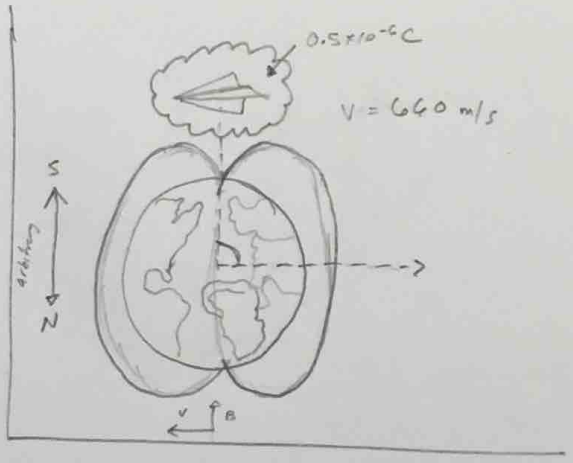
11.21 Magnetic Fields & Lines

(A) Aircrafts sometimes acquire small static charges. Suppose a supersonic jet has a $0.5\,\mu C$ charge & flies due west at a speed of 660 m/s over Earth's South magnetic pole, where the 8.00×10^{-5} T magnetic field points straight up. What are the direction & the magnitude of the magnetic force on the plane? (B) Discuss whether the value obtained in part (a) implies whether this is a significant or negligible effect.

$F = q(v \times B) = qvB\sin\theta$, θ is the direction between the velocities direction & magnetic field strength.



$= (0.5\times10^{-6}\,C)(660\,m/s)(8\times10^{-5}\,T)\sin(90)$

$= 2.64\times10^{-8}\,C\,m/s\,T$, $T = \frac{N}{A\,m}$

$= 2.64\times10^{-8}\,\frac{C\,N}{A\,S}$, $A = C/s$

$\frac{C\,N}{(C/s)s}$

$\boxed{F = 2.64\times10^{-8}\,N}$

(B) The effect of this is negligible to the jet

11.25 **Motion of a charged Particle in a Magnetic field.**

A cosmic-ray electron moves a 7.5×10^6 m/s perpendicular to earth's magnetic field at an altitude where the field strength is 1.0×10^{-5} T. What is the radius of the circular path the electron follows?

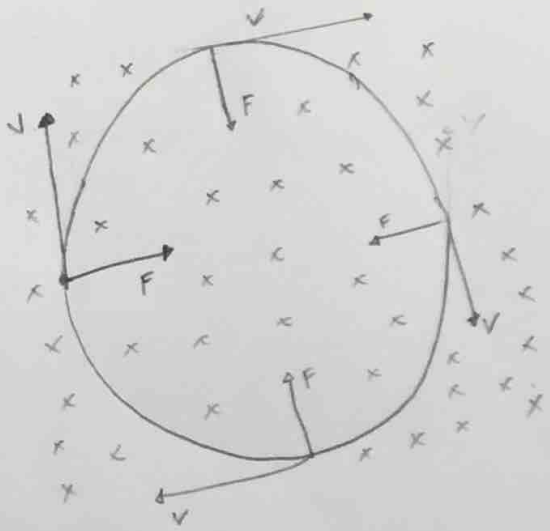
$V = 7.5 \times 10^{+6}$ m/s $\perp$ $B = 1.0 \times 10^{-5}$ T $\quad q = 1.602 \times 10^{-19}$ C

$m_e = 9.11 \times 10^{-31}$ kg

$F = qvB$, $F_c = \frac{mv^2}{r}$ $\Rightarrow$ $qvB = \frac{mv^2}{r}$

$$r_e = \frac{mv}{qB} = \frac{(9.11 \times 10^{-31})\text{kg}\,(7.5 \times 10^6\ \text{m/s})}{(1.602 \times 10^{-19}\text{C})(1.0 \times 10^{-5}\text{T})}$$

$$\boxed{r_e = (4.26\ \text{m})\left(\frac{\text{kg}}{\text{CTs}}\right)}$$



magnetic(F) is $\perp$ to velocity so the velocity changes it's direction but not the magnitude resulting in uniform circular motion.

11.37 Magnetic Force on a current Carrying Conductor

(A) A DC powerline for light-rail systems carries 1000 A at an angle of 30° to Earth's 5×10^{-5} T field. What is the force on a 100m-section of this line? (B) Discuss the practical concerns this presents if any.

(A) $F = I(\ell \times B)$ → the force on a section of wire of length ℓ carrying a current I through B

$= I \ell B \sin\theta$ giving us the strength

θ = is the angle between the wire & the magnetic field

ℓ - direction of the vector gives the direction of the current through the wire.

$F = (1000A)(100m)(5 \times 10^{-5} T)\sin(30^\circ)$

$= 2.5\ A\,m\,T$, $T = \frac{N}{Am}$

$\boxed{F = 2.5\ N}$

(B) This force is very negligible $1N = 0.224$ pounds of Force

thus $2.5N = 0.56$ lbs of F.

A USB charger uses 2.5W, where $1W = 1N\,m/s$