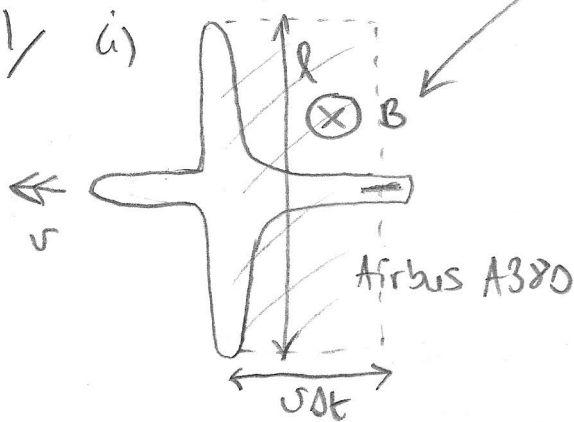


ELECTROMAGNETISM

Earth's magnetic field



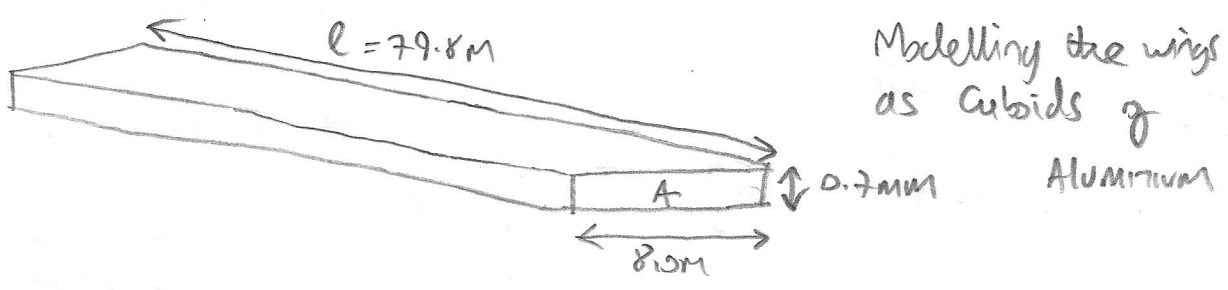
In dt seconds, the wings sweep out area $v dt l$.

The magnetic flux linked is $\therefore B v dt l$ and \therefore the rate of change of magnetic flux linked is $\frac{d\Phi}{dt} = B v l$.

By Faraday's law, this is the EMF induced across the wings.

$$V = B v l = 65 \times 10^{-6} \text{ T} \times 1050 \times \frac{1000 \text{ m}}{3600 \text{ s}} \times 79.8 \text{ m}$$

$$= \boxed{1.51 \text{ V}}$$



$$I = \frac{V}{R} \quad R = \frac{\rho l}{A}$$

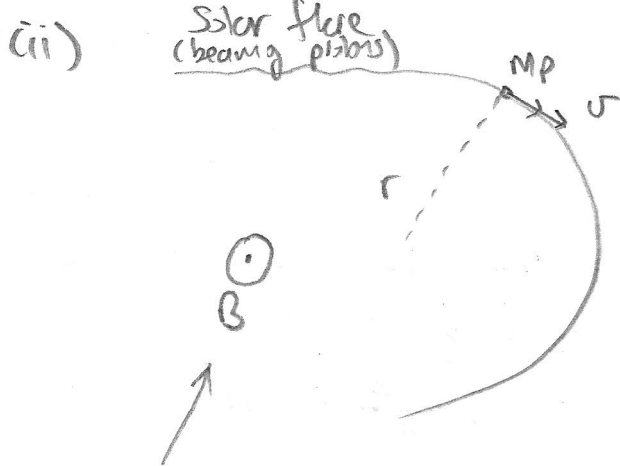
$$\therefore I = \frac{V A}{\rho l} = \frac{1.51 \times 8.0 \times 0.7 \times 10^{-3}}{2.7 \times 10^{-8} \times 79.8}$$

$$= \boxed{3920 \text{ A}}$$

This seems rather large, so one hopes the wings can either (i) harness this current or (ii) increase the resistance of the wings via insulating material.

However, the power of 5.9 kW (VI) is likely to be relatively minor in terms of the jet engine power.

Although, with a thrust of $\times 65.1 \text{ kW}$ (Boeing 747 \rightarrow the A380 will probably be larger) the induced currents and resulting EM braking effect might actually be significant.



Magnetic field of Jupiter

Newton II:

$$\frac{m_p v^2}{r} = B_e v$$

$$\frac{m_p v}{B_e} = r$$

$$r = \frac{1.67 \times 10^{-27} \times 4.90 \times 10^3}{4.17 \times 10^{-6} \times 1.60 \times 10^{12}}$$

$$r = 12.3 \text{ m}$$

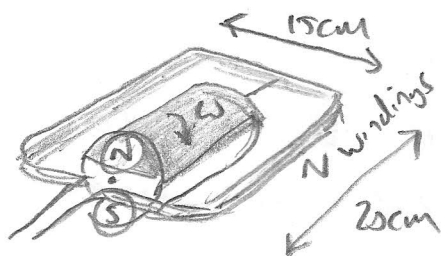
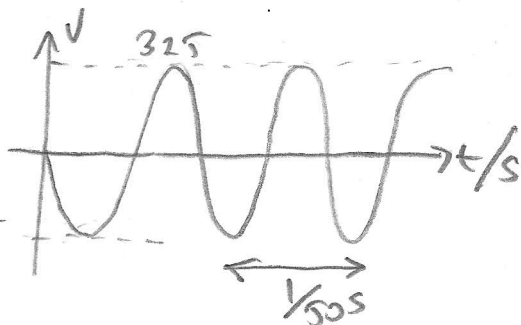
which on the scale of Jupiter is tiny. So expect a visible aurora effect at the poles.

(iii) Diesel generator produces mains AC

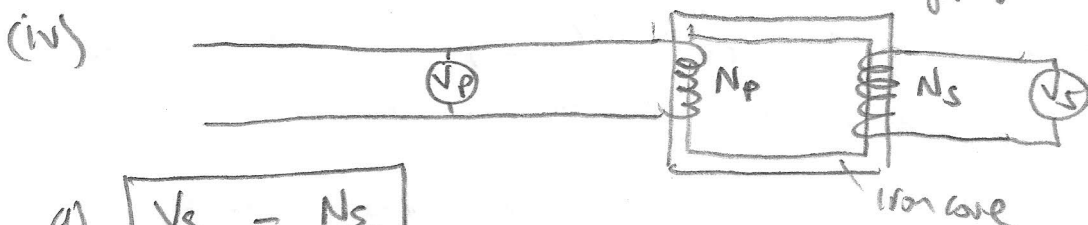
$$e = -N B A \omega \sin \omega t$$

So $N = \frac{V_{\text{max}}}{B A \omega}$ # windings in generator

$$\therefore N = \frac{325}{0.05 \times (20 \times 10^{-2} \times 15 \times 10^{-2}) \times 2\pi \times 50} = 690$$



AC generator



$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\therefore N_p = \frac{V_p}{V_s} N_s = \frac{500 \text{ kV}}{4 \text{ kV}} \times 50 = 6250$$

