#11 AP-C Magnetic Fields and Forces

AP-C Objectives (from College Board Learning Objectives for AP Physics)

1) Forces on moving charges in magnetic fields

i. Calculate the magnitude and direction of the force in terms of q, v, and B, and explain why the magnetic force can perform no work.

ii. Deduce the direction of a magnetic field from information about the forces experienced by charged particles moving through that field.

iii. Describe the paths of charged particles moving in uniform magnetic fields.

iv. Derive and apply the formula for the radius of the circular path of a charge that moves perpendicular to a uniform magnetic field.

v. Describe under what conditions particles will move with constant velocity through crossed electric and magnetic fields

2) Forces on current-carrying wires in magnetic field

i. Calculate the magnitude and direction of the force on a straight segment of currentcarrying wire in a uniform magnetic field.

ii. Indicate the direction of magnetic forces on a current-carrying loop of wire in a magnetic field, and determine how the loop will tend to rotate as a consequence of these forces.

iii. Calculate the magnitude and direction of the torque experienced by a rectangular loop of wire carrying a current in a magnetic field.

3. Fields of long current-carrying wires

i. Calculate the magnitude and direction of the field at a point in the vicinity of such a wire

ii. Use superposition to determine the magnetic field produced by two long wires

iii. Calculate the force of attraction or repulsion between two long current-carrying wires.

4. Biot-Savart law and Ampere's law

i. Use Biot-Savart law to deduce the magnitude and direction of the contribution to the magnetic field made by a short straight segment of current-carrying wire

ii. Use the Biot-Savart law to derive and apply the expression for the magnitude of B on the axis of a circular loop of current.

iii. State Ampere's Law in integral form precisely.

iv. Use Ampere's law, plus symmetry arguments and the right-hand rule, to relate magnetic field strength to current for planar or cylindrical symmetries.

v. Apply the superposition principle to determine the magnetic field produced by combinations of the configurations listed above.

5. Be familiar with Maxwell's equations so you can associate each equation with its implications.