Physics Prelab #7: Magnetic Fields and induced EMF
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Objective: To investigate the EMF created by a varying magnetic field in a coil

Theory: Electromotive Forces (EMF) convert one form of energy to another. All EMFs can produce a potential difference between two points, called terminals. The high potential terminal is denoted with a + sign, and the low with a - sign. When the terminals are connected to a circuit, the potential difference causes any free charges within the circuit to move, thereby doing work on the charges. The important property of the EMF is that it can produce a potential everywhere in the circuit and can produce a current. Magnetic fields and conductors can produce EMF's of varying strengths. Consider a loop that is connected to a circuit component and is centered in a magnetic field. Changes in dimension of the loop will cause a current to be produced. Likewise, if the magnitude of the magnetic field should change and the size of the loop is constant, a current will also be produced. In either case, the charges in the conductor feel the presence of the magnetic field. When the loop changes size or the magnetic field changes strength, the flux through the loop changes. This change in flux that induces the EMF in the loop.

The change in flux produces an EMF which is given by $\varepsilon = -\frac{\Delta \phi}{\Delta t}$
In the case where the loop changes size over time the equation for the EMF is $\varepsilon = -B\frac{\Delta A}{\Delta t}$
If the magnitude of the magnetic field changes over time then the equation for the EMF can be written as $\varepsilon = -N\pi r^2\frac{\Delta B}{\Delta t}$ In the experiment, a magnet will be attached to a spinning rod. A coil will be fixed beside the rod and the magnet will pass by the coil. We will see how the rate of change of the magnetic field and the number of loops in the coil affects the EMF produced.
Procedure:
Part 1: The magnet on the rod was spun so that it quickly passes the coil-sensor bundle.
A single peak was zoomed in on in the magnetic field and the EMF graph was locked into the same time axis. The B field with field traces, EMF and derivative graph were printed off. Vertical

lines were drawn on the printout from the starting positions to the magnetic field curve. Four more runs were done in which we fit the derivative by adjusting the multiplicative factor each time.

Part 2: The arm was spun with as large a rotation rate as possible. Data was recorded until the spinning came to a stop. Only peaks were used in the data table to show a constant max B field. The values of the maximum B field for the last 10 spins were put in a column next to the value of the measured peak. We found out the time it took to make a rotation by measuring from peak to consecutive peak on the magnetic field graph.