Suggested problems: Chapter 30- HRW-Principles of Physics- ISV 10th Edition

1. In Fig. 30-21, 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 = 0.125 T points out of the page. (a) If the rails are separated by L = 25.0 cm and the speed of the rod is 38.0 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?

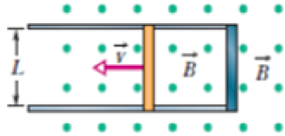

Fig. 30-21

Answer: (a) 0.0119 V; (b) 6.60 x 10^{-4} A (c) 7.83 $\times 10^{-6}$ W

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46. A wire loop of radius 25 cm and resistance 8.5 Ω is located in a uniform magnetic field $\vec{B}$ that changes in magnitude as given in Fig. 30-41. The vertical axis scale is set by B_s = 0.80 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?

Fig. 30-41

Answer: (a) - 0.079 V (b) zero V; (C)+ 0.079 V

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55. Figure 30-46 shows a rod of length L = 12.0 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 0.400 Ω; 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?

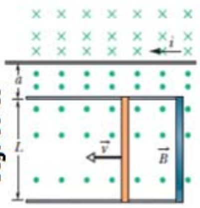

Fig. 30-46

Answer: (a) 256 μV ; (b) 641 μA ; (c) 1.64$\times 10^{-7}$ W; (d) 3.29 $\times 10^{-8}$ N; (c) 1.67$\times 10^{-7}$ W

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71. In Fig. 30-54, a circular loop of wire 10 cm in diameter (seen edge-on) is placed with its normal at an angle $\vec{N}$ at and angle θ = 20° with the direction of a uniform magnetic field $\vec{B}$ of magnitude 1.5 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?

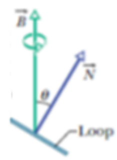

Fig. 30-54

Answer: zero

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77. In Fig. 30-58, the magnetic flux through the loop increases according to the relation $\Phi_B = 3.0t^2 + 7.0t$, 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 = 1.5 s? (b) Is the direction of the current through R to the right or left?


Fig. 30-58

Answer: (a) 16 mV ; (b) current is to the left through *R*