••24 In Fig. 28-37, a charged particle moves into a region of uniform magnetic field $\vec{B}$, goes through half a circle, and then exits that region. The particle is either a proton or an electron (you must decide which). It spends 130 ns in the region. (a) What is the magnitude of $\vec{B}$? (b) If the particle is sent back through the magnetic field (along the same initial path) but with 2.00 times its previous kinetic energy, how much time does it spend in the field during this trip?

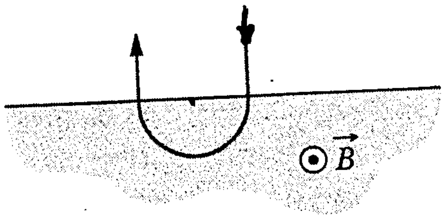
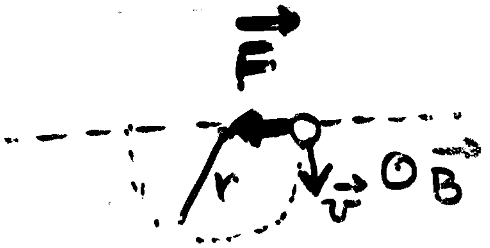


Fig. 28-37 Problem 24.

a) $t = 130$ ns



The particle is a proton (positive charge)

$$T = \frac{2\pi r}{v} = \frac{2\pi}{v}\frac{mv}{qB} = \frac{2\pi m}{qB}$$

$$\Rightarrow B = \frac{2\pi m}{qT}$$

$T = 130 \times 2 = 260$ ns

$$B = \frac{2\pi \times 1.67\times 10^{-27}}{1.6\times 10^{-19} \times 260\times 10^{-9}} = 0.25 \text{ Tesla.}$$

b) Doubling K will increase the speed by $\sqrt{2}$. The period will be the same but the radius will increase

•35 A 13.0 g wire of length $L = 62.0$ cm is suspended by a pair of flexible leads in a uniform magnetic field of magnitude 0.440 T (Fig. 28-40). What are the (a) magnitude and (b) direction (left or right) of the current required to remove the tension in the supporting leads? ILW

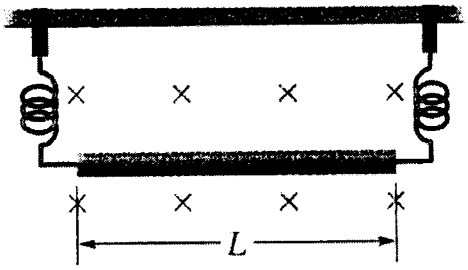
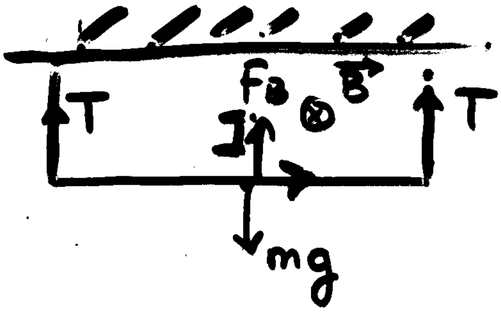


Fig. 28-40 Problem 35.

a) & b)



$$2T + F_B - mg = 0$$

To remove T $\Rightarrow$ $T = 0$

$$\Rightarrow F_B - mg = 0$$

$$I \ell B - mg = 0$$

$$I = \frac{mg}{\ell B} = \frac{13 \times 10^{-3} \times 9.8}{0.62 \times 0.44}$$

$$\boxed{I = 0.467 \text{A}}$$

The current is to the right!

sec. 28-9 Torque on a Current Loop

•39 Figure 28-41 shows a rectangular 20-turn coil of wire, of dimensions 10 cm by 5.0 cm. It carries a current of 0.10 A and is hinged along one long side. It is mounted in the xy plane, at angle $\theta = 30°$ to the direction of a uniform magnetic field of magnitude 0.50 T. In unit-vector notation, what is the torque acting on the coil about the hinge line? **SSM**

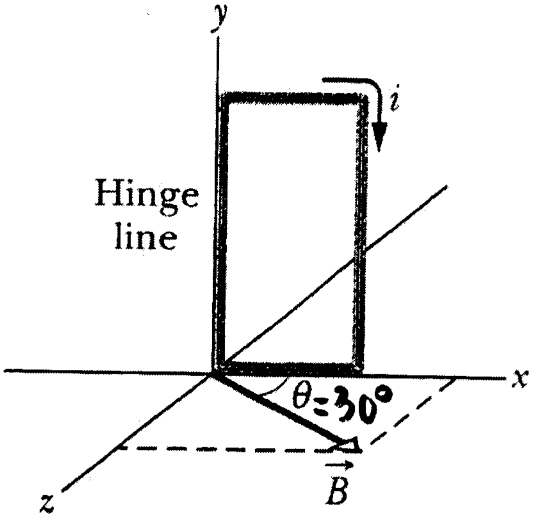
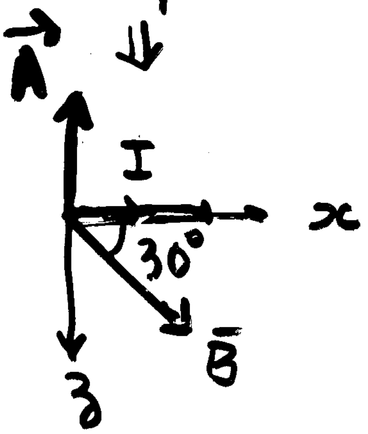


Fig. 28-41 Problem 39.

Top view !



magnitude:

$\tau = NIAB \sin\theta$

↑ angle between $\vec{A}$ and $\vec{B}$.

$\theta = 30° + 90° = 120°$

$\tau = 20 \times 0.1 \times \underbrace{0.1 \times 0.05}_{A} \times 0.5 \sin 120°$

$= 0.0043 \ N \cdot m$

Direction: $-y$ axis.

$\vec{\tau} = -0.0043\,\hat{j} \ N.m.$