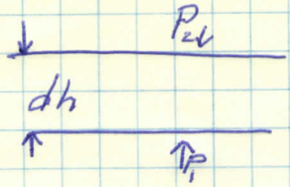
P-1 # Aeronomy 22 Nov

Garriot -



$$dp = dM_{gravity} = -\rho\, dh\, g$$

$$\rho = n_{umber}\, m_{olec.}$$

$$p = nkt$$

$$\frac{dp}{dh} = -nmg\left(\frac{kt}{kt}\right) \quad \boxed{H \equiv \frac{kt}{mg}}$$

$$\frac{dp}{dh} = -\frac{p}{H} \qquad \ln p = -\frac{k}{H} + \text{const}$$

$$p = p_0\, e^{-h/H} \qquad H \equiv \text{scale height}$$

now $Z = \int_0^h \frac{dh}{H}$ (reduced Height)

$$p = p_0\, e^{-z}$$

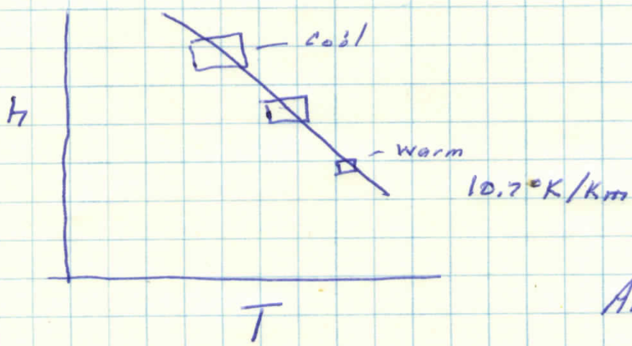
$$\& \quad n = n_0\left(\frac{T_0}{T}\right)e^{-z}$$

Air has ~constant composition - to 100KM

temp $\propto$ H

Temp variation c̄ alt.

Adiabatic lapse rate is limiting rate of temp.



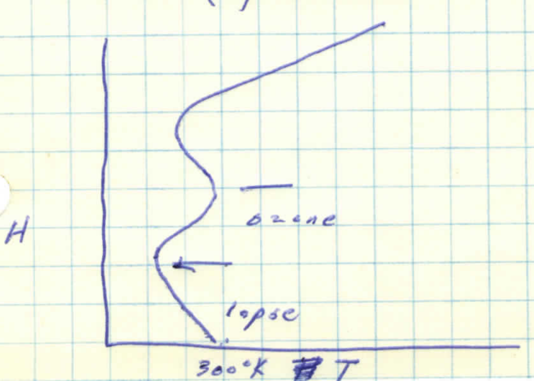
Atmosphere is unstable if lapse rate is exceeded-

2°K/1000' } actual tropospheric rate
~ 6.5°K/KM

reduction in rate caused by presence of H_2O vapor

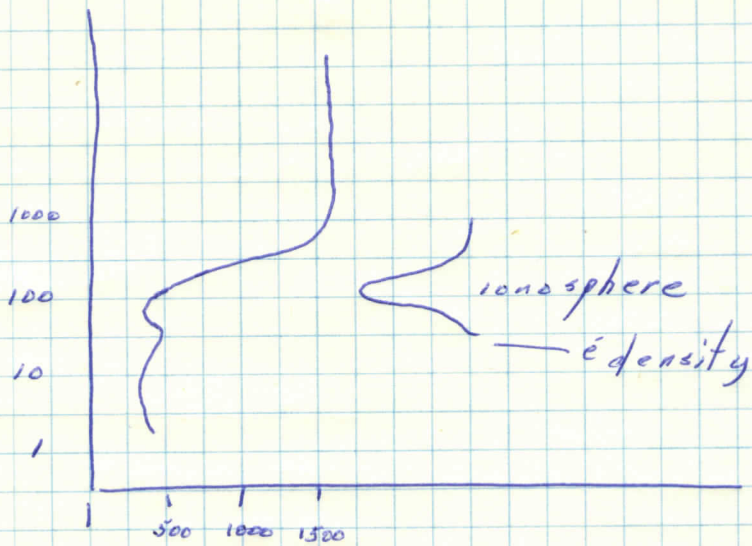
There is isothermal height region under ozone region

Ozone (1%) absorbs U.V. and is warmed



P-2 Aeronomy Nov 22, '67

Once temp. is known other factors may be calculated to 100 KM - above this diffusion separation occurs $\bar{c}$ ↑ He, etc.



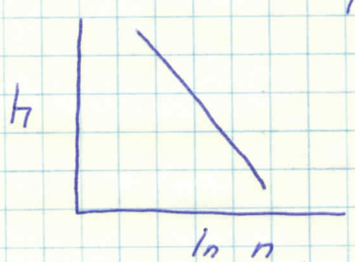
Compute altitude of dissociation

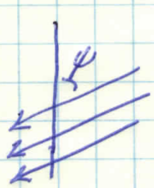
Optical X sect.

Flux - 1 photon/cm²

Probability of absorption has cm² dimens.

May be considered in terms of area.





$$dI \propto I_0\, n\, \overset{\text{length}}{ds}\, \underset{\text{cross sect}}{\sigma}$$

$$\int_h^\infty \frac{dI}{I} = \int_h^\infty + n\sigma \sec\psi\, dh$$

$$\ln I_\infty - \ln I_h = \sigma \sec\psi \int_h^\infty n\, dh$$

$$I_{(h)} = I_\infty \exp\left[\underbrace{-\sigma \sec\psi\, n H}_{-\tau}\right] \qquad \int \underline{n\,dh} = \int n_0 \left(\frac{T_0}{T}\right) e^{-z}\, dh \times \frac{kt/mg}{kt/mg}$$

$$= n_0 H_0$$

$\sigma_{O_2} = 5 \times 10^{-19}$ cm² (1200 - 1800 Å)

Aeronomy

22 Nov.

$\sigma \sim 5 \times 10^{-9}\ cm^2$ ($120 - 180\ m\mu$)

$H \sim 10\ Km,\ 10^6\ cm$

$n \sim 2 \times 10^{12}$

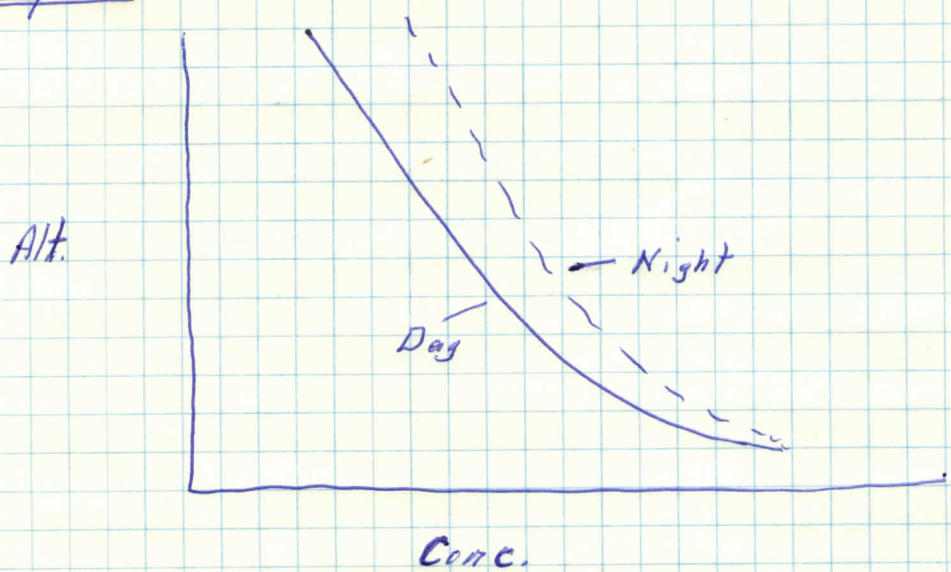
Life of O_2 molecule $\approx \frac{1}{I_\infty \sigma}$

$\approx$ 3 days

Undissociated O_2 must diffuse up

Temp. of thermosphere is dependent upon U.V. radiation

Ionosphere



Calc. Approx. Isothermal, only 1 constituent (ionization X sect. not absorption σ prev. used.

q = prod. rate of electrons + ions $= n \sigma I$ (elec/cm²/sec)

$= n \sigma I_\infty e^{-\tau}$

Ioniz. thresh. O - 911 $\AA$

N_2 - 796 $\AA$

O_2 - 1025 $\AA$

$\frac{dq}{dh} = 0$ Alt. of peak prod.

$= e^{-\tau} \frac{dn}{dh}\ n e^{-\tau} \left(-\frac{d\tau}{dh}\right)$

$\tau = \sigma n H \sec \psi$

Calc. cont.

$$* \quad 1 = n \sigma H \sec \psi = \tau \qquad q = q_0 = \frac{n_0 \sigma I_\infty}{\infty}$$

$$q = \sigma I_\infty n_0 e^{-z}$$

Alt. at which there is unit opt. depth.

$$= \frac{I_\infty}{e H_0}$$ value of peak prod. rate

$$= q_0 \exp\left[1 - z - \sec \psi e^{-z}\right]$$ ← Chapman Prod. funct.

$\sigma_{ioniz} = 10^{-15}$ cm.

These calculations assume plane parallell atmosphere.

Loss functions

$$O_2^+ + e \rightarrow O^\circ + O^\circ$$

Loss Rate $= \alpha N^2$

$$\frac{dN}{dt} = q - \alpha N^2 = 0 \qquad N = \sqrt{\frac{q}{\alpha}} = \sqrt{\frac{q_0}{\alpha}} \exp \frac{1}{2}\left[1 - \cancel{\frac{z}{3}} - \sec\psi \, e^{-z}\right]$$

$I_\infty = 10^{10}$ photons/cm² $\qquad N_{max} \approx \sqrt{\frac{1000}{10^{-7}}} = 10^5$

Compare Simplified Calc. to Meas. Ionosphere.