NORTH SOUTH UNIVERSITY

Department of Mathematics & Physics

Assignment – 8

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Section	: 4
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Ans. to the ques.no. 01

We know that,

Change on a proton, $q = 1.60 \times 10^{-19}$ C

Mass of a proton, $m = 1.67 \times 10^{-27}$ kg

a)

We know,

Magnetic force on a change, $F_B = qVB \sin\theta$

$$\therefore V = \frac{F_B}{qB\sin\theta}$$

$$= \frac{6.50 \times 10^{-17}}{1.60 \times 10^{-19} \times 2.60 \times 10^{-3} \times \sin(23^\circ)}$$

$$= 399891.35 \ ms^{-1}$$

An

b)

We know,

kinetic energy, $KE = \frac{1}{2} mv^2$

$$= \frac{1}{2} \times 1.67 \times 10^{-27} \times \cancel{(399891)^2} \ (399891.35)^2$$

$$= 1.34 \times 10^{-16} \ J$$

$$= \frac{1.34 \times 10^{-16}}{1.60 \times 10^{-19}} \text{ eV}$$

$$= 837.5 \text{ eV}$$

Ans.

Ans. to the ques. no. 03

Given that,

$$V = (2 \times 10^{6} \, ms^{-1})\hat{i} + (3 \times 10^{8} \, ms^{-1})\hat{j}$$

$$B = (0.03 \, T)\hat{i} - (0.15 \, T)\hat{j}$$

We know,

change of an electron, $q = -1.60 \times 10^{-19}$ C

Therefore,

Force on the electron,

$$\vec{F}_B = q\vec{V} \times \vec{B}$$

$$= (-1.60 \times 10^{-19}) \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2\times10^{6} & 3\times10^{8} & 0 \\ 0.03 & 0.15 & 0 \end{vmatrix}$$

$$= (-1.60\times10^{-19}) \left\{ \hat{i}(0) - \hat{j}(0) + \hat{k}\left(2\times10^{6}\times0.15 - 3\times10^{8}\times0.03\right)\right\}$$

$$= (-1.60\times10^{-19})(-8700000)\,\hat{k}$$

$$= (1.392\times10^{-12}\ N)\,\hat{k}$$

Here the ~~magne~~ magnitude of force due to magnetic Field is, $(1.392\times10^{-12}\ N)$ directed to the positive z axis.

b)

change of a proton, $q = 1.60\times10^{-19}$ C

$\therefore$ Force, $\vec{F}_B = q\,\vec{v}\times\vec{B}$

$$= (1.60\times10^{-19}) \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2\times10^{6} & 3\times10^{8} & 0 \\ 0.03 & 0.15 & 0 \end{vmatrix}$$

$$= (1.60\times10^{-19}) \left\{ \hat{k}\left(2\times10^{6}\times0.15 - 3\times10^{8}\times0.03\right)\right\}$$

$$= (1.60\times10^{-19})(-8700000)\,\hat{k}$$

$$= -\hat{k}\,(1.392\times10^{-12}\ N)$$

Therefore, force is same as electron just direction is opposite. (-z axis).

Ans. to the ques. no.5

Given,

$$\vec{B} = B_x \hat{i} + (3B_x)\hat{j}$$

$$\vec{v} = (2)\hat{i} + (4)\hat{j}$$

$$\vec{F_B} = (6.40 \times 10^{-19} N)\hat{k}$$

We know,

Charge on an electron, $q = -1.60 \times 10^{-19}$ C

And,

$$\vec{F_B} = q\vec{v} \times \vec{B}$$

$$= q \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 4 & 0 \\ B_x & 3B_x & 0 \end{vmatrix}$$

$$= q\{\hat{i}(0) - \hat{j}(0) + \hat{k}(6B_x - 4B_x)\}$$

$$= (q 2B_x)\hat{k}$$

Therefore,

$$6.40 \times 10^{-19} = B_x \cdot 2 \times (-1.60 \times 10^{-19})$$

$$\therefore B_x = \frac{6.40 \times 10^{-19}}{-2 \times 1.60 \times 10^{-19}} = -2 \text{ T}$$

An

Ans. to the ques. no. 06

Given,

$$\vec{B} = (10\hat{i} - 20\hat{j} + 30\hat{k})\ mT$$

$$\vec{v} = v_x\hat{i} + v_y\hat{j} + (2\ km/s)\hat{k}$$

$$\vec{F}_B = (4\times10^{-17} N)\hat{i} + (2\times10^{-17} N)\hat{j}$$

We know,

Change on a proton, $q = 1.60\times10^{-19}\ C$

and,

$$\vec{F}_B = q\vec{v}\times\vec{B}$$

$$= q\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ v_x & v_y & 2\times10^{3} \\ 10\times10^{-3} & -20\times10^{-3} & 30\times10^{-3} \end{vmatrix}$$

$$= q\left\{\hat{i}(30\times10^{-3}v_y + 40) - \hat{j}(30\times10^{-3}v_x - 20) + \hat{k}(-20\times10^{-3}v_x - 10\times10^{-3}v_y)\right\}$$

$$\Rightarrow (4\times10^{-17} N)\hat{i} + (2\times10^{-17} N)\hat{j} = q(30\times10^{-3}v_y + 40)\hat{i} - q(30\times10^{-3}v_x - 20)\hat{j} + q(-20\times10^{-3}v_x - 10\times10^{-3}v_y)\hat{k}$$

Comparing the corresponding components of $\hat{i}$,

$$4\times10^{-17} = q(30\times10^{-3}V_y + 40)$$

$$\Rightarrow \quad 30\times10^{-3}V_y + 40 = \frac{4\times10^{-17}}{1.6\times10^{-19}}$$

$$\Rightarrow \quad V_y = \frac{250-40}{30\times10^{-3}}$$

$$= 7000 \text{ m/s}$$

$$= 7 \text{ km/s}$$

Ans

Now, $\hat{j}$,

$$2\times10^{-17} = -q(30\times10^{-3}V_x - \cancel{10\times10^{-3}}\,20)$$

$$\Rightarrow \quad 30\times10^{-3}V_x - 20 = \frac{2\times10^{-17}}{-1.6\times10^{-19}}$$

$$\Rightarrow \quad V_x = \frac{-125+20}{30\times10^{-3}}$$

$$= -3500 \text{ m/s}$$

$$= -3.5 \text{ km/s}$$

An

Ans. to the ques. no. 07

Given,

$$\vec{v} = (12\times10^3\ m/s)\hat{j} + (15\times10^3\ m/s)\hat{k}$$

$$\vec{B} = (400\times10^{-6}\ T)\hat{i}$$

$$\vec{a} = (2\times10^{12}\ m/s^2)\hat{i}$$

We know,

Change on an electron, $q = -1.6\times10^{-19}\ C$

Mass of an electron, $m = 9.11\times10^{-31}\ kg$

Now,

Magnetic Force on q,

$$\vec{F}_B = q\,\vec{v}\times\vec{B}$$

$$= q\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 12\times10^3 & 15\times10^3 \\ 400\times10^{-6} & 0 & 0 \end{vmatrix}$$

$$= q\left\{\hat{i}(0) - \hat{j}(-400\times10^{-6}\times15\times10^3) + \hat{k}(-400\times10^{-6}\times12\times10^3)\right\}$$

$$= (-9.6\times10^{-19}\ N)\hat{j} + (7.68\times10^{-19}\ N)\hat{k}$$

Electric Force on q,

$$\vec{F}_E = q\vec{E}$$

$$= (-1.6\times10^{-19})\,\vec{E}$$

Total Force,

$$\vec{F} = \vec{F}_B + \vec{F}_E$$

$$\Rightarrow m\vec{a} = \vec{F}_B + \vec{F}_E$$

$$\Rightarrow \vec{F}_E = m\vec{a} - \vec{F}_B$$

$$\Rightarrow q\vec{E} = m\vec{a} - \vec{F}_B$$

$$\therefore \vec{E} = \frac{m\vec{a} - \vec{F}_B}{q}$$

$$= \frac{(9.11\times10^{-31}\times2\times10^{12}\,N)\,\hat{i} + (9.6\times10^{-19}\,N)\,\hat{j} - (7.68\times10^{-19}\,N)\,\hat{k}}{1.6\times10^{-19}}$$

$$= (11.39\ N/C)\,\hat{i} + (6\ N/C)\,\hat{j} - (4.8\ N/C)\,\hat{k}$$

Ans

Ans. to the ques. no. 41

Here,

Magnetic Field direction is into the page. And the gravity force in downward. So, if we want to balanced the gravity force we need magnetic force to the upward. ~~P~~ According to right hand rules for upward force we need to blow the current in rightward.

And the magnitude of the current will be,

$$i = \frac{mg}{LB}$$

$$= \frac{13 \times 10^{-3} \times 9.8}{0.62 \times 0.440}$$

~~= 0.47 A (Right)~~

~~Ans~~

$$= 467 \text{ mA (Right)}$$

Ans