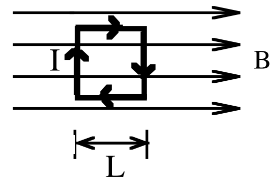
Closed book. No work needs to be shown for multiple-choice questions.

1. There is a current I flowing in a clockwise direction in a square loop of wire that is in the plane of the paper. If the magnetic field B is toward the right, and if each side of the loop has length L, then the net magnetic torque acting on the loop is:

a. $2ILB$.
b. ILB.
c. $2IBL^2$.
d. IBL^2.
e. zero.

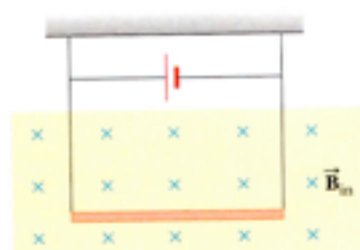


2. A proton moving at a speed of 3.8×10^6 m/s cuts across the lines of a magnetic field at an angle of 70°. The magnitude of the magnetic field is 0.25×10^{-4} T. What is the magnitude of the force acting on the proton?

a. 5.1×10^{-18} N.
b. 9.0×10^{-18} N.
c. 1.4×10^{-17} N.
d. 2.3×10^{-17} N.
e. 2.6×10^{-18} N.

3. A conductor suspended by two flexible wires as shown in the figure has a mass for unit length of 0.040 kg/m. What current must exist in the conductor for the tension in the supporting wires to be zero when the magnetic field is 3.6 T into the page?

a. 0.11 A to the left.
b. 0.11 A to the right.
c. 0.011 A to the left.
d. 0.011 A to the right.
e. zero.

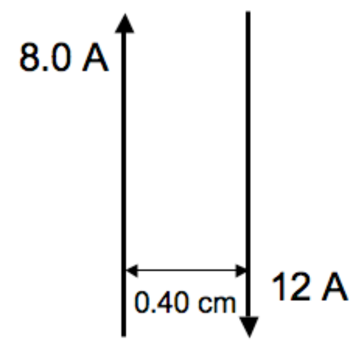


4. A singly charged positive ion has a mass of 2.5×10^{-26} kg. After being accelerated though a difference of potential of 1000 V, the ion enters a magnetic field of 0.5 T, in a direction perpendicular to the field. Calculate the radius of the path of the ion in the field.

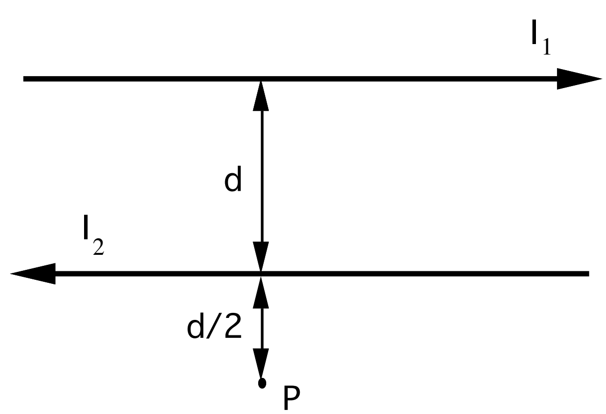
a. 1.77 cm.
b. 3.54 cm.
c. 7.08 cm.
d. 0.89 cm.
e. 2.66 cm.

5. Two long straight wires are parallel and carry current in the opposite direction. The currents are 8.0 Amps and 12 Amps and the wires are separated by 0.40 cm. The magnetic field at a point midway between the wires is:

a. 0.
b. 4.0×10^{-4} T.
c. 8.0×10^{-4} T.
d. 1.2×10^{-3} T.
e. 2.0×10^{-3} T.



6. In the sketch, the two long straight wires are separated by a distance of d = 36 cm. The currents are $I_1 = 8.0$ A to the right in the upper wire and $I_2 = 5.0$ A to the left in the lower wire. What is the magnitude and direction of the magnetic field at point P, that is a distance of d/2 = 18 cm below the lower wire?



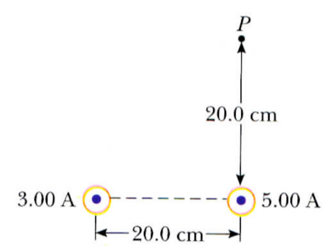
a. 1.1 μT, out of the page.
b. 1.1 μT, into the page.
c. 8.5 μT, out of the page.
d. 2.6 μT, into the page.
e. 2.6 μT, out of the page.

7. A magnetic field of 5.0 T is measured inside a solenoid with 800 turns and that is 10.0 cm long. The radius of the solenoid is 3.0 cm. What is the current through one of the solenoid's loops?

a. 30 A.
b. 9.9×10^2 A.
c. 5.0×10^2 A.
d. 1.0×10^3 A.
e. 1.0×10^4 A.

8. The wires in the figure carry currents of 3.00A and 5.00 A in the directions indicated. Find the magnitude of the magnetic field at point P, located 20 cm above the wire carrying the 5.00 A current.

a. 5.0 μT.
b. 2.1 μT.
c. 7.1 μT.
d. 4.2 μT.
e. 6.7 μT.



Recall that

$F = k_e \frac{|q_1||q_2|}{r^2}$; $k_e = 8.99 \times 10^9 \ \frac{\mathrm{N \cdot m^2}}{\mathrm{C^2}}$; $e = 1.60 \times 10^{-19}\mathrm{C}$; $\varepsilon_o = 8.85 \times 10^{-12} \ \frac{\mathrm{C^2}}{\mathrm{N \cdot m^2}}$;

$m_e = 9.11 \times 10^{-31}$ kg; $m_p = 1.673 \times 10^{-27}$ kg; $m_n = 1.675 \times 10^{-27}$ kg; $1 \text{ eV} = 1.602 \times 10^{-19}\,\mathrm{J}$;

$1 \text{ kWh} = 3.60 \times 10^6\,\mathrm{J}$; $\vec{\mathbf{F}} = q_o \vec{\mathbf{E}}$; $E = k_e \frac{|q|}{r^2}$; $\Phi_E = EA\cos\theta$; $\Phi_E = \frac{Q_{inside}}{\varepsilon_0}$; $PE_{elec,\text{point}} = k_e \frac{qq_0}{r}$;

$V_{point\ charge} = k_e \frac{q}{r}$; $\Delta PE_{elec} = q_0 \Delta V$; $C = \frac{Q}{\Delta V}$; $C_{parllel\ plate} = \varepsilon_0 \frac{A}{d}$; $C_{dielectric} = \kappa \varepsilon_0 \frac{A}{d}$;

$\frac{1}{C_{series\ eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$; $C_{parallel\ eq} = C_1 + C_2 + C_3 + \ldots$; $I = \frac{\Delta Q}{\Delta t}$;

$R = \frac{\Delta V}{I} = \rho \frac{L}{A}$; $\rho = \rho_o\left[1 + \alpha(T - T_o)\right]$; $R = R_o\left[1 + \alpha(T - T_o)\right]$; $Power = I(\Delta V) = I^2 R = \frac{(\Delta V)^2}{R}$;

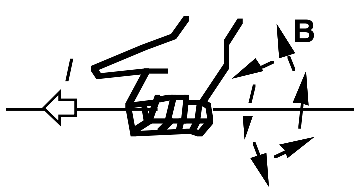
$\rho_{Silver} = 1.59 \times 10^{-8}\,\Omega \cdot \mathrm{m}$; $\rho_{Copper} = 1.7 \times 10^{-8}\,\Omega \cdot \mathrm{m}$

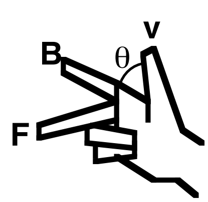
$I_{in} = I_{out}$; $\frac{1}{R_{parallel\ eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$; $R_{series\ eq} = R_1 + R_2 + R_3 + \ldots$; $\sum \Delta V_{loop} = 0$;

$\tau = RC$; $q_{\text{charge}} = Q_{final}\left(1 - e^{-t/RC}\right)$; $q_{\text{discharge}} = Q_0 e^{-t/RC}$; $\oint \vec{B} \times d\vec{l} = \mu_o I_{cross}$; $\mu_o = 4\pi.10^{-7}$ T.m/A

$F_{on\ q} = qvB\sin\theta$; $F_{on\ I} = ILB\sin\theta$; $\tau = BIAN\sin\theta$; $\tau = |\vec{r}||\vec{F}|\sin\theta$; $\tau = \mu B\sin\theta$; $\mu = NIA$;

$r = \frac{mv}{qB}$; $p = mv$; $F_{cent} = \frac{\mathrm{mv}^2}{r}$; $B_{wire} = \frac{\mu_o I}{2\pi r}$; $B_{coil} = N\frac{\mu_o I}{2R}$; $B_{solenoid} = \mu_o \left(N/\ell\right) I$; $\frac{F_1}{\ell} = \frac{\mu_o I_1 I_2}{2\pi d}$;





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$A_{circle} = \pi r^2$; $A_{sphere} = 4\pi r^2$; $A_{square} = L^2$; $g = 9.80 \text{ m/s}^2$; 100 cm = 1 m; 1,000 mA = 1 A;

2.54 cm = 1 in; 12 in = 1 ft; 5,280 ft = 1 mi; 1,609 m = 1 mi; 0.3048 m = 1 ft; $A_{circle} = \pi r^2$;

$A_{cyl.side} = 2\pi rh$; $A_{sphere} = 4\pi r^2$; $g = 9.80 \text{ m/s}^2$; $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$; 100 cm = 1 m;

$1\ \mu\mathrm{F} = 1.0 \times 10^{-6}\mathrm{F}$; $1\ \mathrm{MW} = 1.0 \times 10^6\mathrm{W}$; 1,000 W = 1 kW; 60 s = 1 min; 60 min = 1 hr;

2.54 cm = 1 in; 12 in = 1 ft; 5,280 ft = 1 mi; 1,609 m = 1 mi; 0.3048 m = 1 ft