1. Problem 30-24. (**+6 pts**)

   I. +2 pts - correct expression for the potential difference between the rim and the center of the disc.

   $$\Delta V = -\int \vec{\mathbf{E}} \cdot d\vec{\mathbf{l}}$$

   II. +3 pts - correct electric field

      i. +2 pts - for forces acting on charges (Students must include the centripetal acceleration. If they omit the resultant force then they receive 0/3 pts for this section.)

      $$q\,\vec{\mathbf{E}} + q\,\vec{\mathbf{v}} \times \vec{\mathbf{B}} = -\frac{m_q\,v^2\,\hat{r}}{r}$$

      ii. +1 pts - correct expression for the magnitude of the electric field.

      $$E = q\,v\,B + \frac{m_q\,v^2}{r} \quad (\text{with } v = \omega\,r)$$

   III. +1 pt - correct answer for $|\Delta V|$ ($|\Delta V = 9.2 \times 10^{-3}\,V$).

2. Problem 32-7. (**+4 pts**)

   (a) +2 pts

      i. +1 pt for finding the contribution of flux due to the 2A circuit ($\Phi_{1,2}$ - in my notation.)

      ii. +1 pt for calculating the mutual inductance correctly

      $$\Phi_{1,2} = M_{2,1}\,I_{2A} \;\rightarrow\; M_{2,1} = 1 \times 10^{-3}\,H$$

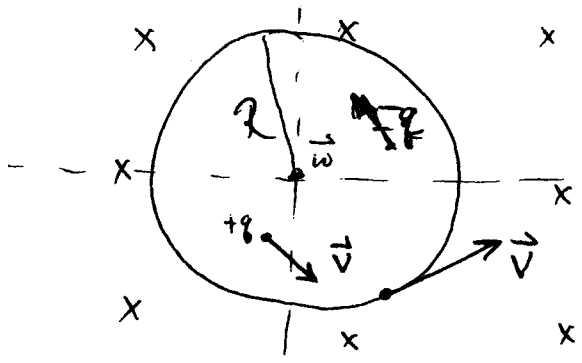
   (b) +2 pts

      i. +1 pt for summing the total flux contributions (self + mutual inductance)

      $$\Phi_2 = M_{2,1}\,I_1 + L\,I_2$$

      ii. +1 pt for correct flux through 2A circuit ($\Phi_2 = 3 \times 10^{-3}\,T\,m^2$)

30-24

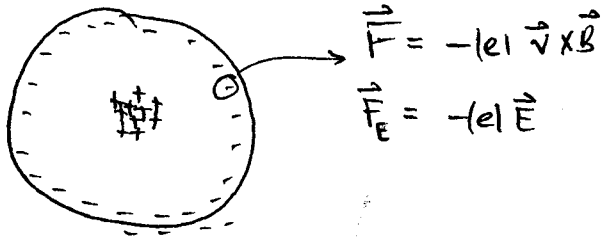


Neutral disc ($n_{+q} = n_{-q}$)

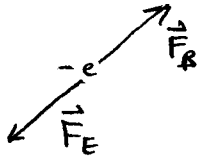
+q will feel a Magnetic force : $\vec{F} = q\vec{v} \times \vec{B}$ → towards center of disc

−q feel a Mag. force → away from center of disc.

Disc



FBD:



$$\Rightarrow \sum F_r = |e|vB - |e|E = -m_e \frac{v^2}{r}$$

electrons are accelerating!!

@ the edge!

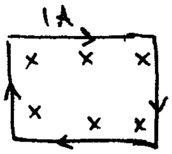
$$\Rightarrow E = \frac{evB}{e} + \frac{m_e v^2}{eR} = \frac{e}{e}\omega R B + \frac{m_e \omega^2 R}{e}$$

$$E(r) = \omega r B + \frac{m_e \omega^2 r}{|e|} = r\left(\omega B + \frac{m_e \omega^2}{|e|}\right)$$

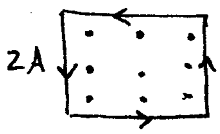
$$\Rightarrow \Delta V(R,0) = -\int \vec{E}\cdot d\vec{l} = -\int_R^0 r\left(\omega B + \frac{m_e \omega^2}{|e|}\right) dr = \frac{1}{2}\omega B R^2 + \frac{1}{2}\frac{m_e \omega^2 R^2}{|e|}$$

$$\Delta V(R,0) = 9.2\times10^{-3}\,V + 7.85\times10^{-11}\,V \simeq 9.2\times10^{-3}\,V$$

32-7



$\Phi_{B_0} = 0.010\ T\cdot m^2$ "isolation"



$\Phi_{B_1} = \Phi_{B_0} + \Phi_{2,1} = 0.012\ T\cdot m^2$

$\Rightarrow \boxed{\Phi_{2,1} = 0.002\ T\cdot m^2}$

(a) $\underset{\text{thru 1}}{\Phi_{2,1}} = M_{2,1} \underset{\text{from 2A}}{I_{2A}} \Rightarrow M_{2,1} = M_{1,2} = \dfrac{\Phi_{2,1}}{2A} = \dfrac{2\times10^{-3}}{2}\ H = \underline{1\times10^{-3}\ H}$ #

(b) $\Phi_2 = M_{2,1} I_1 + L I_2 = (1\times10^{-3}\ H)(1\ A) + (1.0\times10^{-3})\,2\ A = 3\times10^{-3}\ T\cdot m^2$

$\boxed{\Phi_2 = 3\times10^{-3}\ T\cdot m^2}$ with $\underline{L = 1\times10^{-3}\ H}$.