**Masters Entrance Exam - Space Physics: Ionosphere**

50 points. Answer the following questions. Show all work and explain your answers where prompted. Chinese or English answers are acceptable.

1. GPS functions by estimating the range from a receiver to a GPS satellite whose position is known. The range error $\Delta\rho$ introduced to GPS signals by the ionosphere is given by the following equation:

$$\Delta\rho = \frac{40.3\,TEC}{f^2}$$

Here, $\Delta\rho$ is range error in units of cm, TEC is the total electron content in units of TECu. 1 TECu = 10^{16} electrons m^2. f is the GPS frequency in GHz.
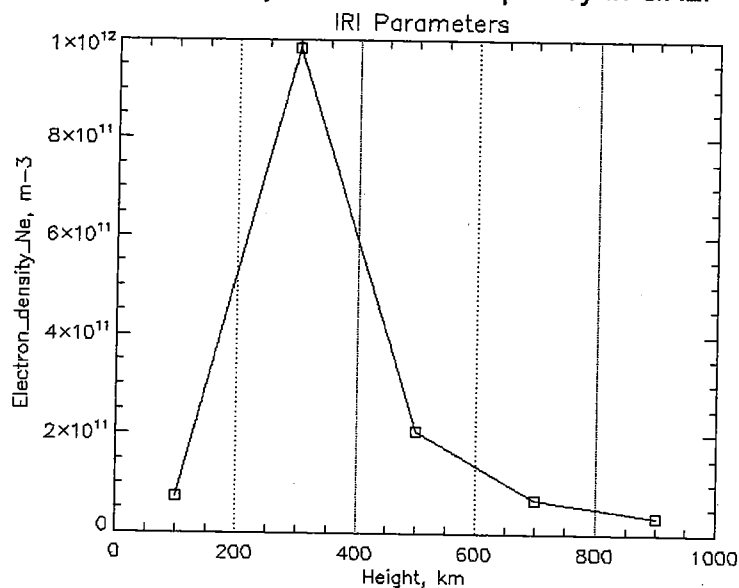
a) (15 points) The above figure shows the vertical electron density profile over Taiwan. Estimate the range error for a GPS satellite located directly overhead using a frequency of 1.5 GHz.

b) (10 points) Would you expect the range error to be larger during the daytime or the nighttime? Explain your reasoning.

注意:背面有試題

參考用

2. The figure below shows the % change in the ratio of [O] to [N₂] (atomic oxygen density to molecular nitrogen density) in the thermosphere following a wave event in a numerical model. Dotted contours correspond to negative values. Ignore the thick black line. Answer the following questions.

(a) O/N2
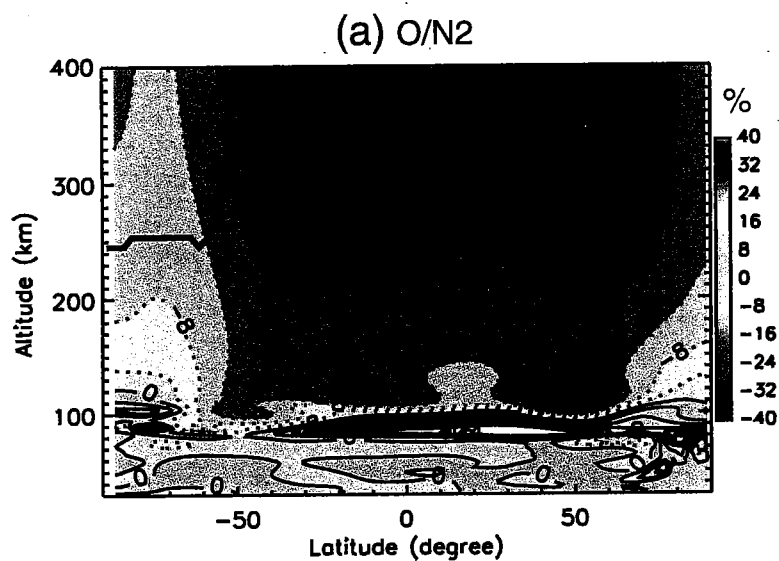
a) (15 points) Will the atmospheric drag experienced by a satellite at 400 km altitude increase or decrease following the wave event? Why? Justify your answer quantitatively.

b) (10 points) Will the total electron content (TEC) of the ionosphere increase or decrease following the wave event? Why? Explain the physical or chemical mechanism for this change.

注意:背面有試題

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＊請在答案卷(卡)內作答

Space Physics: Magnetosphere (50 points)

3.Under the ideal MHD condition, please

(a)derive the equilibrium state of momentum equation in terms of magnetic pressure and magnetic tension.

(b)explain the existence of equilibrium plasma sheet and plasmasphere by using answer (a).

(c)describe the frozen-in condition qualitatively. (30 points)

4.(a) Please explain the existence of ring current based on the particle drift motion. (b) If a particle initially locates at 8 R_E on the equatorial plane with the energy of 3 keV and pitch angle of 90°, determine the particle's energy when it moves earthward to 4 R_E on the equatorial plane by assuming the Earth's magnetic field is a dipole field and describe the adiabatic invariants you used. (20 points)