Section 11.2.1 The Maxwell Equations

Exercise: We can deduce from energy considerations and Gauss’s law for the field around a monopole $q_m$ that in the rest frame of the monopole the force law is

$$F' = \frac{dp'}{dt} = cq_mB'$$

where $B'$ is the magnetic field. Find a covariant expression that reduces to this in the rest frame, and show from this that the force law in any other frame is

$$F = \frac{dp}{dt} = cq_m \left[ B - \frac{1}{c^2} (v \times E) \right]$$

where $E$ is the electric field, and $v$ the particle velocity.

Exercise: To make the laws of physics invariant under the duality transformation (11.117) and (11.118), it is necessary also that the forces on particles be invariant under the same transformation. Use this to show that the force $F$ (the rate of change of the momentum $p$) on a magnetic monopole $q_m$ in an electromagnetic field is

$$F = \frac{dp}{dt} = cq_m \left[ B - \frac{1}{c^2} (v \times E) \right]$$

where $E$ is the electric field, $B$ the magnetic field, and $v$ the particle velocity.