In the following questions, you have to show all your intermediate steps while deriving the equations and when calculating numerical results.

Q.1. MAGNETOSPHERE

(5) (a) Show that the magnetopause distance **at the subsolar point** can be found as $R_{mp}= (B^2/\mu_o n m_p Vsw^2)^{1/6}$ (Re), where B_o is the planet's magnetic field at the equator (B_o), R_e is the planet's radius. Explain all the terms and give all the math steps and assumptions etc to reach the final result.

(5) (b) Calculate the magnetopause and bow shock distance from the center of the Earth at the subsolar point for the average solar wind conditions of density (n) = 5 #/cm^3 and speed (V_{sw})= 450 km/s. **Important:** Give your answer **in units of [Re].**

(2) (c) At what magnetic latitude (Λ) we can observe the aurora for these conditions.

(5) (d) Can we observe the aurorae over Istanbul under the solar wind conditions given in part-b? Why?

(5) (e) In order to observe the aurora over Istanbul (42^{O}N), what should be the solar wind dynamic pressure? **Important:** Give your answer **in units of [nPa].**

Q.2. Search Question/Brain Storm:

- Discuss why the Moon does not have any livable atmosphere in the context of the **role** that the magnetosphere plays in developing a livable atmosphere. Hint: first consider the role of the magnetosphere for creating a livable atmosphere on Earth and then consider how it does it. And then compare the situation on Moon.

- Explore what Joule heating is.

- Challenge question: The amount of energy that northern lights (aurora) deposited into the Earth's upper atmosphere at the heights of 120 km is on the order of 10^{12} GW. Can you think of a way to collect this energy and use it as a new source for the renewable energy on the ground? Discuss how you can or why you cannot.

♣ *Note:*
1. *Homework returned after due date will not be accepted.*
2. *Electronic submission of Homework is not accepted. Return your homework in paper work with your handwriting.*
3. *Photocopied or Scanned homework is not accepted.*
4. ***Do not** use COMPUTER PRINTER OUTPUTS for your homework. Use **your handwriting**.*