

**Drop your homework to assistan's (M.B. Kelebek) mail box or office desk.**

**Read Chapter on Atmospheric Structure on your class notes.** The objectives of this homework assignment are:

- To make sure you understand the basic concepts and hydrostatic law and its applications in upper atmosphere.
- To exercise the mathematical derivations and computational components of the course.
- To review some of the material covered in class

**(10) Q.1. Use of hydrostatic balance an ideal gas law for mass density and number density.**

Derive an expression that shows the number density ( $n$ ) in an isothermal atmosphere decreases exponentially with height.

**(10) Q.2. This question shows how density in the upper atmosphere change.**

At 200 km in Earth's thermosphere, the number density of atomic oxygen is  $10^{10} \text{ cm}^{-3}$ , and the number density of hydrogen atom is  $10^7 \text{ cm}^{-3}$ . The temperature is constant with height above 200 km and is 500 K. Assume that these are the only constituents:

- What is the number density of atomic Oxygen at 500 km?
- What is the number density of Hydrogen at 500 km?
- What is the mass density of both species at 500 km? Which one is greater?
- What is the mass density of both species at 200 km? Which one is greater?

**Q.3. This exercise is about to determine the dominant constituent in the upper atmosphere under different solar activity conditions.**

**(10)** (a) Assume that at 1000 [km] of altitude, the atmosphere is in approximate diffusive equilibrium, with a constant temperature of 1500 [K] which corresponds to high level solar activity, and that the number concentration of molecules of atomic oxygen O and atomic hydrogen H at 1000 [km] is  $n_{\text{Oxy}}=10^6 \text{ [cm}^{-3}]$  and  $n_{\text{Hyd}}=10^4 \text{ [cm}^{-3}]$ , respectively. Make an estimate of the altitude at which a satellite will measure more atomic Hydrogen than atomic Oxygen.

**(5)** (b) Do the same as in part (a) for  $T=500 \text{ K}$  corresponding to low solar activity.

**(5)** (c) Compare your results in (a) and (b). Comment on why the differences occur.

**(3)** (d) If you were **to avoid** the effect of oxygen, **at which altitude** you would like to place your satellite? **Why?**

**(3)** (e) **Is your answer in (d) still a good altitude** for all solar activity conditions? How would your answer will change when the solar activity conditions are different than your answer in (d) corresponding to?

**Q.4. (10)** This part tests your ability of independent research.

Search Topic/Brain Storm: Answer using your **own words**. **Do not copy from internet** ! It is a plagiarism.

- Consider **how density varies** in the thermosphere, and **explain and discuss** if you can measure the temperature in thermosphere using a thermometer. If yes, why; if not, why?
- Explain why the temperature in stratosphere peaks at about 50 km while the stratospheric ozone peaks at 15-20 kms?

\* Note:

- Homework returned after due date will not be accepted.
- Electronically typed Homework is not accepted. Return your homework in paper work with your handwriting.

PHYSICS OF UPPER ATMOSPHERE  
MTO357E, CRN: 12785  
Instructor: Z.KaymaZ

HOMEWORK-IV  
Given : 14.Dec.2023  
Due\* : 28.Dec.2023, 17:30

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3. Photocopied or Scanned homework is not accepted.

4. **Do not** use COMPUTER PRINTER OUTPUTS for your homework unless it is with **your handwriting**.