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19. A truck is carrying a steel beam of length 15.0 m on a freeway. An accident causes the beam to be dumped off the truck and slide horizontally along the ground at a speed of 25.0 m/s. The velocity of the center of mass of the beam is northward while the length of the beam maintains an east-west orientation. The vertical component of the Earth's magnetic field at this location has a magnitude of $35.0 \mu\text{T}$. What is the magnitude of the induced emf between the ends of the beam?

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23. **M** Figure P31.23 shows a top view of a bar that can slide on two frictionless rails. The resistor is $R = 6.00 \, \Omega$, and a 2.50-T magnetic field is directed perpendicularly downward, into the paper. Let $\ell = 1.20 \, \text{m}$. (a) Calculate the applied force required to move the bar to the right at a constant speed of 2.00 m/s. (b) At what rate is energy delivered to the resistor?

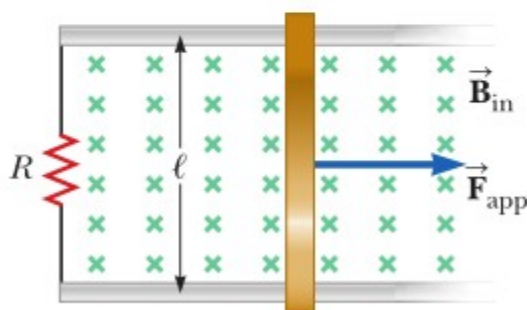


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25. Review. Figure P31.25 shows a bar of mass $m = 0.200$ kg that can slide without friction on a pair of rails separated by a distance $\ell = 1.20$ m and located on an inclined plane that makes an angle $\theta = 25.0^\circ$ with respect to the ground. The resistance of the resistor is $R = 1.00 \Omega$ and a uniform magnetic field of magnitude $B = 0.500$ T is directed downward, perpendicular to the ground, over the entire region through which the bar moves. With what constant speed v does the bar slide along the rails?

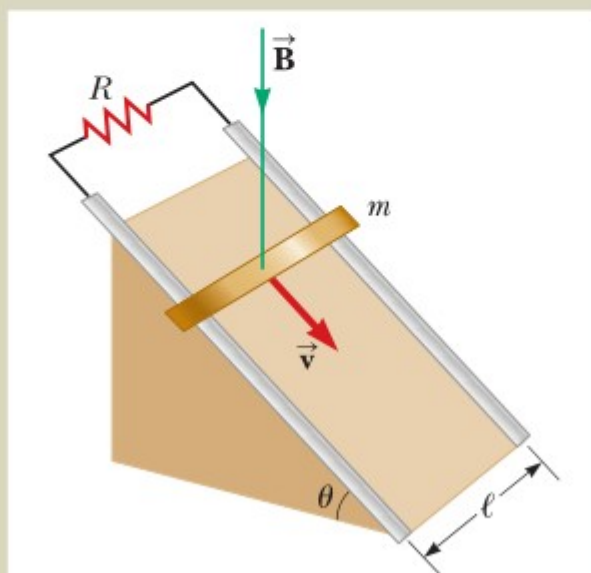


Figure P31.25 Problems 25 and 26.

- 27. M** The *homopolar generator*, also called the *Faraday disk*, is a low-voltage, high-current electric generator. It consists of a rotating conducting disk with one stationary brush (a sliding electrical contact) at its axle and another at a point on its circumference as shown in Figure P31.27. A uniform magnetic field is applied perpendicular to the plane of the disk. Assume the field is 0.900 T , the angular speed is $3.20 \times 10^3\text{ rev/min}$, and the radius of the disk is 0.400 m . Find the emf generated between the brushes. When superconducting coils are used to produce a large magnetic field, a homopolar generator can have a power output of several megawatts. Such a generator is useful, for example, in purifying metals by electrolysis. If a voltage is applied to the output terminals of the generator, it runs in reverse as a *homopolar motor* capable of providing great torque, useful in ship propulsion.

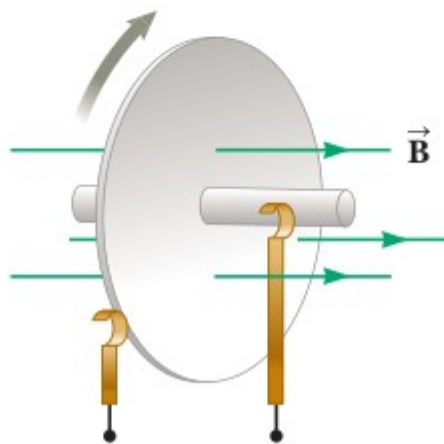


Figure P31.27