

Hydrodynamics

Homework 9: Martian thermodynamics

12. December 2024

Problem:

The atmosphere of Mars is composed mainly of CO_2 , which has the specific heat at constant pressure $c_p^m = 844 \text{ J/kg/K}$ and the specific heat at constant volume $c_v^m = 655 \text{ J/kg/K}$. The gravity on the surface is 3.7 m/s^{-2} , the atmospheric pressure near the surface is $p_0 = 600 \text{ Pa}$ and the temperature in the summer near the equator is around 20°C . Assume that the temperature is constant in some vertical extent.

Use the equation of state and the equation of hydrostatic equilibrium to compute the pressure in the altitude $z = 10 \text{ km}$.

Compute the scale height parameter H describing the decrease of pressure by

$$p = p_0 e^{-\frac{z}{H}}$$

and compare it with the scale height for the atmosphere of Earth, for which the specific heats are $c_p = 1005 \text{ J/kg/K}$ and $c_v = 718 \text{ J/kg/K}$.