Physics Exploration Homework Supplement P111-16.pdf

Explorations into Electromagnetic Induction

Go to the Physics Exploration Center. Enter through the resource room in 311/312 Thaw Hall. This exploration involves understanding the phenomena of electromagnetic induction. Go to the setup with magnets, coils and galvanometer (the magnitude and direction of the deflection of the needle in this device indicates the magnitude and direction of current in the coil to which this device is connected). Another part of exploration involves several small solenoids with different number of turns connected to each other in series and a galvanometer. **Notice that you have not been provided any battery. In each of the cases below, you must predict the direction of induced current if there is an induced current.**

(1) Predict what you would observe if you brought the north pole of a bar magnet close to the big coil with the pole pointing toward the loop. Predict how your observations will differ if you (a) held the north pole stationary close to the coil and (b) pulled the north pole away from the coil. Explain your reasoning. Now perform the exploration and explain any discrepancy between your prediction and observation. (Set-up P111-16A.pdf)

(2) Predict how the observations will differ if the bar magnet was kept fixed and the big coil was brought toward the north pole, held stationary or taken away from the north pole compared to part (1). Also, predict how the observations will differ if we repeated the experiment with south pole instead of north pole in part (1). Explain your reasoning for each case. Now perform the exploration and explain any discrepancy between your prediction and observation.

(3) Predict what you would observe if you hold the big coil close to the north pole of the bar magnet and crush the coil to make its area smaller. What happens if you increase the area by bringing the coil to the original shape? Explain your reasoning. Now perform the exploration and explain any discrepancy between your prediction and observation (Make sure you hold the coil still when you crush it and crush it as fast as you can). (Set-up P111-16B.pdf)

(4) Predict what you would observe if you hold the big coil close to the north pole of the bar magnet and then rotate the coil back and forth so that the angle that the normal to the area of the loop makes with the magnetic field changes. Explain. Now perform the exploration and explain any discrepancy between your prediction and observation.

(5) Predict how the induced current will differ when a bar magnet is slid into the solenoids with different number of turns but all other parameters are kept same. Explain. Now insert the north pole of a bar magnet inside each of the small solenoids with different number of turns connected to each other in series and a galvanometer (make the angle and speed with which you insert the bar magnet into to the solenoids as similar as possible to ensure that all other parameters are fixed). Do you observe what you predicted? (Set-up P111-16C.pdf)

(6) In all of parts (l)-(5) explain why the conservation of energy is not violated even though electrical energy is produced without any battery (which provides chemical energy).