Gravitational self energy of a homogeneous massive sphere

(a) Determine the gravitational self energy of a homogeneous sphere of radius $R$ and mass $M$.
(b) Infer, by analogy, the electrostatic self energy of a homogeneous, spherical charge distribution (radius $R$, total charge $q$).
(c) Under the (quite unrealistic) assumption that the total energy $E = m_e c^2$ of an electron at rest consists entirely of electrostatic self energy, determine the radius of the electron (in SI units). This value is known under the name classical electron radius.

Solution: