Minigroupwork 3, solutions, 2016

a)

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

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

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

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

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

For solar minimum, daytime we have:

n_e(120 km) = $7 \cdot 10^4$ cm^{-3} = $7 \cdot 10^{10}$ m^{-3}

Thus

$\alpha = 9.8 \cdot 10^{-14}$ m^{3}s^{-1}

b)

$$f_p = \frac{1}{2\pi}\sqrt{\frac{n_e e^2}{\varepsilon_0 m_e}} \quad \approx 9\sqrt{n_e}$$

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

$$\Rightarrow$$

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

$$h = 140\ km$$

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