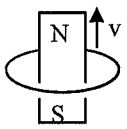
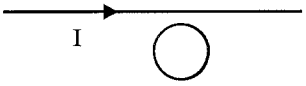
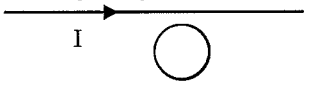
Induction

1. Find the direction of the induced current in the wire loop.

a) The magnet is pulled out. b) The current in the long straight wire is increasing. c) The current in the long straight wire stays constant.



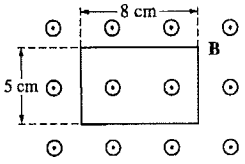




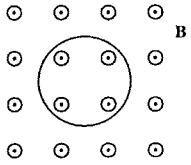
d) The current in the long straight wire stays constant while the wire loop moves along the current.

e) The current in the long straight wire stays constant while the wire loop moves away from the current.

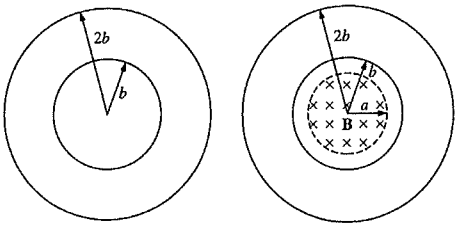
2. A rectangular wire loop is at rest in a uniform magnetic field **B** of magnitude 0.8 T that is directed out of the page. The loop measures 5 cm by 8 cm, and the plane of the loop is perpendicular to the field, as shown to the right. a) What is the total magnetic flux through the loop? b) The magnetic field is now increased at the rate of 0.01 T/s. i) What is the induced emf in the loop? ii) In which direction does the induced current flow?



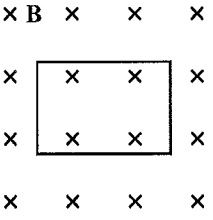
3. A single circular loop of wire in the plane of the page is perpendicular to a uniform magnetic field **B** directed out of the page, as shown to the right. The loop has a diameter of 20 cm and the field has a magnitude of 3 T. Now the loop is turned so that its plane is parallel to the field direction in 0.5 s. What is the average induced emf in the 0.5 s?

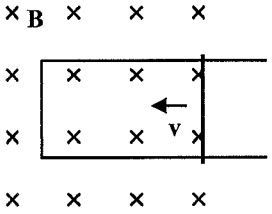


4. Two concentric circular loops of radii b ($b = 0.1$m) and $2b$, made of the same type of wire, lie in the plane of the page, as shown to the right. A uniform magnetic field **B** that is perpendicular to the plane of the page now passes through the loops, as shown to the right. The field is confined to a region of radius a ($a = 0.08$ m), where $a < b$, and is decreasing at a constant rate of 0.02 T/s.
   a) Find the induced emf in the wire loop of radius b.
   b) Find the induced emf in the wire loop of radius $2b$.



5. A rectangular loop of wire 0.2 m high and 0.3 m wide is placed in a uniform magnetic field of 0.5 T. The loop has a total resistance of 0.1 Ω.
   a) Calculate the magnetic flux Φ through the loop.
   The field now begins to decrease uniformly to 0.1 T in 2 s.
   b) Find the emf induced in the loop during this period.
   c) Calculate the magnitude of the current in the loop during this period. Does this current flow clockwise or counterclockwise?





6. A conducting rod is moved to the left on a U-shaped conductor in a uniform magnetic field B = 2 T that points into the page as shown in the figure to the left. The moving rod is 10 cm long and moves with a speed of 5 cm/s. a) Find the induced emf developed in the rod, b) the direction of the induced current, and c) the electric field in the rod.

7. A rectangular wire loop of 50 turns, a width of 0.3 m and a height of 0.1 m is situated so that the left edge of the loop is just outside the region of uniform magnetic field of 0.4 T. The total resistance of the loop is 0.2 Ω. A force F is used to pull the loop to the left at a constant speed of 0.6 m/s so the loop moves out of the region with magnetic field. a) Find the direction of the induced current in the loop. b) Find the induced emf in the loop. c) Find the induced current in the loop. d) Find the force F. Neglect gravity, friction and air resistance.