1. In single-fluid MHD, few simplifying assumptions are made. One of them is the assumption of charge-neutral plasma. The charge separation in plasma is negligible at spatial and temporal scales much larger than the Debye length $\lambda_D = \sqrt{\frac{\varepsilon_0 kT}{n_e e^2}}$ and the inverse plasma frequency $\omega_p^{-1} = \sqrt{\varepsilon_0 m_e / e^2 n_e}$. The characteristic "hydrodynamic" height scale in the solar interior $\Lambda = \frac{k_B T(z)}{M g(z)}$, where k_B is Boltzmann constant, $T(z)$ is the temperature, M is the mean atomic weight, and $g(z)$ is the gravity acceleration. The characteristic time scale can be roughly defined as $T = \Lambda/V$, where V is the sound speed. Assume also that solar plasma is fully ionized hydrogen, and electron mass is negligible compared to proton mass ($n_e = n_p$, and $n_p = \varrho(z)/m_p$). Use previous exercise and the standard solar Model S to demonstrate that MHD approximation is valid in the solar interior.

Here:
ε_0=$8.854 \cdot 10^{-12}\ F/m$ – permittivity of free space
$e = 1.602 \cdot 10^{-19}$ C – electron charge
$m_e = 9.109 \cdot 10^{-31} kg$ - electron mass
$m_p = 1.673 \cdot 10^{-27} kg$ - proton mass
$M = 1.661 \cdot 10^{-27} kg$ - mean atomic weight of hydrogen