Q- A horizontal wire of length 0.10m and mass 0.020kg carries a current in the earth's magnetic field where it is horizontal and of magnitude $5.0*10^{-5}$ T.
a) Determine the minimum magnitude of the current in the wire if the wire remains motionless in the air above the surface of the earth in the magnetic field.
b) Show, by means of a drawing, the relative direction of the current and the magnetic field.

a) The force experienced by a current carrying wire in a magnetic field is given by

$$\vec{F} = I\vec{L} \times \vec{B}$$

Here L is the length of the wire and its direction is taken in the direction of current and B is he magnetic field

Or the magnitude of the force on the wire is given by

$$F = BIL\sin\theta$$

Here θ is the angle between the direction of current (wire) and the field.

The wire will remain motionless if the magnetic force will balance the weight of the wire and as for the current should be minimum, $\sin\theta = 1$ (maximum), thus the wire should be perpendicular to the magnetic field and the direction of the current must be such that left hand rule gives the force in upward direction.

Hence for the magnitude of minimum current

Or $$I = \frac{mg}{BL} = \frac{0.020*9.8}{5.0*10^{-5}*0.10} = 39200\,\text{A}$$ (very large)

b) the direction of the magnetic force should be upward direction and thus using right hand rule we can draw the figure as given. Figure is showing the top view. The magnetic force will be upward while the weight will be downward.