NATIONAL UNIVERSITY OF MODERN LANGUAGES, ISLAMABAD

Department of Software Engineering

Final Term Examination SPRING 2021

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Submitted to

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(Hamza Mehmood)

(Sp-21-110)

(Physics)

(Question:- 1)

Magnetic force on a Current carrying conductor:-

A conducting wire with length l and cross-sec area A; Wire is in a uniform magnetic field $\vec{B}$, perpendicular and directed into the plane drift velocity v_d is upward and, perpendicular to $\vec{B}$.

Average force on each charge is $\vec{F} = q\vec{v_d} \times \vec{B}$, directed to the left the magnitude of the force is

$F = qv_dB$.

The number of charges per unit volume is n number of charges equal to nAl.

$$\boxed{F = (nAl)(qv_dB) = (nqv_dA)(lB)}$$

current density is $\vec{J} = nqv_d$
JA is the total current I.

$F = IlB$

$F = I\vec{l} \times \vec{B}$ (magnetic force on a straight wire segment)

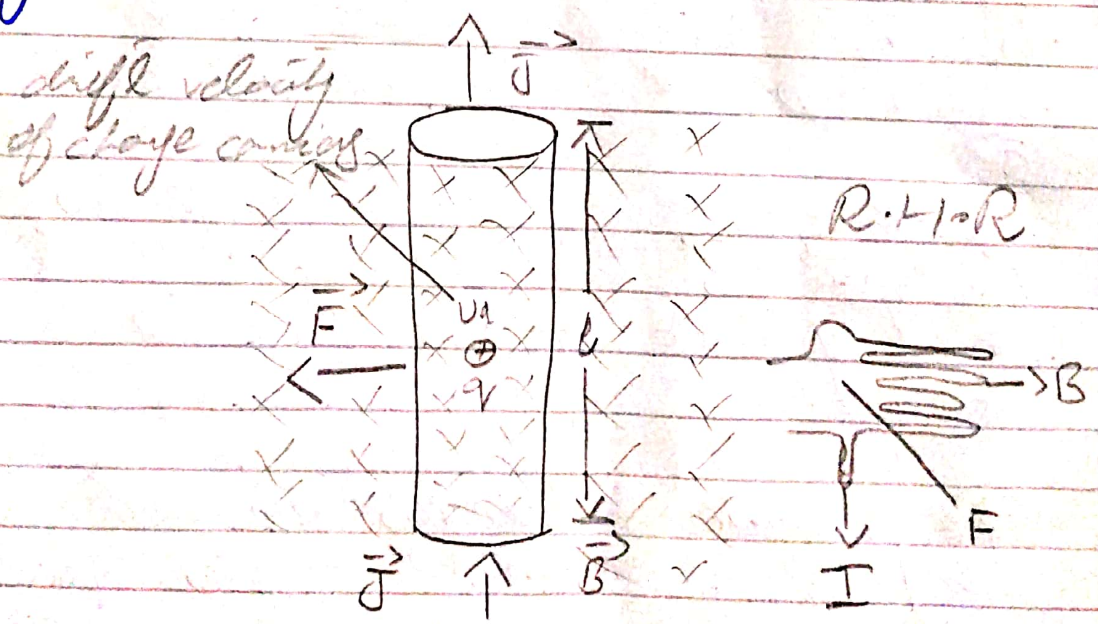
if the $\vec{B}$ field is not $\perp$ to the wire but makes an angle ϕ.

$$\boxed{F = IlB_\perp = IlB\sin\phi}$$

if the conductor is not straight we can divide it into infinitesimal segments $d\vec{l}$. The force $d\vec{F}$ on each segment is

$$\boxed{d\vec{F} = I\,d\vec{l} \times \vec{B}}$$ (magnetic force on an infinitesimal section)

diagram:-



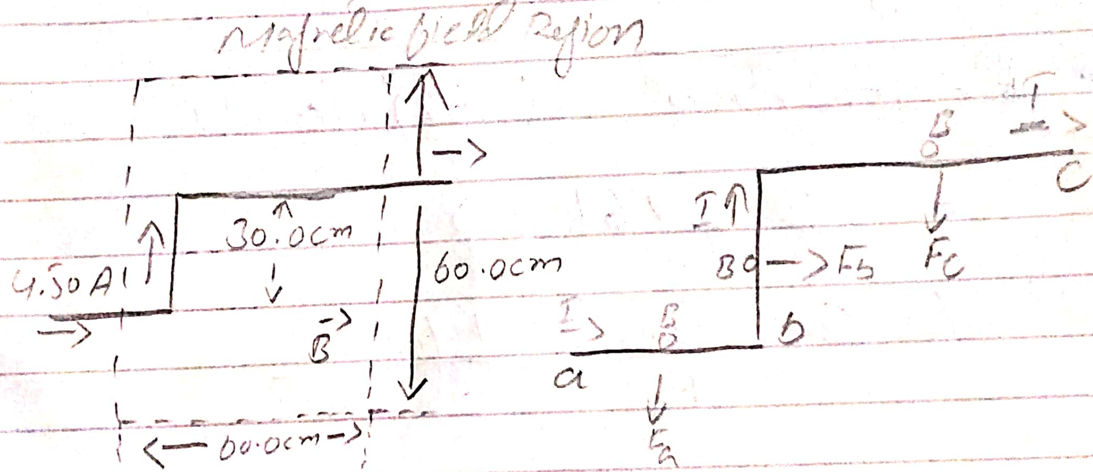
$$\boxed{F = IlB}$$

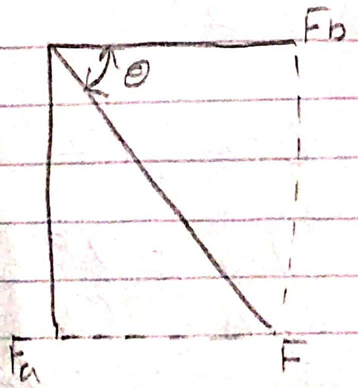
Magnetic force is given by:-

$$\boxed{F = I l B \sin\theta}$$

where I is the current, l is the length of a straight conductor in a uniform magnetic field B and θ is the angle between l and B.
The force follows **RHR** with the thumb in the direction of I.

(b)





Part B:-

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

$$F = 4.50 \begin{bmatrix} 0.6 \\ 0.3 \\ 0.0 \end{bmatrix} \times \begin{bmatrix} 0 \\ 0 \\ 0.242 \end{bmatrix}$$

$F_x = 0.0726$

$F_y = -0.1452$

$F_z = 0$

$$|\vec{F}| = \sqrt{(0.0726)^2 + (-0.1452)^2}$$

$$= 0.7305 N$$

$$\theta = \tan^{-1}\left(\frac{-0.1452}{0.0726}\right)$$

$$\boxed{= -63.34}$$

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(Question 2)
(Ans :- 2)

In loop 1

voltage = 6V , $V_b = 4V$, $V_c = 2V$

Resistan = 3Ω , $2\Omega = R_a$

current = $I_a = ?$

Resistor = $5\Omega\, b = R_c$

Loop Rule:-

$$V = IR$$

$$-6 = 2(I_a) + 3(I_a - I_b) + 4 = 0$$

$$5I_a - 3I_b = 2 \rightarrow (1)\ eq.$$

Apply Loop Rule on 2

$$V = IR$$

$$-4 + 3(I_b - I_a) + 5I_b + 6(I_b - I_c) = 0$$

$2-3I_a+14I_b=6I_c-4 \rightarrow eq\ 2$

Applying loop Rule to 3.

$8(I_c-I_b+4I_c+2=6$

$-6I_b+10I_c=2$

By Eq I, we get:-

$5I_a=2+3I_b$

$I_a=\frac{2+3I_b}{5} \rightarrow 4\ eq.$

By equation we get:-

$-3\left(\frac{2+3I_b}{5}\right)-6I_c=4$

$-\frac{6-9I_b}{5}-6I_c=4$

$-30-9I_b-30I_c=20$ (By LCM)

$-9I_b-30I_c=50$ eq (5)

Multiplying eq with 3

$3(6I_3+10I_c=2)$

$18I_3+30I_c=-6 \rightarrow 6\ eq.$

Now adding 5 and 6

$$= 18I_b + 30I_c - (9I_b + 30I_c) = -6 + 50$$

$$-27I_b = 44$$

$$I_b = \frac{44}{27}$$

$$\boxed{I_b = -1.62}$$

Putting This in eq I

$$5I_a - 3I_a = 2$$
$$5I_a - 3(1.62) = 2$$

$$5I_a - 4.86) = 2$$

$$5I_a = 2 + 4.86$$

$$\boxed{I_a = 1.372\,A}$$

Putting value of I_b in eq 3

$$-6I_b + 10I_c = -2$$
$$-6(-1.62) + 10I_c = -2$$

$$9.72 + 10I_c = -2$$

$$10I_c = -11.72$$

$$\boxed{I_c = -1.172\,A}$$

(Question:- 3)

Given data:

$f = 400\,Hz$
$A = 0.555\,m$
$v = 81\,m/s$
$t = 0$ Max (+) displacement

$A = 0.555\,m$

Angular frequency

$$\omega = 2\pi f$$
$$= 2\pi(4.00)$$
$$\omega = 25.12 \text{ rad/s}$$

Time period

$$T = \frac{1}{f} \Rightarrow \frac{1}{4.00} \Rightarrow 0.250\,s$$

wave length from the wave speed of

$$\lambda = \frac{v}{f} = \frac{8\,m/s}{4\,Hz}$$
$$= 2\,m$$

wave number

$$k = \frac{2\pi}{\lambda} \Rightarrow \frac{2\pi}{2m}$$
$$\Rightarrow 3.14\,m^{-1}$$

(b)

$$y = (x, t) = (4.00\text{m}) \cos 2\pi \left(\frac{x}{2\text{m}} - \frac{t}{0.25\text{s}} \right)$$

$$= 4.00\text{m} \cos \frac{2\pi}{0.5} (0.25x - 2t$$

$$= 4.00 \cos 12.56 (0.25x - 2t)$$

$$y(x, t) = 4.00 \cos (3.14x - 25.12t)$$

(c)

$v = ?$

acceleration $= ?$

$$v = \frac{\Delta x}{\Delta t}$$

$$\Rightarrow \frac{4.00\text{m}}{0.25\text{s}}$$

$$= 16\text{ms}^{-1}$$

$$a = \frac{\Delta v}{\Delta t} = \frac{16\text{ ms}^{-1}}{0.25\text{s}}$$

$$\boxed{= 64\text{ms}^{-2}}$$