Exosphere:

True/False

- Collisions do not occur into the exosphere at all
- The Sun has an exosphere
- Lighter the species is, greater its escaping flux is.

The distribution function of particles is supposed maxwellian at the top of the atmosphere

$$f(v) = n_0\sqrt{\frac{16}{\pi}}\frac{v^2}{v_{th}^3}\exp\left(-\frac{mv^2}{2k_BT}\right), \quad v_{th} = \sqrt{\frac{2k_BT}{m}}$$

Question

The thermal escape is given by:

$$F_{\rm esc} = \frac{1}{2}\int_{v_{\rm esc}}^{+\infty} vf(v)\mathrm{d}v$$

(1/2 comes from the fact we consider only upward particles). Calculate F

Hint:

$$v_{\rm esc} = \sqrt{\frac{2GM}{r_{\rm exo}}}$$

$$\int_a^{+\infty} x^3\exp(-bx^2)\,\mathrm{d}x = \frac{a^2b+1}{2b^2}\exp(-ba^2)$$

Plot F_{esc} as a function of $\lambda_c = GMm/k_BTr_{exo}$. What is the physical meaning of λ_c?

Ionosphere:

True/False

- The more energetic a solar photon is, the deeper in the atmosphere it is likely to be absorbed.
- The more energetic an auroral electron is, the deeper in the atmosphere it is likely to be thermalised.
- Let's consider two wavelengths, λ_1 and λ_2, with $\lambda_1 > \lambda_2$ and a photoabsorption cross section $\sigma(\lambda)$ associated with a given neutral species. If $\sigma(\lambda_1) < \sigma(\lambda_2)$, then solar photons of wavelength λ_1 are going to deposit their energy deeper in the atmosphere than the more energetic solar photons of wavelength λ_2.
- The solar flux decreases linearly with the distance from the Sun
- Solar photons of 180 nm are effective ionisers
- The profile in altitude of the electron density always peaks at the same altitude as the profile in altitude of the electron production rate.

- In the ionospheric region, the ion densities are several orders of magnitude lower than the neutral densities.
- Both ionospheric electrons and photoelectrons are thermal.

Bonus:

We apply a constant magnetic field B_z to a very cold plasma moving initially along x at the velocity v_x. What is the shape of the distribution function of such a plasma in the (v_x, v_y) plane?

And for pick up ions?