

Minigroupwork 3, solutions, 2015

a)

$$\frac{dn_e(t)}{dt} = 0 \Rightarrow$$

$$\alpha = \frac{q}{n_e^2}$$

$$q(z) = a_i I(z) n_n(z) = a_i I_0 e^{-H a_a n_0 e^{-\frac{z}{H}}} n_0 e^{-\frac{z}{H}}$$

I get a scale height of, say, 7.2 km (using molecular oxygen). Then

$$q = 3.9 \cdot 10^8 \text{ m}^{-3} \text{ s}^{-1}$$

For solar maximum, daytime we have:

$$n_e(120 \text{ km}) = (8+5) \cdot 10^4 \text{ cm}^{-3} = 1.3 \cdot 10^{11} \text{ m}^{-3}$$

Thus

$$\alpha = 2.3 \cdot 10^{-14} \text{ m}^3 \text{ s}^{-1}$$

b)

$$f_p = \frac{1}{2\pi} \sqrt{\frac{n_e e^2}{\epsilon_0 m_e}} \approx 9 \sqrt{n_e}$$

$$f_p = 5 \cdot 10^6 = 9 \sqrt{n_e}$$

\Rightarrow

$$n_e = \left(\frac{5 \cdot 10^6}{9} \right)^2 = 3 \cdot 10^{11} \text{ m}^{-3}$$

$$h = 140 \text{ km}$$

$$t = \frac{2h}{c} = \frac{280 \cdot 10^3}{3 \cdot 10^8} = 10^{-3} \text{ s}$$