PREFLIGHTS **LESSON 3 – FARADAY'S LAW AND INDUCED ELECTRIC FIELDS**

LEARNING OBJECTIVES:

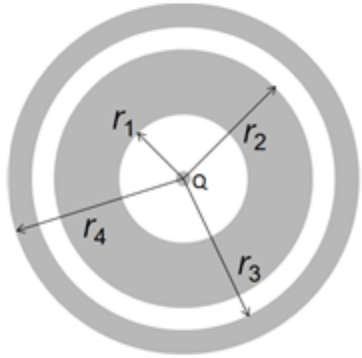
1. **Describe Faraday's law, in particular the problems to which it applies and the conclusions that can be drawn from it.**
2. **Calculate induced electric fields using Faraday's law and Lenz's law.**

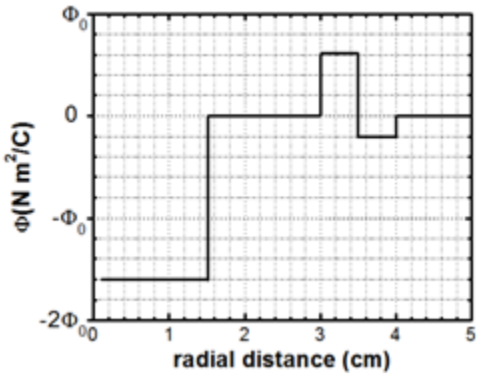
1) Consider Example 7.5 in Griffiths. One should get the same results if the magnet is held stationary while the loop is moved at a constant velocity v. According to Griffiths, the current flows in that case due to the Lorentz force on the charges. However, assuming a magnetic field that points straight to the left, as is indicated by the **M** vector shown in Figure 7.21, the velocity of the loop and the magnetic field of the magnet would be parallel, making the magnetic force on the charges in the loop zero. How could one analyze the situation with the loop moving rather than the magnet and get the correct current using the Lorentz force equation?

2) For Example 7.5, assume you were given values for the magnetization, velocity, length of the magnet, etc. Describe how you could use those values and what you know about the magnetic field of a permanent magnet to produce a graph of flux vs. time similar to Figure 7.22.

3) Consider Example 7.8 in Griffiths. If the wheel has mass M, then the final tangential velocity of the wheel, calculated from the angular momentum, will be $v = \lambda\pi a^2 B_0/M$. Assume values of $\lambda = 1 \times 10^{-5}$ C/m, $a = 1$ m, $B_0 = 1$ T, and $M = 1$ kg. On a separate sheet of paper, use the equation for velocity to calculate the current I created by the spinning wheel. On the same sheet of paper, calculate the magnetic field at the center of the wheel due to that current (you may want to look back at Example 5.6). On page 304, Griffiths says, "the flux produced by the induced current is typically only a tiny fraction of the original." Does the magnetic field that you calculated support that statement?

4) ***Note: This is a review question from Physics 361.*** A charged particle of charge Q is held at the center of two concentric spherical shells. The figure on the right shows a cross section. The inner and outer radii of the inner sphere are respectively $r_1 = 1.5$ cm and $r_2 = 3.0$ cm, and the inner and outer radii of the outer sphere are $r_3 = 3.5$ cm and $r_4 = 4.0$ cm. The graph shows the net electric flux through a spherical surface centered on the particle as a function of the radius of the Gaussian sphere. Which of the following statements are true? More than one statement may be true, so list *all* that are true.





a. The inner shell could be a conductor.

b. The magnitude of the net charge on the inner shell is equal to the magnitude of the net charge on the outer shell.

c. The net charge on the outer shell is positive.

d. The charge on the inner surface of the inner shell is negative.

e. The outer shell could be a conductor.

f. The charge on the inner surface of the outer shell is zero.

g. The charge on the outer surface of the outer shell is positive.

5) What did you find difficult or confusing in the pre-class work? If nothing was difficult or confusing, tell me what you found most interesting. Please be as specific as possible.

6) Document whatever help you received on the preclass work.