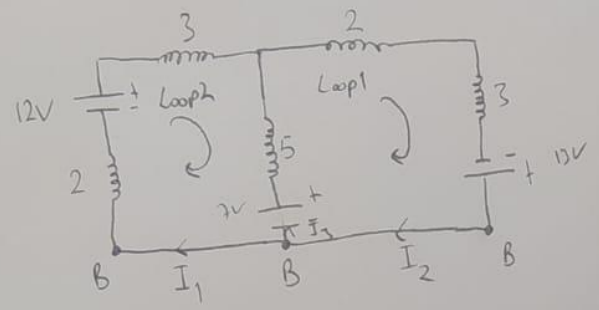
Q1)

a)



For loop 1:

$\Delta\mathcal{E} = 13 + 5I_3 + 7 - 2I_2 - 3I_2 = 0 \qquad 5I_3 - 5I_2 = -20$

For loop 2:

$\Delta\mathcal{E} = -5I_3 - 7 - 2I_1 + 12 - 3I_1 = 0 \qquad 5I_3 + 5I_1 = 5$

$I_2 + I_3 = I_1$

$5I_3 - 5I_2 = -20$

$10I_3 + 5I_2 = 5$

$15I_3 = -15A$

$I_3 = -A$

$I_2 = 3A$

$I_2 + I_3 = I_1 = 2A$

A → B

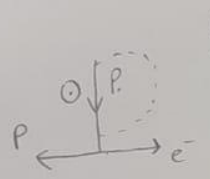
The director of I_3 is wrong.

b)

$V_a - V_b = 12 - 2.I_1$

$= 8V$

Q2)



a) $F = qVB\sin\theta \qquad \theta = 90^\circ \qquad e = 1.6 \times 10^{-19}$

$$V = \frac{|F|}{e|B|} = \frac{3.20 \times 10^{-15}}{(1.6 \times 10^{-19}) \times (4 \times 10^{-3})} = 5 \times 10^{6}\ m/s$$

b) $F = \frac{mV^2}{r} \qquad \frac{mV}{qB} = \frac{(9.11 \times 10^{-31})(5 \times 10^{6})}{(1.6 \times 10^{-19})(4 \times 10^{-3})} \longrightarrow r = 5.82 \times 10^{-3}$

c) $T = \frac{2\pi . r}{V} \qquad T = \frac{2 \times 3.14 \times 7.11 \times 10^{-3}}{5 \times 10^{6}}$

$T = 8.93 \times 10^{-9}\ s$

$T = \frac{1}{f} \qquad f = \frac{1}{T} \qquad f = 0.1119 \times 10^{9}\ s^{-1}$

Q3)

A)

$$\vec{B_1} = \frac{\mu_0 \cdot I}{4b} \text{ (out of page)} +$$

$$\vec{B_2} = \frac{\mu_0}{4} \cdot \frac{I}{a} \text{ (out of page)} +$$

$$\vec{B}_{Total} = \vec{B}_2 + \vec{B}_1 = \frac{\mu_0 \cdot I}{4} \left(\frac{1}{a} + \frac{1}{b}\right)$$

B)

$$\oint B \cdot ds = \mu_0 I_{enc}$$

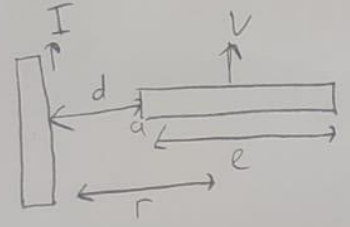
$$B \cdot 2\pi r = \mu_0 \cdot I \left(\frac{\pi r^2}{\pi R^2}\right)$$

$$r < R \quad \{ B = \frac{\mu_0 \cdot I r}{2\pi \cdot R^2} \quad \text{put } r = R$$

$$r \geq R \quad \{ B = \frac{\mu_0 \cdot I \cdot R}{2\pi \cdot R^2} = \frac{\mu_0 \cdot I}{2\pi \cdot R}$$

B is maximum when $r = R$

Q4)



$\ell = d.r$

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

$E = -B V \ell \qquad dE = -BV dr$

$$\int_a^b dE = -\int_d^{d+\ell} B.V.dr$$

$\curvearrowright V_{ba}$

$$V_{ba} = \frac{-\mu_0 I.V}{2\pi} \int_d^{d+\ell} \frac{1}{r} \longrightarrow \frac{-\mu_0 I.V}{2\pi} . \ln(r) \Big|_d^{d+\ell}$$

$$V_{ba} = -\frac{\mu_0 . I.V}{2\pi} . (\ln(d+\ell) - \ln(d)) \ m/s$$

(left direction)