

1. Show that the invariant

$$I_2 = e^{iklm} F_{ik} F_{lm}$$

can be written as a fourdivergence

$$I_2 = e^{iklm} F_{ik} F_{lm} = 4 \frac{\partial}{\partial x^i} (e^{iklm} A_k \frac{\partial}{\partial x^l} A_m).$$

2. Use the action integral to show, that μ_0 must be given in units of kg m/C^2 , when the electric charge is given in units of C.
3. Let's consider *charge conjugation*, where all charges change sign. Show that all Maxwell's equations and the Lorentz force equation remain invariant, when \mathbf{E} and \mathbf{B} fields are changed appropriately.
4. Show the continuity equation for charge

$$\frac{\partial \rho}{\partial t} + \nabla \cdot \mathbf{j} = 0$$

starting from Maxwell's equations in 3-vector form.