Minigroupwork 3, solutions, 2014

a)

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

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

$q = 3.8 \cdot 10^4$ cm^{-3}s^{-1} = $3.8 \cdot 10^{10}$ m^{-3}s^{-1}

For solar maximum, daytime we have:

n_e(150 km) = $3 \cdot 10^5$ cm^{-3} = $3 \cdot 10^{11}$ m^{-3}

Thus

$\alpha = 4.2 \cdot 10^{-13}$ m^{3}s^{-1}

b)

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

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

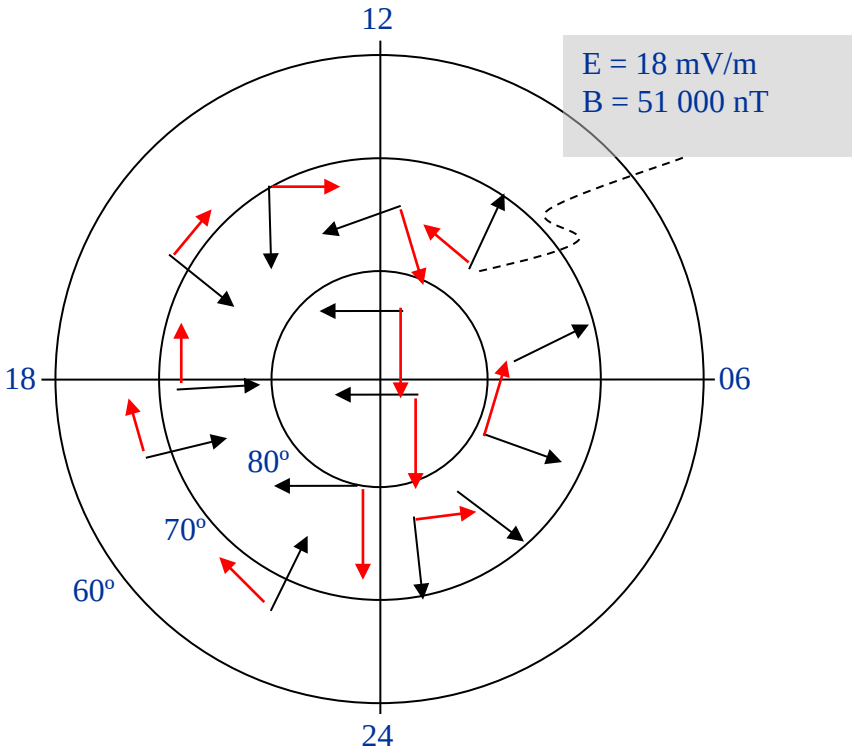
$$\Rightarrow$$

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

$$h = 140\ km$$

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

c)



$$v_d = \frac{\mathbf{E}\times\mathbf{B}}{B^2} = \frac{E}{B} = \frac{18\cdot10^{-3}}{51000\cdot10^{-9}} = 353\ \text{ms}^{-1}$$