PHY114 S09 Problem Set 5

S. G. Rajeev

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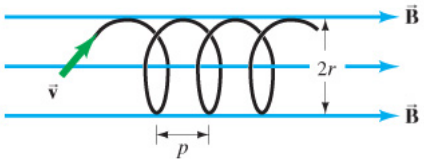
7 Probs Due March 2

1. A 570Ω and a 2300Ω resistor are connected in series with 18V battery. What is the voltage across each resistor?

2. A heart pacemaker is designed to operate at 79 beats/min using a 5.5 μF capacitor in a simple RC circuit. What value of resistance should be used if the pacemaker is to fire (capacitor discharge) when the voltage reaches 75% of maximum?

3. A long wire stretches along the x-axis and carries a 2.2 A current to the right (*i.e.*, $+x$). The wire is in a uniform magnetic field $\mathbf{B} = (0.22\mathbf{i} - 0.34\mathbf{j} + 0.20\mathbf{k})$ T. Find the force per unit length acting on the wire. (Remember that force is a vector.)

4. An electron enters a uniform magnetic field of magnitude 0.31T, at a 41° angle to the direction of the field. Determine the radius r and pitch p (distance between loops) of the electron's helical path assuming its speed is 2.7×10^6m/s. See the figure.



5. Protons with momentum 3.8×10^{-16}kg · m/s are magnetically steered clockwise in a circular path 3.0km in diameter at Fermi National Accelerator Laboratory in Illinois. Determine the magnitude and direction of the field in the magnets surrounding the beam pipe.

6. A power line carries a current of 97 A west along the tops of 9.0 m-high poles. What is the direction and the magnitude of the magnetic field produced at the ground? Compare with the Earth's magnetic field.

7. The ratio of mass m to (positive) charge q of an ion may be accurately determined in a mass spectrometer.The spectrometer consists of two regions: one that accelerates the ion through a potential V and a second that measures its radius of curvature R in a perpendicular magnetic field B. Find the speed v with which the ion exits the acceleration region, as a function of q,m and V. Then find the radius of curvature R as a function of q,m,v and B. Use these results to get a formula for the ratio $\frac{q}{m}$ as a function of V,B and R.