Physics 104 : Discussion 6a

4. A long, straight wire carrying a current of 2.00 A is placed along the axis of a cylinder of radius 0.500 m and a length of 3.00 m. Determine the total magnetic flux through the cylinder.

20.4 The magnetic field lines are tangent to the surface of the cylinder, so that no magnetic field lines penetrate the cylindrical surface. The total flux through the cylinder is $\boxed{\text{zero}}$.

10. The flexible loop in Figure P20.10 has a radius of 12 cm and is in a magnetic field of strength 0.15 T. The loop is grasped at points *A* and *B* and stretched until its area is nearly zero. If it takes 0.20 s to close the loop, find the magnitude of the average induced emf in it during this time.

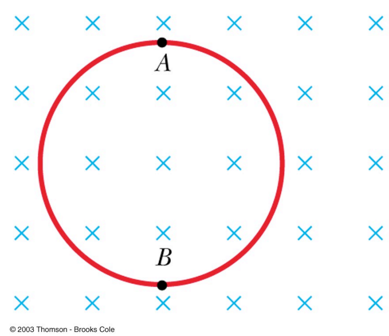

Figure P20.10

20.10 $|\varepsilon| = \dfrac{\Delta\Phi_B}{\Delta t} = \dfrac{B(\Delta A)\cos\theta}{\Delta t}$

$$= \frac{(0.15\text{ T})\left[\pi(0.12\text{ m})^2 - 0\right]\cos 0°}{0.20\text{ s}} = 3.4\times10^{-2}\text{ V} = \boxed{34\text{ mV}}$$

22. A helicopter has blades of length 3.0 m, rotating at 2.0 rev/s about a central hub. If the vertical component of Earth's magnetic field is 5.0×10^{-5} T, what is the emf induced between the blade tip and the central hub?

20.22 During each revolution, one of the rotor blades sweeps out a horizontal circular area of radius ℓ, $A = \pi\ell^2$. The number of magnetic field lines cut per revolution is $\Delta\Phi_B = B_\perp A = B_{vertical}A$. The induced emf is then

$$\varepsilon = \frac{\Delta\Phi_B}{\Delta t} = \frac{B_{vertical}(\pi\ell^2)}{1/f} = \frac{(5.0\times10^{-5}\text{ T})\left[\pi(3.0\text{ m})^2\right]}{0.50\text{ s}} = 2.8\times10^{-3}\text{ V} = \boxed{2.8\text{ mV}}$$

24. A bar magnet is held above the center of a wire loop in a horizontal plane, as shown in Figure P20.24. The south end of the magnet is toward the loop. The magnet is dropped. Find the direction of the current through the resistor (a) while the magnet is falling toward the loop and (b) after the magnet has passed through the loop and moves away from it.

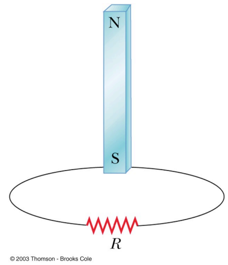

Figure P20.24

20.24 (a) To oppose the approach of the south end of the magnet, the magnetic field along the axis of the loop should be directed downward. Thus, the current must be **clockwise when viewed from above** the loop.

(b) To oppose the departure of the north end of the magnet, the magnetic field should be directed upward along the axis of the loop, so the current must be **counterclockwise when viewed from above**

26. In Figure P20.26, what is the direction of the current induced in the resistor at the instant the switch is closed?

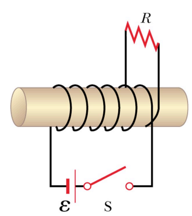

Figure P20.26

20.26 When the switch is closed, the magnetic field due to the current from the battery will be directed to the left along the axis of the cylinder. To oppose this increasing leftward flux, the induced current in the other loop must produce a field directed to the right through the area it encloses. Thus, the induced current is **left to right** through the resistor.