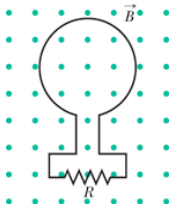
Chapter 31 – Problem Day

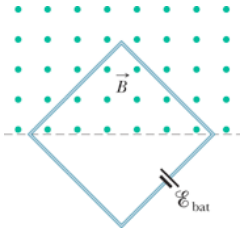


1. In the figure, the magnetic flux through the loop increases according to the flux $\Phi_B = 6t^2 + 7t$, where Φ_B is in milliwebers and t is in seconds. (a) What is the magnitude of the emf induced in the loop when $t = 2$ s? (b) Is the direction of the current through R to the right or left?

4. An elastic conducting material is stretched into a circular loop of 12.0 cm radius. It is placed with its plane perpendicular to a uniform 0.800 T magnetic field. When released, the radius of the loop starts to shrink at an instantaneous rate of 75.0 cm/s. What emf is induced in the loop at that instant?

5. A 120-turn coil of radius 1.8 cm and resistance 5.3 Ω is coaxial with a solenoid of 220 turns/cm and diameter 3.2 cm. The solenoid current drops from 1.5 A to zero in time interval $\Delta t = 25$ ms. What current is induced in the coil during Δt?

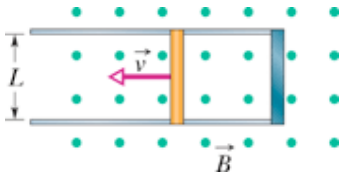
11. A square wire loop with 2.00 m sides is perpendicular to a uniform magnetic field, with half the area of the loop in the field as shown in the figure. The loop contains an ideal battery with emf $\varepsilon = 20$ V. If the magnitude of the field varies with time according to $B = 0.042 - 0.87t$, with B in teslas and t in seconds, what are (a) the net emf in the circuit and (b) the direction of the (net) current around the loop?



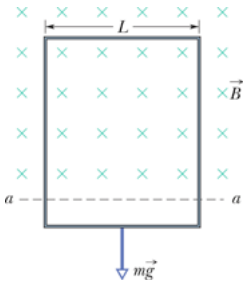
19. One hundred turns of (insulated) copper wire are wrapped around a wooden cylindrical core of cross-sectional area 0.0012 m². The two ends of the wire are connected to a resistor. The total resistance in the circuit is 13 Ω. If an externally applied uniform longitudinal magnetic field in the core changes from 1.60 T in one direction to 1.60 T in the opposite direction, how much charge flows through a point in the circuit during the change?

30. A loop antenna of area 2.00 cm² and resistance 5.21 μΩ is perpendicular to a uniform magnetic field of magnitude 17.0 μT. The field magnitude drops to zero in 2.96 ms. How much thermal energy is produced in the loop by the change in field?

31. In the figure, a metal rod is forced to move with constant velocity along two parallel metal rails, connected with a strip of metal at one end. A magnetic field of magnitude $B = 0.35$ T points out of the page. (a) If the rails are separated by $L = 25$ cm and the speed of the rod is 55.0 cm/s, what emf is generated? (b) If the rod has a resistance of 18.0 Ω and the rails and connector have negligible resistance, what is the current in the rod? (c) At what rate is energy being transferred to thermal energy?



34. In the figure, a long rectangular conducting loop, of width L, resistance R, and mass m, is hung in a horizontal, uniform magnetic field B that is directed into the page and that exists only above line aa. The loop is then dropped; during its fall, it accelerates until it reaches a certain terminal speed v_t. Ignoring air drag, find an expression for v_t.



Chapter 31 – Problem Day Answers

1a) 31mV
1b) left

4) 0.452 V

5) 0.03 A

11a) 21.7 V
11b) ccw

19) 29.5 mC

30) 7.50×10^{-10} J

31a) 0.0481 V
31b) 2.67 mA cw
31c) 0.129 mW

34) $v_t = \frac{mgR}{B^2L^2}$