(1, 20%) Derive the Brünt-Väisälä frequency under inhomogeneous and adiabatic atmosphere. Please also describe physical meaning of the frequency.

(2, 20%) What are the main chemical reactions (including production and loss) of terrestrial ionospheric plasma in the E and F (F1 + F2) region, respectively?

(3, 20%) Derive the specific, Pedersen and Hall conductivity and explain their physical meanings.

(4, 20%) For a dipole field, two electric field components (meridional E_{MI} and zonal E_{ZI}) mapped from the ionosphere to the magnetosphere in the equatorial plane can be expressed as

$$E_{MI} = 2L\sqrt{L - \frac{3}{4}} E_{RM}$$

$$E_{ZI} = L^{\frac{3}{2}} E_{ZM}$$

where the L value is the distance from the center of the earth to the equatorial crossing point measured in earth radii (R_E), E_{RM} is the radial magnetospheric component at the equatorial plane, and E_{ZM} is the zonal magnetospheric component there. Please derive these relationships.

(5, 20%) What's the reflection condition for a sounding high frequency wave? What are the plasma densities at those reflection points of the sounding wave?

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