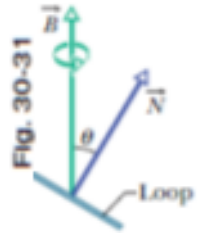


Suggested problems from Chapter 30

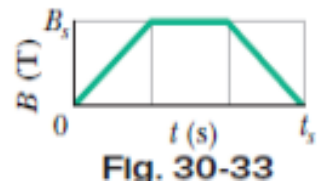
The quiz questions will be same or very similar to the following text-book problems. Refer to the course website for the latest version of this document. You are encouraged to seek the help of your instructor during his office hours.

1. In Fig. 30-31, a circular loop of wire 10 cm in diameter (seen edge-on) is placed with its normal at an angle \vec{N} at an angle $\theta = 30^\circ$ with the direction of a uniform magnetic field \vec{B} of magnitude 0.50 T. The loop is then rotated such that \vec{N} rotates in a cone about the field direction at the rate 100 rev/min; angle θ remains unchanged during the process. What is the emf induced in the loop?



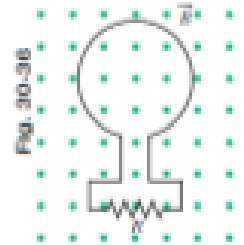
Answer: zero

4. A wire loop of radius 12 cm and resistance 8.5Ω is located in a uniform magnetic field \vec{B} that changes in magnitude as given in Fig. 30-33. The vertical axis scale is set by $B_s = 0.50$ T, and the horizontal axis scale is set by $t_s = 6.00$ s. The loop's plane is perpendicular to \vec{B} . What emf is induced in the loop during time intervals (a) 0 to 2.0 s, (b) 2.0 s to 4.0 s, and (c) 4.0 s to 6.0 s?



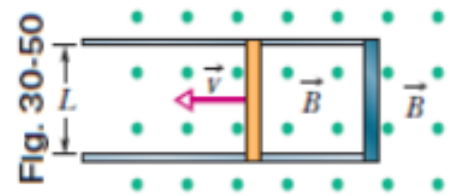
Answer: (a) 0.031 V = 31 mV ; (b) to the left

7. In Fig. 30-36, the magnetic flux through the loop increases according to the relation $\Phi_B = 6.0t^2 + 7.0t$, where Φ_B is in milliwebers and t is in seconds. (a) What is the magnitude of the emf induced in the loop when $t = 2.0$ s? (b) Is the direction of the current through R to the right or left?



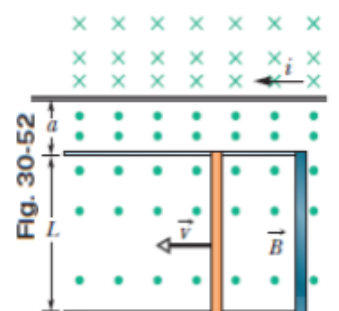
Answer: (a) -0.011 V = 31 mV ; (b) zero ; (c) $+0.011$ V = 31 mV

29. In Fig. 30-50, a metal rod is forced to move with constant velocity \vec{v} along two parallel metal rails, connected with a strip of metal at one end. A magnetic field of magnitude $B = 0.350$ T points out of the page. (a) If the rails are separated by $L = 25.0$ cm and the speed of the rod is 55.0 cm/s, what emf is generated? (b) If the rod has a resistance of 18.0Ω 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?



Answer: (a) 0.0481 V = 48.1 mV ; (b) 0.00267 A = 2.67 mA ; (c) 1.29×10^{-4} W = 129 mW

33. Figure 30-52 shows a rod of length $L = 10.0$ cm that is forced to move at constant speed $v = 5.00$ m/s along horizontal rails. The rod, rails, and connecting strip at the right form a conducting loop. The rod has resistance 0.400Ω ; the rest of the loop has negligible resistance. A current $i = 100$ A through the long straight wire at distance $a = 10.0$ mm from the loop sets up a (nonuniform) magnetic field through the loop. Find the (a) emf and (b) current induced in the loop. (c) At what rate is thermal energy generated in the rod? (d) What is the magnitude of the force that must be applied to the rod to make it move at constant speed? (e) At what rate does this force do work on the rod?



Answer: (a) 240 μ V ; (b) 600 μ A ; (c) 1.44×10^{-7} W = 144 nW ; (d) 2.87×10^{-8} N = 28.7 nN ; (e) 1.44×10^{-7} W = 144 nW