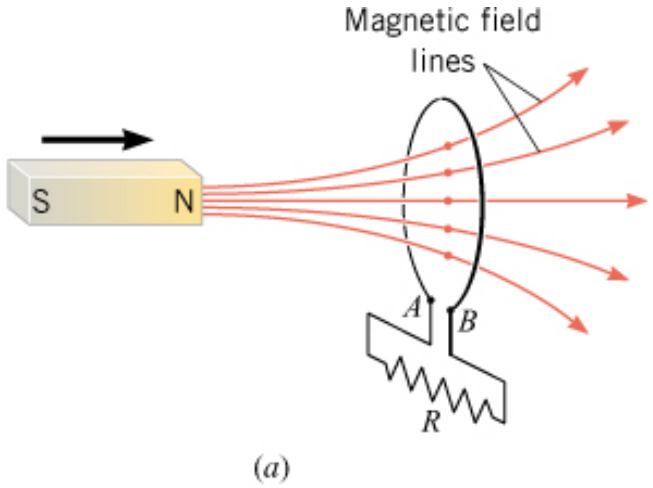
The induced electromagnetic force (emf) resulting from a changing magnetic flux has a polarity that leads to an induced current whose direction is such that the induced magnetic field opposes the original flux change.

Reasoning Strategy

1. Determine whether the magnetic flux that penetrates the coil is increasing or decreasing.
2. Find what the direction of the induced magnetic field must be so that it can oppose the change in flux by adding or subtracting from the original field.
3. Use RHR-2 to determine the direction of the induced current.

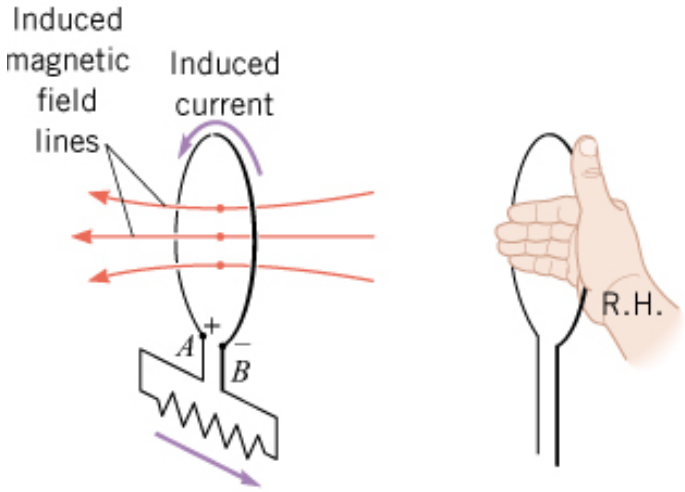
The emf Produced by a Moving Magnet

A permanent magnet is approaching a loop of wire. The external circuit consists of a resistance. Find the direction of the induced current and the polarity of the induced emf.



(a)

Since the applied magnetic field in the loop is increasing and pointing to the right, Lenz's law says an induced current will be created in the loop to try to oppose this change by creating an induced magnetic field to the left.

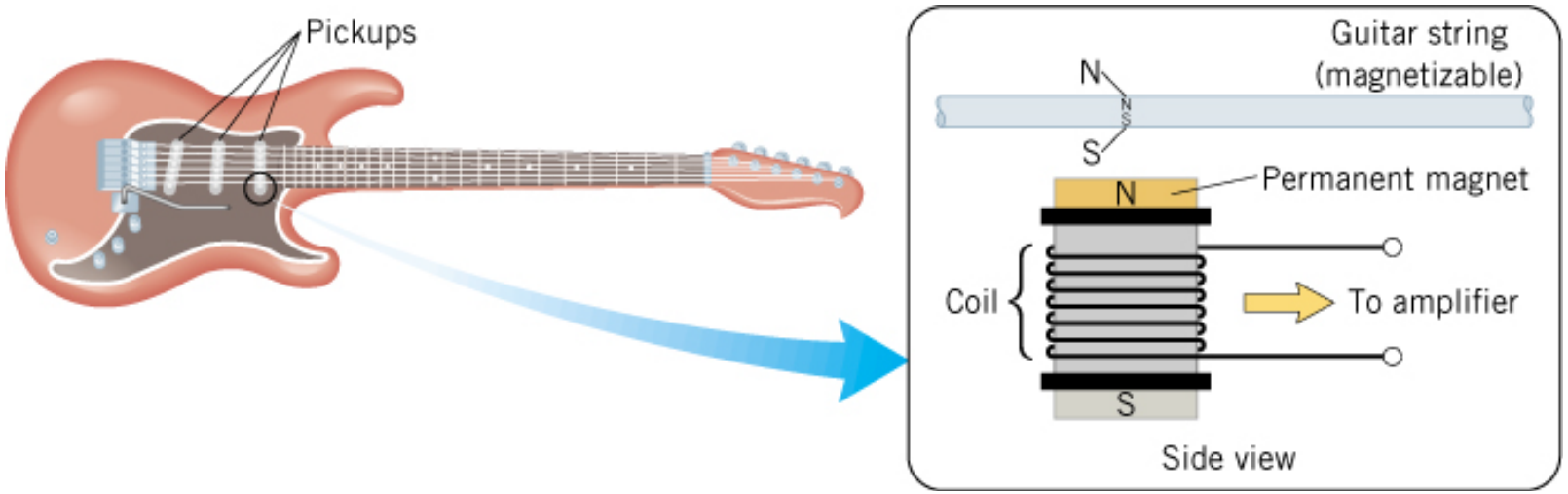


(b)

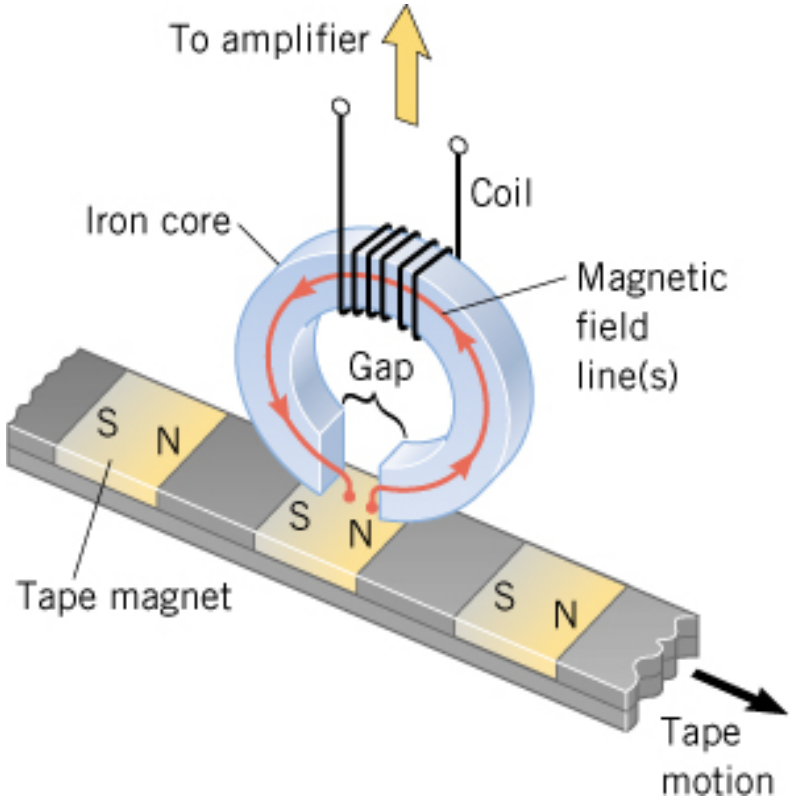
Applications of Electromagnetic Induction to the Reproduction of Sound

Electric guitar pickup

When the string of an electric guitar vibrates, an emf is induced in the coil of the pickup from the vibration of the induced magnetization in the string. The two ends of the coil are connected to the input of an amplifier which is connected to speakers.

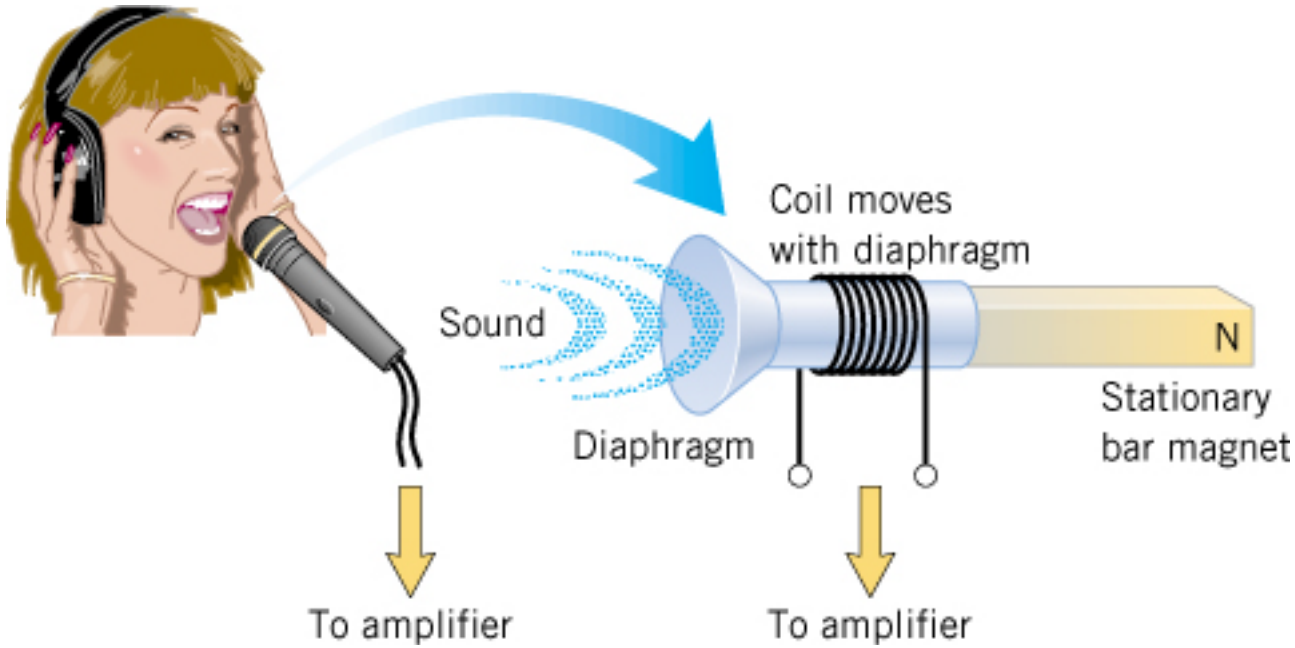


Playback head of a tape deck



As each “tape magnet” goes by the gap, some magnetic field lines pass through the iron core and coil. The changing flux in the coil creates an induced emf which is then amplified and then sent to the speakers.

Moving coil microphone



When a sound wave strikes the diaphragm, a coil fixed to the diaphragm vibrates over a stationary bar magnet, changing the flux in the coil and inducing an emf in the coil which is then amplified and sent to, e.g., speakers.

References:

1) Humanic. (2013). www.physics.ohio-state.edu/~humanic/. In Thomas Humanic Brochure Page.

Physics 1200 Lecture Slides: Dr. Thomas Humanic, Professor of Physics, Ohio State University, *2013-2014 and Current.* *www.physics.ohio-state.edu/~humanic/*

2) Cutnell, J. D. & Johnson, K. W. (1998). *Cutnell & Johnson Physics, Fourth Edition*. New York: John Wiley & Sons, Inc.

The edition was dedicated to the memory of Stella Kupferberg, Director of the Photo Department: "We miss you, Stella, and shall always remember that a well-chosen photograph should speak for itself, without the need for a lengthy explanation"

3) Martindale, D. G. & Heath, R. W. & Konrad, W. W. & Macnaughton, R. R. & Carle, M. A. (1992). *Heath Physics*. Lexington: D.C. Heath and Company

4) Zitzewitz, P. W. (1999). *Glencoe Physics Principles and Problems*. New York: McGraw-Hill Companies, Inc.

5) Schnick, W.J. (n.d.). *Calculus-based physics, A Free Physics Textbook*. Retrieved from http://www.anselm.edu/internet/physics/cbphysics/index.html