Q.1. SOLAR WIND

(5) (a) Calculate the required time for each of the following to travel the Sun-Earth distance and compare them.

(i) visible light produced in the photosphere (give your answer in minutes)
(ii) x-rays from a flare (give your answer in minutes)
(iii) Solar wind particles traveling at 400 km/s (give your answer in days)
(iv) A CME moving with a velocity of 1500 km/sec (give your answer in days)
(iv) A jet aircraft traveling at 220 m/s (give your answer in years)

(5) (b) It takes a photon produced at the center of the Sun to reach the surface about 2×10^5 years. How long does it take this photon to travel the same distance in free space? Explain why these two differ by such a large factor.

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(26) Q.2. SOLAR WIND (20, 6)

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 **20×10^4 #/cm^3**, **450 km/sec**, and **$2{,}5 \times 10^6$ ºK.** Assume that the total magnetic field is given by the radial component of the magnetic field, i.e. (B_r) and it is given as 5 Gauss. İgnore Bϕ. Using these values,

(a) **Calculate** the value of solar wind parameters shown in the Table below at 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 (V_{sw}) (km/s)					
Density (n) (#/cm^3)					
B_{tot} (nT)					
T (ºK)					

(15, 10) Q.3. SOLAR WIND

(a) Under the conditions given in previous question (**Q2**), calculate the dynamic pressure, gas pressure, and magnetic pressure at the Earth's distance.

(b) Calculate the sound speed and Mach number at the Earth's distance and decide if the solar wind supersonic or not at this distance.

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(10) Q.4. HELIOPAUSE

The heliopause is the boundary between the heliosphere (solar system) and the stellar system. This boundary is determined by the balance between the solar wind dynamic pressure and the dynamic pressure of the stellar wind. Use the initial values at the solar surface given/found in question-2 above. Assume that the stellar wind has density of **0.2 #/cm^3**, velocity of **25 km/sec**, determine where the heliosphere ends, i.e. at what distance heliopause occurs. Give your answer in AU.

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(10) Q.5. Search Question/Brain Storm: Keep your answers concise and Do not copy from internet.

a. What are Lagrangian points? Make a definition.

b. How many Lagrangian Points are there in the Sun-Earth system? Use a sketch to show their locations.

c. Why should a scientist locate a spacecraft at L1 location? What is the use of it?

d. Explore ACE and CLUSTER spacecraft. Make a Table that compares their orbital characteristics including orbit (elliptical, circular, polar, equatorial etc.), their location (apogee, perigee, or altitude/distance), orbital period (in days), whether they are magnetospheric or interplanetary mission, and their scientific tasks to study the space environment. Give distances in units of Re, periods in days. **Note:** Be careful, Ace has its orbit around L1 point, not around Earth. Give your answer accordingly. Give radial distance from Earth as altitude.

♣ *Note:*
1. *Homework returned after due date will not be accepted.*
2. *Scanned homework is not acceptable.*
3. *Photocopied homework is not acceptable.*
4. ***Do not** use **computer printer outputs** for your homework. Use **your handwriting**.*