Quiz #10 Ch#28 T122 Phys102.28-30-v1

Student ID:……… Student Name:………… Section # ……….

Q#1: A 1.0-C charge moves with a velocity $\vec{v} = (2.0\, i + 3.0\, j)$ m/s and experiences a magnetic force $F_B = (15\, i - 10\, j + 8.0\, k)$ N in a magnetic field $B = B_2\, j + 5.0\, k$. Then y- component of magnetic field B_2 is :

$$F_B = q(\vec{V} \times \vec{B}) = 1 \times (2\vec{i} + 3\vec{j}) \times (B_y \vec{j} + 5\vec{k}) = 2B_y \vec{k} - 10\vec{j} + 15\vec{i}$$

$$F_B = 15\vec{i} - 10\vec{j} + 8.0\vec{k} = 2B_y\vec{k} - 10\vec{j} + 15\vec{i}$$

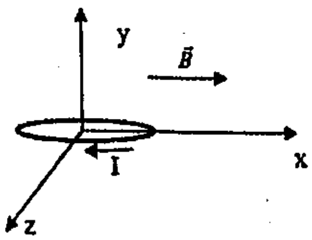
$$B_y = \frac{8}{2} = 4\,T$$

Q#2: A proton moves with constant velocity, $v = (8.0\times10^5$ m/s$)\, i$, through crossed electric and magnetic fields. If the magnetic field is $B = (2.5$ mT$)\, j$, what is the electric field? [i, j *and* k are the unit vectors in the positive x, y and z directions, respectively].

$$-\vec{E} = (\vec{V} \times \vec{B}) \Rightarrow \vec{E} = -(\vec{V} \times \vec{B}) = -8\times10^{5}\vec{i} \times 2.5\times10^{-3}\vec{j}$$

$$E = -8\times10^{5} \times 2.5\times10^{-3}(\vec{i}\times\vec{j}) = -2\times10^{3}\vec{k}$$

Q#3: A 100 turns coil, lies in xz-plane, has an area of 2.0 m^2 and carries a current $I = 0.3$ A in the direction indicated in the following figure. The coil lies in a magnetic field directed along the x-axis and has a magnitude of 1.5 T. What is magnitude and direction of the torque on the coil?



$$\tau = \vec{\mu} \times \vec{B}$$

$$\vec{B} = 1.5\,\vec{i}$$

$$\mu = NiA(-\vec{j}) = -100\times0.3\times2\times\vec{j}$$

$$= -60\vec{j}$$

$$\vec{\tau} = \vec{\mu} \times \vec{B} = -60\vec{j} \times 1.5\,\vec{i}$$

$$\vec{\tau} = -90(\vec{j}\times\vec{i}) = 90\,\vec{k}$$

Quiz #10 Ch#28 T122 Phys102.28-30-v2

Student ID:........ Student Name:........... Section # ....

Q#1: At one instant, an electron is moving in the *xy* plane. The components of its velocity are $v_x = 5.0 \times 10^5$ m/s and $v_y = 3.0 \times 10^5$ m/s. A magnetic field $B = 0.80$ T is in the positive *y* direction. At that instant, what is the magnetic force on the electron? .

$$\vec{F}_B = q(\vec{V} \times \vec{B}) = -1.6\times10^{-19}\left(5\times10^{5}\,\vec{i} + 3\times10^{5}\,\vec{j}\right)\times 0.8\,\vec{j}$$

$$= -1.6\times0.8\times10^{-14}\times5\times(\vec{i}\times\vec{j})$$

$$\vec{F}_B = -6.4\times10^{-14}\,\vec{k}$$

Q#2: A proton is moving with velocity of $v = (1.5\,i + 1.5\,j) \times 10^6$ m/s. It enters a region of a uniform magnetic field pointing in the negative z direction. What is the direction of a uniform electric field in the xy plane that will make the proton move un-deflected?

$$\vec{E} = -(\vec{V}\times\vec{B}) = -\left[(1.5\vec{i}+1.5\vec{j})\times10^{6}\times B_3(-\vec{k})\right]$$

$$= B_3\left[1.5\times10^{6}\left[(\vec{i}\times\vec{k}) + (\vec{j}\times\vec{k})\right]\right] = 1.5\times10^{6}\times B_3\left[-\vec{j}+\vec{i}\right]$$

$$\vec{E} = 1.5\times10^{6}\times B_3\left[\vec{i}-\vec{j}\right]$$

$$\theta = \tan^{-1}(E_y/E_x) = \tan^{-1}\left(\frac{-1}{+1}\right) = 135^0$$

Q#3: In Figure 9, a square loop of wire of side 0.50 m lies in the xy plane. The current in the loop is 0.25 A. There is a uniform magnetic field B in the positive y direction of magnitude 0.75 T. What is the toque on the loop?

Fig#

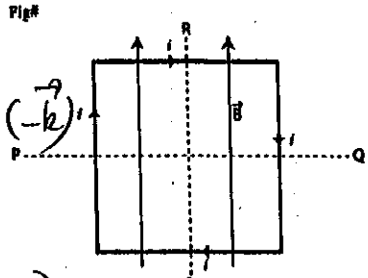


Figure 9

$$\vec{B} = 0.75\,\vec{j}$$

$$\vec{\mu} = i A(-\vec{k}) = 0.25\times(0.5)^2\times(-\vec{k})$$

$$\vec{\mu} = -0.0625\,\vec{k}$$

$$\tau = \vec{\mu}\times\vec{B} = -0.0625\,\vec{k}\times0.75\,\vec{j}$$

$$= -0.0625\times0.75\times(\vec{k}\times\vec{j})$$

$$\vec{\tau} = 0.0469\,\vec{i}$$

Quiz #10 Ch#28 T122 Phys102.28-30-v3

Student ID:........ Student Name:........... Section # ....

Q#1: An electron has a velocity: $v = (5 \times 10^6\ i - 3 \times 10^6\ j)$ m/s and moves through a uniform magnetic field: $B = (0.5\ i + 0.3\ j)$ T. Find the magnetic force (in Newtons) on the electron.

$$\vec{F}_B = q(\vec{V} \times \vec{B}) = -1.6\times10^{-19} \times (5\times10^{+6}\vec{i} - 3\times10^{+6}\vec{j}) \times (0.5\vec{i} + 0.3\vec{j})$$

$$= -1.6\times10^{-19} \times [5\times10^{6}\times0.3\times(\vec{i}\times\vec{j}) - 3\times10^{+6}\times0.5\times(\vec{j}\times\vec{i})]$$

$$= -4.8\times10^{-13}\ \vec{k}$$

Q#2: An electron with a velocity $v = 5.0\times 10^7\ i$ (m/s) enters a region of space where perpendicular electric and magnetic fields are present. The electric field is $E = -10^4\ j$ (N/C). What magnetic field (in Tesla) will allow the electron to go through undeflected?

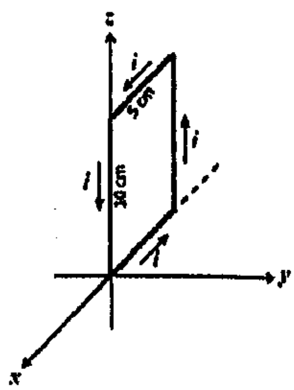
$$+\vec{E} = (\vec{V} \times \vec{B})$$

$$+(-10^4\ \vec{j}) = 5\times10^7 \times \vec{i} \times \vec{B}$$

$$-10^4\ \vec{j} = 5\times10^7 (\vec{i} \times \vec{B})$$, B is in the direction of $\vec{k}$

$$|B| = \frac{10^4}{5\times10^7} = 2\times10^{-4}\ T$$

Q#3: Figure 8 shows a 20- turn rectangular coil of dimensions 10 cm by 5.0 cm. It carries a current of 0.10 A, and is hinged along one long side. There is a uniform magnetic field $B = 0.5\ i$ T in the region. In unit vector notation what is the torque acting on the coil about the hinge line?



$$\vec{B} = 0.5\ \vec{i}\ T$$

$$\mu = N i A\ \vec{j}$$

$$= 20\times0.1\times5\times10\times10^{-4}\times\vec{j}$$

$$= 0.01\ \vec{j}$$

$$\vec{\tau} = \vec{\mu}\times\vec{B}$$

$$= 0.01\ \vec{j} \times 0.5\ \vec{i}$$

$$= 0.01\times0.5\times(\vec{j}\times\vec{i})$$

$$= -0.005\ \vec{k} = -5\times10^{-3}\ \vec{k}$$

Quiz #10 Ch#28 T122 Phys102.28-30-v4

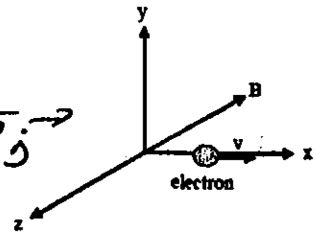
Student ID:……… Student Name:………… Section # ……….

Q#1: In the figure, an electron of speed 2.0×10^5 m/s moves along positive x axis in a uniform magnetic field of 0.2 T pointing into the page -z direction. The magnetic force on the electron is :

$\vec{F}_B = q(\vec{v}\times\vec{B})$, $v = 2\times10^5\,\vec{i}$; $\vec{B} = -0.2\,\vec{k}$ T

$F_B = -1.6\times10^{-19}\times\left((2\times10^5\times\vec{i})\times(-0.2\times\vec{k})\right)$

$= 0.64\times10^{-14}\times(\vec{i}\times\vec{k}) = -6.4\times10^{-15}\,\vec{j}$



Q#2: The following figure shows a proton moving at a constant speed of 300 m/s along the negative x-axis through uniform electric and magnetic fields. The electric field is directed along the positive y-direction and has a magnitude of 900 N/C. What is the magnitude and direction of the magnetic field?

$-\vec{E} = (\vec{v}\times\vec{B})$; $v = 300(-\vec{i})$ m/s

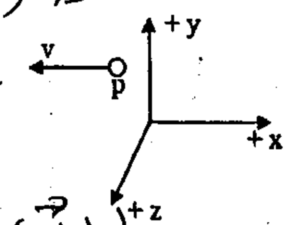
$E = 900\,\vec{j}$ N/C

$E = -(\vec{v}\times\vec{B})$

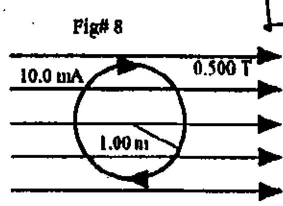
$900\,\vec{j} = -(300(-\vec{i})\times\vec{B})$

$3\ \cancel{900}\,\vec{j} = \cancel{300}(\vec{i}\times\vec{B})$ (B must in $(-\vec{k})$)

$3 = B \Rightarrow \boxed{B = 3T}$ ✓



Q#3 A single circular loop of radius 1.00 m carries a current of 10.0 mA. It is placed in a uniform magnetic field of magnitude 0.500 T that is directed parallel to the plane of the loop, as shown in **FIGURE 8**. What is the magnitude of the torque exerted on the loop by the magnetic field?



$\vec{\mu} = NiA(-\vec{k})$

$= 1\times10\times\pi R^2\times(-k)$

$\vec{\mu} = 10\pi(-k)\times10^{-3}$

$\vec{B} = 0.5\,\vec{i}$

$\vec{\tau} = \vec{\mu}\times\vec{B} = 10\pi(-\vec{k})\times0.5\,\vec{i}\times10^{-3}$

$= 5\pi(-\vec{k}\times\vec{i})\times10^{-3} = 5\pi\times10^{-3}\times(-\vec{j})$

$|\tau| = 5\pi\times10^{-3} = 1.57\times10^{-2}$ N.m

Quiz #10 Ch#28 T122 Phys102.28-30-v5

Student ID:......... Student Name:........... Section # ....

Q#1: What is the magnitude of the magnetic force on a charged particle ($Q = +5.0\ \mu C$) moving with a speed of 80 km/s in the positive *x* direction in a region containing a uniform magnetic field B with components $B_x = 5.0\ T$, $B_y = 4.0\ T$, and $B_z = 3.0\ T$?

$\vec{B} = 5\vec{i} + 4\vec{j} + 3\vec{k}$; $\vec{v} = 80\ km/s\ \vec{i} = 8\times10^4\ m/s\ \vec{i}$

$\vec{F}_B = q(\vec{v}\times\vec{B}) = 5\times10^{-6}\times(8\times10^4\ \vec{i})\times(5\vec{i}+4\vec{j}+3\vec{k})$

$= 40\times10^{-2}\times[4\times(\vec{i}\times\vec{j}) + 3(\vec{i}\times\vec{k})] = 0.4(4\vec{k} - 3\vec{j})$

$\vec{F}_B = 1.6\vec{k} - 1.2\vec{j}$; $|F_B| = \sqrt{(1.6)^2 + (1.2)^2} = 2N$

Q#2 A proton travels through both a uniform magnetic field and a uniform electric field. The magnetic field is given by $B = 2.5\ i\ (mT)$. At one instant, the velocity of the proton is $v = 2.0\times10^3\ j\ (m/s)$ and the net force acting on it is zero. Find the electric field in units of V/m. Ignore the gravitational force on the proton.

$-E = (\vec{v}\times\vec{B}) \Rightarrow E = -(\vec{v}\times\vec{B})$

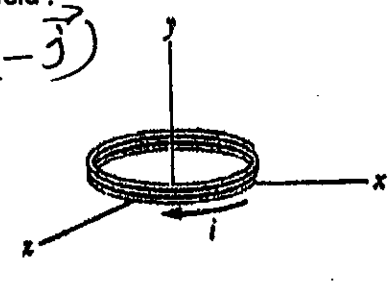
$E = -((2\times10^3\ \vec{j}\times(2.5\times10^{-3}\ \vec{i}))$

$\vec{E} = -5(\vec{j}\times\vec{i}) = 5\vec{k}$

Q#3: The coil in **FIGURE 7** has its plane parallel to the *xz* plane, and carries current $I = 1.0$ A in the direction indicated. The coil has 8.0 turns and a cross sectional area of $4.0\times10^{-3}\ m^2$, and lies in an external uniform magnetic field that is given by $B = -2i$ (mT). Find the torque (in units of $\mu N.m$) on the coil due to the magnetic field.

$\vec{\mu} = NiA(-\vec{j}) = 8\times1\times4\times10^{-3}\times(-\vec{j})$

$\vec{\mu} = -32\vec{j}$



$\vec{B} = -2\vec{i}\times10^{-3}\ T$

$\tau = \vec{\mu}\times\vec{B}$

$= (-32\vec{j})\times(-2\times10^{-3}\ \vec{i})$

5

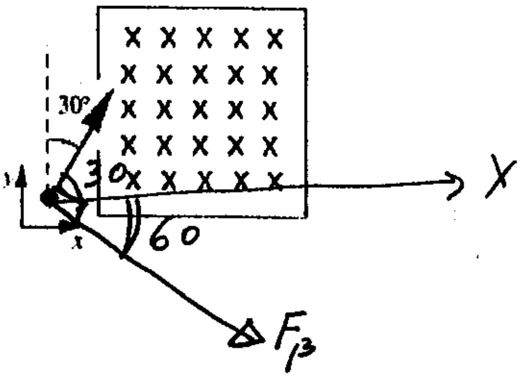
$= 64\times10^{-3}(\vec{j}\times\vec{i}) = -64\vec{k}$

Quiz #10 Ch#28 T122 Phys102.28-30-v6

Student ID:........ Student Name:........... Section # ....

Q#1: An electron enters a region that contains a magnetic field directed into the page as shown in figure 7. The velocity of the electron makes an angle of 30 degrees with the +y axis. What is the direction of the magnetic force on the electron when it enters the field?

$\vec{F}_B$ 60° below X-axis



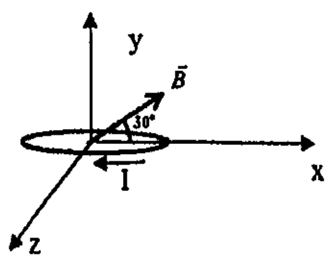
Q#2: A uniform magnetic field of magnitude 2.0 T, directed along the positive *y* axis, crosses an electric field E. What is magnitude and direction of the electric field needed to guide an electron with a speed of 30 m/s along a straight line in the positive *x* axis direction?.

$-\vec{E} = (\vec{v} \times \vec{B})$; $\vec{B} = 2\vec{j}$ T ; $\vec{v} = 30\vec{i}$ m/s

$E = -(\vec{v} \times \vec{B}) = -(30\vec{i} \times 2\vec{j}) = -60(\vec{i} \times \vec{j})$

$\vec{E} = -60\vec{k} = 60(-\vec{k}) = 60 \text{ V/m} (-\vec{k})$

Q#3: A 20-turn coil, with an area of 1.5 m^2, lies in the *xz* plane and carries a current *I* = 0.20 A in the direction indicated in Figure 11. The coil is placed in a uniform magnetic field that lies in the xy plane and makes an angle of 30° with the + x-axis, and has a magnitude of 0.50 T. What is the torque on the coil?



$\vec{B} = 0.5\cos 30\,\vec{i} + 0.5\sin 30\,\vec{j}$

$\vec{\mu} = NiA(-\vec{j})$

$= 20 \times 0.2 \times 1.5(-\vec{j})$

$\vec{\mu} = -6\vec{j}$

$\vec{\tau} = \vec{\mu} \times \vec{B} = -6\vec{j} \times (0.5\cos 30\,\vec{i} + 0.5\sin 30\,\vec{j})$

$= -6 \times 0.5 \times \cos 30 \times (\vec{j} \times \vec{i})$

$\tau = -2.6 \times (\vec{j} \times \vec{i}) = -2.6 \times (-\vec{k}) = 2.6\vec{k}$