Magnetism Topics and Objectives

**Magnetism (9%)**

**Magnetic Fields (4%)**

**Forces on moving charges in magnetic fields**

Students should understand the force experienced by a charged particle in a magnetic field, so they can:

(1)  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.

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

(3)  Describe the paths of charged particles moving in uniform magnetic fields.

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

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

**Forces on current-carrying wires in magnetic fields**

Students should understand the force exerted on a current-carrying wire in a magnetic field, so they can:

(1)  Calculate the magnitude and direction of the force on a straight segment of current-carrying wire in a uniform magnetic field.

(2)  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.

**Fields of long current-carrying wires**

Students should understand the magnetic field produced by a long straight current-carrying wire, so they can:

(1)  Calculate the magnitude and direction of the field at a point in the vicinity of such a wire.

(2)  Use superposition to determine the magnetic field produced by two long wires.

(3)  Calculate the force of attraction or repulsion between two long current-carrying wires.

**Electromagnetism (5%)**

**Electromagnetic induction (including Faraday’s law and Lenz’s law)**

Students should understand the concept of magnetic flux, so they can calculate the flux of a uniform magnetic field through a loop of arbitrary orientation.

Students should understand Faraday’s law and Lenz’s law, so they can:

(1)  Recognize situations in which changing flux through a loop will cause an induced *emf* or current in the loop.

(2)  Calculate the magnitude and direction of the induced *emf*and current in a loop of wire or a conducting bar under the following conditions:

a)    The magnitude of a related quantity such as magnetic field or area of the loop is changing at a constant rate.