

Problem Set 2

(Due: September 18, 2008)

1) Jackson, problem 1.10.

Prove the *mean value theorem*: For charge-free space the value of the electrostatic potential at any point is equal to the average of the potential over the surface of *any* sphere centered on that point.

2) Jackson, problem 1.12.

Prove *Green's reciprocity theorem*: If Φ is the potential due to a volume-charge density ρ within a volume V and a surface-charge density σ is on the conducting surface S bounding the volume V , while Φ' is the potential due to another charge distribution ρ' and σ' , then

$$\int_V \rho \Phi' d^3x + \int_S \sigma \Phi' da = \int_V \rho' \Phi d^3x + \int_S \sigma' \Phi da$$

3) Jackson, problem 1.15.

Prove *Thomson's theorem*: If a number of surfaces are fixed in position and a given total charge is placed on each surface, then the electrostatic energy in the region bounded by the surfaces is an absolute minimum when the charges are placed so that every surface is an equipotential, as happens when they are conductors.