Answer on Question 57877, Physics, Electromagnetism

Question:

A proton, travelling with a velocity of $4.6 \cdot 10^6\ m/s$ due east, experiences a magnetic force that has a maximum magnitude of $5.8 \cdot 10^{-14}\ N$ due south. What are the magnitude and direction of the magnetic field causing the force?

Solution:

a) Let's write the magnetic force that acts on the proton travelling with a velocity v in a magnetic field B:

$$\boldsymbol{F} = q(\boldsymbol{v} \times \boldsymbol{B}),$$

$$F = qvBsin\theta,$$

here, $q = 1.6 \cdot 10^{-19}\ C$ is the charge of the proton, v is the velocity of the proton, B is the magnitude of the magnetic field, θ is the angle between the velocity and the magnetic field (the magnitude of the magnetic force is a maximum, it means that the velocity is perpendicular to the magnetic field, so that $\theta = 90^\circ$).

Then, from the previous formula we can find the magnitude of the magnetic field:

$$B = \frac{F}{qvsin\theta} = \frac{5.8 \cdot 10^{-14}\ N}{1.6 \cdot 10^{-19}\ C \cdot 4.6 \cdot 10^6\ m/s \cdot sin90^\circ} = 0.078\ T.$$

b) We can predict the direction of the magnetic field causing the force from the right hand rule №1. According to it, the magnetic field points upward, perpendicular to the earth's surface.

Answer:

a) $B = 0.078\ T$.

b) The magnetic field points upward, perpendicular to the earth's surface.