

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} cm^{-3} , and the number density of hydrogen atom is 10^7 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

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

3. Photocopied or Scanned homework is not accepted.

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