Home Work 8

8-1 In Fig. 28-34, a conducting rectangular solid of dimensions d_x = 5.00 m, d_y = 3.00 m, and d_z = 2.00 m moves at constant velocity **v** = (20.0m/s)**i** through a uniform magnetic field **B** = (30.0mT)**j**. What are the resulting (a) electric field within the solid, in unit-vector notation, and (b) potential difference across the solid?

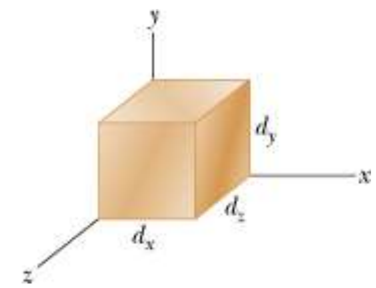


Figure 28-34 Problems 15.

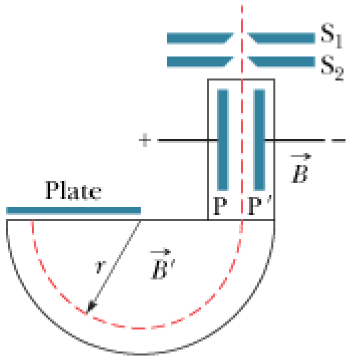


Figure 28-53Problem 76.

8-2 Bainbridge's mass spectrometer, shown in Fig. 28-53, separates ions having the same velocity. The ions, after entering through slits, S_1 and S_2, pass through a velocity selector composed of an electric field produced by the charged plates P and P′, and a magnetic field **B** perpendicular to the electric field and the ion path. The ions that then pass undeviated through the crossed **E** and **B** fields enter into a region where a second magnetic field **B′** exists, where they are made to follow circular paths. A photographic plate (or a modern detector) registers their arrival. Show that, for the ions, $q/m = E/rBB'$, where r is the radius of the circular orbit.

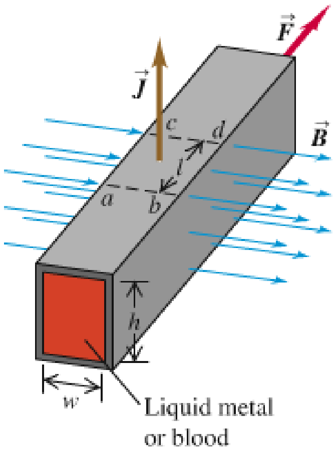
8-3 A 1.0 kg copper rod rests on two horizontal rails 1.0 m apart and carries a current of 50 A from one rail to the other. The coefficient of static friction between rod and rails is 0.60. What are the (a) magnitude and (b) angle (relative to the vertical) of the smallest magnetic field that puts the rod on the verge of sliding?

8-4 A positron with kinetic energy 2.00 keV is projected into a uniform magnetic field **B** of magnitude 0.100 T, with its velocity vector making an angle of 89.0° with **B**. Find (a) the period, (b) the pitch p, and (c) the radius r of its helical path.

8-5

27.90 ••• **The Electromagnetic Pump.** Magnetic forces acting on conducting fluids provide a convenient means of pumping these fluids. For example, this method can be used to pump blood without the damage to the cells that can be caused by a mechanical pump. A horizontal tube with rectangular cross section (height h, width w) is placed at right angles to a uniform magnetic field with magnitude B so that a length l is in the field (Fig. P27.90). The tube is filled with a conducting liquid, and an electric current of density J is maintained in the third mutually perpendicular direction. (a) Show that the difference of pressure between a point in the liquid on a vertical plane through ab and a point in the liquid on another vertical plane through cd, under conditions in which the liquid is prevented from flowing, is $\Delta p = JlB$. (b) What current density is needed to provide a pressure difference of 1.00 atm between these two points if $B = 2.20$ T and $l = 35.0$ mm?

Figure **P27.90**



8-6

27.91 ••• **CP** **A Cycloidal Path.** A particle with mass m and positive charge q starts from rest at the origin shown in Fig. P27.91. There is a uniform electric field $\vec{E}$ in the $+y$-direction and a uniform magnetic field $\vec{B}$ directed out of the page. It is shown in more advanced books that the path is a *cycloid* whose radius of curvature at the top points is twice the y-coordinate at that level. (a) Explain why the path has this general shape and why it is repetitive. (b) Prove that the speed at any point is equal to $\sqrt{2qEy/m}$. (*Hint:* Use energy conservation.) (c) Applying Newton's second law at the top point and taking as given that the radius of curvature here equals $2y$, prove that the speed at this point is $2E/B$.

Figure **P27.91**