FYS 3610

EXERCISES WEEK 35

EXERCISE 1

a) Derive the barometric equation for an isothermal atmosphere and define the scale height.

b) Calculate the scale height for normal air (~21.5% O_2 and 78.5% N_2)at T= 293 K and for T = 243 K. Calculate the scale height for atomic oxygen at T = 2500 K.

c) What is the meaning of $\omega_B = 0$.

d) Show that equation 3.22 can be written as

$$\omega_B^2 = \frac{g}{T}\left[\frac{\partial T}{\partial z} - \frac{\partial T}{\partial z}_{|ad}\right]$$

EXERCISE 2

Visit NASA's home page for the CGM model of the Earth's magnetic field:
http://omniweb.gsfc.nasa.gov/vitmo/cgm_vitmo.html

i) Where is the north CGM pole located?

ii) Calculate CGMLat, CGMLon, magnetic conjugate point, L- value, H, D, Z component for the magnetic field, magnetic field strength, Inclination for the following geographic co-ordinates:
University of Oslo: (59.91, 10.73)
University of Tromsø: (69.7, 18.9)
Andøya Rocket Range: (69.28, 16.01)
Longyearbyen: (78.2, 15.7)

EXERCISE 3

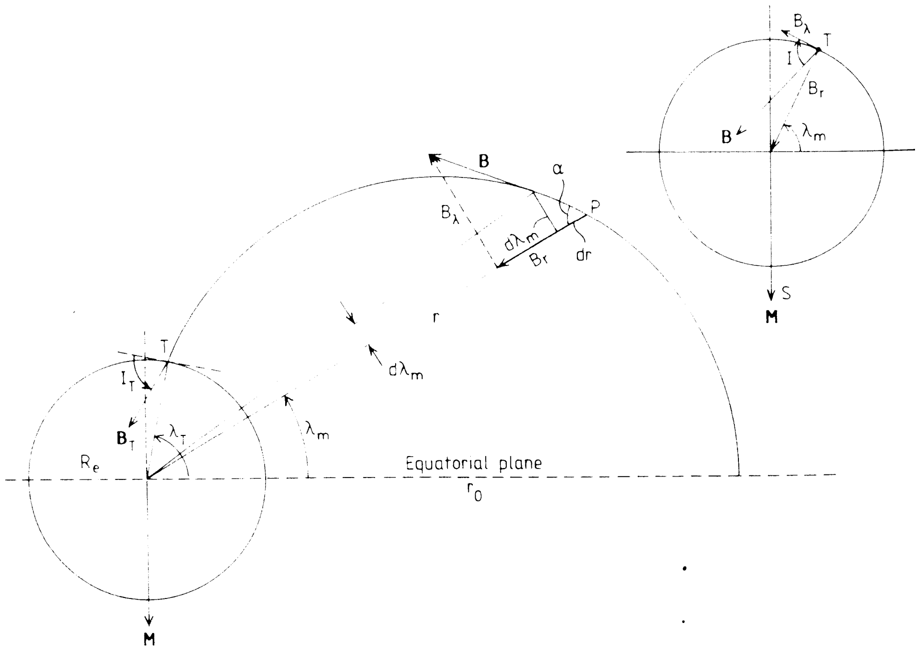

Figure 1: An illustration showing the geometry of the magnetic field line to assist in deriving a geometric formula for B.

Assume a dipole magnetic field. Introducing the magnetic latitude λ_m of which unit vector relates to the co-latitude unit vector defined in the lecture in the following way:

$$\widehat{\lambda}_m = -\widehat{\theta}$$

Then the magnetic field can be written as:

$$\vec{B} = B_r \widehat{r} + B_{\lambda_m} = H_0(-2\sin\lambda_m \widehat{r} + \cos\lambda_m \widehat{\lambda}_m)$$

i) Show that $L = \dfrac{r_0}{R_E} = \dfrac{1}{\cos^2 \lambda_m}$

Hint: $\tan\alpha = \dfrac{r \cdot d\lambda_m}{dr} = \dfrac{B_\lambda}{B_r}$

ii) Estimate B-field strength, inclination and L-value based on the dipole model, and compare with corresponding values calculated in Exercise 2.

EXERCISE 4

Estimate the magnetopause standoff distance in the case when the solar wind speed is 600 km/s and the solar wind density is 10 cm^{-3}.