NCERT EXCERCISE

24/07/21

1

Chapter 4

4.1

no of turns on coil = 100

radius of coil turns = 8 cm 0.8 cm

magnitude in coil = 0.4 A

magnitude is Magnetic field at Centre of Coil can be obtained by

$$|B| = \frac{\mu_0 2\pi n I}{4\pi r}$$

Permeability μ

$$= \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2\pi \times 100 \times 0.4}{0.08}$$

$$= 3.14 \times 10^{-4}$$

magnitude = 3.14×10^{-4} T

4(2) magnitude of Current = 35 A

r = 20 cm or 0.2 cm

$$|B| = \frac{\mu_0 2I}{4\pi r}$$

μ_0 · Permeability of free space

$4\pi \times 10^{-7}$ T m A^{-1}

$$B = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2 \times 35}{0.2}$$

$= 3.5 \times 10^{-5}$ T

4.6 l of wire = 3 cm
= magnitude of current flowing = 10A
strength of magnetic field = 0.27 T

angle between current and magnetic field = θ = 90°

$F = BIl \sin\theta$

$0.27 \times 10 \times 0.3 \times \sin 90°$

8.1×10^{-2} N

Magnetic force = 8.1×10^{-2} N
direction can be obtained from flemings left hand rule

4.7 Magnitude of current flowing in A = 8A (I_A)
magnitude of " in B = 5A (I_B)

distance between them = 0.04 m, 4 cm

length of section of wire A (L)

= 10cm = 0.1m

$F = \frac{\mu_0 I_A I_B l}{2\pi r}$

Permeability = $4\pi \times 10^{-7}\ TmA^{-1}$

$F = \frac{4\pi \times 10^{-7} \times 8 \times 5 \times 0.1}{2\pi \times 0.04} = 2 \times 10^{-5}N$

magnitude = $2 \times 10^{-5}N$

Q8 Solenoid $l = 80cm$

$= 0.8m$

no of turns on solenoid = 5×400

$= 2000N$

Solenoid diameter = 1.8m = 0.018m

current carried = 8.0A

$B = \frac{\mu_0 N I}{l}$

μ_0 = permeability of free space

$= 4\pi \times 10^{-7}\ TmA^{-1}$

$B = \frac{4\pi \times 10^{-7} \times 2000 \times 8}{0.8}$

$= 2.5 \times 10^{-2}T$

4.11 M.g field Strength = 6.5G
= $= 6.5 \times 10^{-4} T$

Speed of electron = $4.8 \times 10^{6} m/s$
charge on electron = $1.6 \times 10^{-19} C$
Mass of electron = $9.1 \times 10^{-31} kg$

$\theta = 90°$

relation for M.g force
$= F = eVB \sin\theta$

$F_c = F$

$\frac{mv^2}{r} = eVB \sin\theta$

$r = \frac{mv}{eB\sin\theta}$

$r = \frac{mv}{eB\sin\theta}$

$\frac{9.1 \times 10^{-31} \times 4.8 \times 10^{6}}{6.5 \times 10^{-4} \times 1.6 \times 10^{-19} \times \sin 90°} = 4.2 \times 10^{-2} m$
$= 4.2 cm$

12 M.g field strength = $6.5 \times 10^{-4} T$
Charge = $1.6 \times 10^{-19} C$

Mass of electron = 9.1×10^{-31}
speed " " = 4.8×10^{6} m/s
radius = $r = 4.2$
0.042 cm

Angular frequency of electron
$= \omega = 2\pi\nu$

Velocity of electron is related to angular frequency = $v = r\omega$

$$\frac{mv^2}{r} = evB$$

$$eB = \frac{mv}{r} = \frac{m(r\omega)}{r} = \frac{m(r \cdot 2\pi\nu)}{r}$$

$$\nu = \frac{Be}{2\pi m}$$

$$\nu = \frac{6.5 \times 10^{-4} \times 1.6 \times 10^{-19}}{2 \times 3.14 \times 9.1 \times 10^{-31}}$$

$= 1.82 \times 10^{6}$ Hz $= 1.8$ MHz

4.13 no of turns = 30

radius = 8.0 m

Area = $(0.08)^2 \pi$

$= 0.0201 m^2$

Current = 6.0 A

mag field strength = 1 T

angle = 60°

$\tau = nIBA \sin\theta$

$30 \times 6 \times 1 \times 0.0201 \times \sin 60$

$= 3.133 \, Nm$

b) It can be defined from relation $T = nIBA \sin\theta$ that of magnitude of applied torque ~~to prevent coil from turning~~ is not dependent on shape of coil, it is dependent on area of coil

answer would change if circular coil in the above case is replaced by a planar coil of some irregular shape that encloses the same area

4.14 radius of coil = 0.16 m > 16 cm
no of turns in coil = 20
current " " = 16 A
radius of second coil = 10 cm
= 0.1 m
Current " " = 10 A
no of turns " " = 25

M.g field =

$$B_1 = \frac{\mu_0 N_1 I_1}{2r_1}$$

$$B_1 = \frac{4\pi \times 10^{-7} \times 20 \times 16}{2 \times 0.16}$$

$$= 4\pi \times 10^{-4}\ T$$ (towards east)

$$B_2 = \frac{4\pi \times 10^{-7} \times 25 \times 18}{2 \times 0.10}$$

$$= 9\pi \times 10^{-4}\ T$$ (towards west)

$$B = B_2 - B_1 = 9\pi \times 10^{-4}\ T - 4\pi \times 10^{-4}\ T$$

$$= 5\pi \times 10^{-4}\ T$$

$$= 5 \times 3.14 \times 10^{-4}$$

$$= 1.57 \times 10^{-3}\ T$$ (towards west)

4.15 Mag field strength = 100G
= 100×10^{-4} T
no of turns per unit = 1000
Current = 15 A
Permeability $\mu_0 = 4\pi \times 10^{-7}$ Tm/A

∴ $B = \mu_0 N i / l$

$N i / l = B / \mu_0$

$= (100 \times 10^{-4}) / (4\pi \times 10^{-7})$

⇒ $N i / l$

$= 7961$

Solenoid Current I = 10 A
" " $l = 0.5$

$\frac{N \times 10}{0.5} = 7961$

⇒ N = 398 turns = 400 turns

4.17. inner radius $r_1 = 25cm = 0.25m$
outer radius $= r_2 = 26cm = 0.26m$
no of turns $= 3500$ turns
Current $= 11A$

a) mag field inside torque is zero
(b) inside core of toroid
mag induction $= B = \frac{\mu_0 N I}{l}$

$l = 2\pi \frac{(r_1+r_2)}{2}$

$\pi(r_1+r_2) = \pi(0.25+0.26) = \pi \times 0.51$

$B = \frac{\mu_0 N I}{l}$

$B = \frac{4\pi \times 10^{-7} \times 3500 \times 11}{\pi \times 0.51}$

$= 3.02 \times 10^{-2} T$

4.18

a) initial velocity is parallel or anti parallel to mag field there is no mag force acting on particle. it move ant deflected

(b) Yes because mag force can change velocity but not mag magnitude

iii) it should be is vertically downward direction

4.19 M.g field = 0.15
p.D = V = 2.0 kV

electron gains K.E

$E = 1/2 mv^2$

$eV = 1/2 mv^2$

$v = \sqrt{\frac{2eV}{m}}$ $v = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 2 \times 10^{3}}{9.1 \times 10^{-31}}}$

$= 2.652 \times 10^{7}$ m/s

b) $F_1 = evB$

$F_2 = \frac{mv^2}{r}$

$F_1 = F_2$

$evB = \frac{mv^2}{r}$

$r = \frac{mv}{eB}$

$r = \frac{9.1 \times 10^{-31} \times 2.652 \times 10^{7}}{0.15 \times 1.6 \times 10^{-19}}$

10^{-3} m = 1 mm

b)= applied force is related to initial velocity. velocity is resolved into two components $V\cos\theta$ and $V\sin\theta$, $V\cos\theta$ is along direction of field it causes electron to move in a straight line. $V\sin\theta$ is along normal and it causes electron to move in circular path

$r = \frac{mv\sin\theta}{Be}$

$r = \frac{9.1\times10^{-31} \times 2.652\times10^{7} \times \sin 30}{0.15\times1.6\times10^{-19}}$

$= 50.25\times10^{-5}$ m

$r = 0.5$ m

20 M.g field = 0.75 T

$V = 15$ kV $= 15\times10^{3}$ V

Electrostatic field = 9.0×10^{5} N/C

K.E = $1/2\, mv^2$

$eV = 1/2\, mv^2$

mass of electron = m

charge of e = e

Velocity = v

$qE = qvB$

$v = E/B$

$1/2\, m (E/B)^2 = qV$

$q/m = E^2 / 2VB^2$

$$\frac{(4.0 \times 10^5)^2}{2 \times 15000 \times (0.75)^2}$$

$= 4.8 \times 10^7\ C/kg$

beam contains deuterium ions

4.24

a) torque $\vec{\tau} = I\vec{A} \times \vec{B}$

$\vec{A} = 50 \times 10^{-4}$

$\vec{B} = 0.3\hat{k}$

$\tau = 12 \times (50 \times 10^{-4}) \hat{\imath} \times 0.3\hat{k}$

$= 1.8 \times 10^{-2}\ J\ Nm$

torque is 1.8×10^{-2} N along negative Y direction

b) 1.8×10^{-2} Nm along negative Y direction, not for $\theta = 0$

c) A is normal to x-z plane

$\vec{A} = -50 \times 10^{-4}$

$\vec{B} = 0.3k$

$\vec{\tau} = 12 \times (-50 \times 10^{-4})\, 0.3k$

$-1.8 \times 10^{-2}\, i$ Nm

d) $\tau = 12 \times 50 \times 10^{-4} \times 0.3$

1.8×10^{-2} Nm

A is normal to coil, coil makes an angle of 30° with y axis A will make angle of 30° with positive x axis in negative y direction, B is directed along z axis

angle between A and B = 90°

~~1.8×10^{-2}~~

e) A is normal to x-y plane in positive z direction

$\vec{A} = 50 \times 10^{-4} k$

$\vec{B} = 0.3 k$

$\vec{\tau} = 12 \times (50 \times 10^{-4}) k \times 0.3 k$

$= 0$

Torque is zero, force = 0

~~$\vec{F} = ...$~~

f) A is normal to x-y plane in negative z direction

$\vec{A} = -50 \times 10^{-4} k$

$\vec{B} = 0.3 k$

$\vec{\tau} = 12 (-50 \times 10^{-4}) \times 0.3 k$

$= 0$

Torque = 0

e) Corresponds to stable

f) Corresponds to unstable equilibrium

4.27) Resistance of galvanometer coil $= G = 12\Omega$

Current $= I = 3mA$

$R = \left(\frac{V}{i_g}\right) - G$

$\frac{18}{3\times10^{-3}} - 12\Omega = 6000 - 12$

$= 5988\Omega$

a galvanometer can be converted to voltmeter by connecting resistor of 5988Ω

4.28 resistance of galvanometer $= G = 15\Omega$

Current through " " $= I_g$

$= 4mA = 4\times10^{-3}A$

Ammeter $= 0$ to 6

$S = \frac{I_g G}{I - I_g}$

$S = S = \frac{4\times10^{-3}\times15}{6 - 0.004}$

$10\times10^{-3}A$

$S = 10mA$

A 10mA resistor should be connected to is parallel to galvanometer.

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