PHYSICS OF UPPER ATMOSPHERE | HOMEWORK-I♣
MTO357E, CRN: 11785 | **NOT COMPULSORY** | Given: Oct. 17, 2023
Instructor: Z. KaymaZ | Due: Oct. 26, 2023

(40) Q.1. SOLAR WIND

The mean distance from the Sun to Mercury, Venus, Earth, Mars and Jupiter are 0.39, 0.72, 1.0, 1.5, and 5.2 AU. Assume that the density, solar wind speed, and temperature **at the base of the corona** are **$30x10^4$ #/cc**, **500 km/sec**, and **$3x10^6$ °K.** Assume that the total magnetic field is given by the radial component of the magnetic field, i.e. (B_r) and is given as 15 Gauss. Ignore Bϕ. Using these values,

(a) **Calculate** the solar wind parameters shown in the Table below for each of these planets. Show your calculations and also fill in the Table. **Assume the base of corona is the surface of the Sun**.
(b) **Make a plot** of number density (n) and temperature (T) with distance (in AU) and **evaluate** how these parameters change with distance in space.

	Mercury	Venus	Earth	Mars	Jupiter
Speed (Vsw) (km/s)					
Density (n) (#/cm^3)					
Btot (nT)					
T (°K)					

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(25) Q.3. SOLAR WIND (15, 10)

(a) Under the conditions given in (Q1), calculate the dynamic pressure, gas pressure, and magnetic pressure at the Earth's distance and compare them.
(b) What is the force on the surface of a satellite with an area of 10 m^2 facing perpendicularly to the solar wind at the Earth's distance.
(c) Calculate the sound speed and Mach number at the Earth's distance and determine whether the solar wind is supersonic or not at this distance.

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(35) Q.2. SOLAR ACTIVITY

This exercise is about discovering "the solar cycle properties using sunspot numbers". The web page to obtain sunspot data for this exercise is http://sidc.oma.be/sunspot-data/ or https://www.ngdc.noaa.gov/stp/space-weather/solar-data/solar-indices/sunspot-numbers/american/lists/

(5) (a) Using the monthly sunspot numbers from January 1989 to December 2017, make a graph of **total or average monthly sunspot number** for your birthday month in each year to identify the long-term pattern of sunspot activity on the Sun.

(5) (b) Based on your graph, **what is** the average periodicity of sunspots?

(5) (c) Make a prediction **when** the next solar maximum and minimum will occur according to your plot.

(5) (d) When you are at the age of 30, **at what stage** in the solar cycle you will be, i.e. the solar maximum, or minimum, or ascending phase or descending phase of the solar activity.

(5) (e) What good will it do if we know when there will be solar maximum or solar minimum? That is, how can the humanity benefit if people know on the occurrence of solar maximum or solar minimum times?

(5) (f) Considering the space weather consequences on the Earth's atmosphere, scientists propose that it is the magnetic polarity of the sunspots that affect the Earth's weather and climate mostly, compared to the variations in sunspot numbers. **Explain** first what sunspot polarity is and accordingly **explain** what Hale cycle is.

(5) (g) Discuss if you see Hale cycle in your plot.

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(10) Q.4. Search Yourself Question/Brain Storm: This part tests your ability to search independently. Do not copy from internet!!!

(a) What is space weather? Give a definition.
(b) Using http://www.spaceweather.com link, **give** a list of space weather indicators related to properties of Sun and solar wind that are used for space weather predictions. Make a **list** of 4 only and explain what they are and what they indicate.
(c) Write down the values of these indicators **at the time** you prepare this homework.

♣ *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****.*