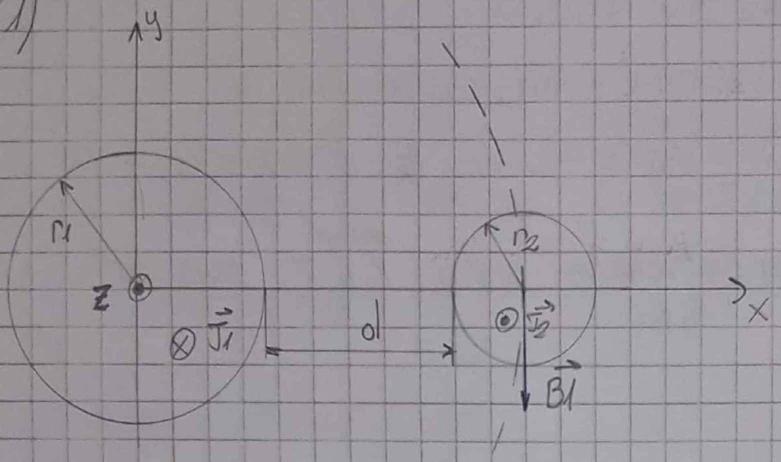
Lugano

1)

$$J = \frac{I}{S} \Rightarrow I = J \cdot S$$



El campo en un conductor infinito

$$\oint_{\ell} \vec{B} \cdot \vec{dl} = \mu_0 I_c \Rightarrow B \int_0^{2\pi} r \, d\theta \cdot 1 = \mu_0 I_c$$

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

$$\Rightarrow B_1 = \frac{\mu_0 \cdot J_1 \cdot \pi \cdot R_1^2}{2\pi (R_1 + d + R_2)} = \frac{\mu_0}{2} \cdot \frac{-13{,}8 \frac{A}{m^2} \cdot (0{,}03m)^2}{(0{,}03m + 0{,}098m + 0{,}08m)}$$

$B_1 = 39{,}412 \ nT \ (-\hat{j})$

B_2 en su propio eje $\Rightarrow \vec{B_2} = 0$ ya que

$\oint_{\ell} \vec{B} \cdot \vec{dl} = \mu_0 I_c$ Pero como la curva está dentro del conductor,

$$\Rightarrow I_C = \int_S \vec{J} \, \vec{ds} = \int_0^{2\pi} d\theta \int_0^{r} r' \, dr' J$$

$$I_C = \int_0^{2\pi} d\theta \int_0^{r} r' dr' \frac{I}{\pi r_2^2} = \frac{I}{\pi r_2^2} \int_0^{2\pi} \frac{r^2}{2}$$

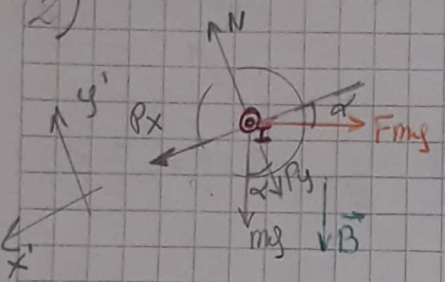
$$J = \frac{I}{S} = \frac{I}{\pi \cdot r_2^2}$$

$$I_C = \frac{\cancel{2\pi} I}{\cancel{\pi} r_2^2} \cdot \frac{r^2}{\cancel{2}} \Rightarrow I_C = \frac{I r^2}{r_2^2}$$

$$\Rightarrow \vec{B} = \frac{\mu_0 I_C}{2\pi r} = \frac{\mu_0}{2\pi \cancel{r}} \cdot \frac{I r^{\cancel{2}}}{r_2^2} = \frac{\mu_0 I r}{2\pi r_2^2} \quad (\text{si } r = 0 \Rightarrow B = 0)$$

Lug 280

2)



$m = 1{,}86\ kg \quad L = 0{,}8\ m \quad \alpha = 28°$

$\vec{B} = 1{,}6\,(-\hat{k})\ T \qquad I = 3{,}1A$

$F_{mg} = I\,\vec{dl} \times B$

$\Rightarrow \Sigma F_{x'} = m \cdot a$

$mg \operatorname{sen}\alpha - F_{mg} \cdot \cos\alpha = m \cdot a$

$\frac{1}{m}\left(mg \operatorname{sen}\alpha - I \cdot L \cdot B \cdot \underset{\operatorname{sen}90°}{1} \cdot \cos\alpha\right) = a$

$\Rightarrow a = \dfrac{1{,}86\ kg \cdot 10\ m/s^2 \cdot \operatorname{sen}28° - 3{,}1\ m \cdot 0{,}8\ m \cdot 1{,}6\ T \cdot \cos 28°}{1{,}86\ kg}$

$a = 2{,}811\ m/s^2$

3)

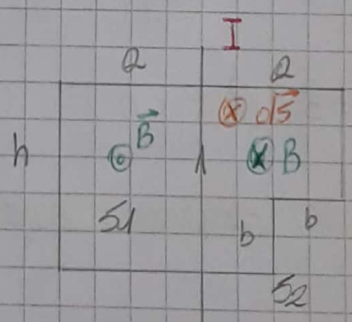
$M = \dfrac{\phi_{mg}}{I}$ Flujo en mi bobina generado por un campo externo por una corriente ext

$\oint_C B \cdot dl = \mu_0 I_C \qquad B \cdot \int_0^{2\pi} r\,d\theta = \mu_0 I \quad \Rightarrow B = \dfrac{\mu_0 I}{2\pi r}$

campo en el conductor

$\cos(180°) = -1$

$\phi = \int_S \vec{B} \cdot \vec{ds} = \int_{S_1} \vec{B} \cdot \vec{ds} + \int_{S_2} \vec{B} \cdot \vec{ds}$

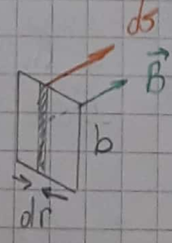


$-S_1 + S_2 = -b^2$ ↳ solo es el area que integro

$S_1 = a \cdot h$

$S_2 = a \cdot h - b^2$

$\phi = \int_{a-b}^{a} \dfrac{\mu_0 I}{2\pi r} \cdot dr \cdot b$



$\phi = \dfrac{\mu_0 I b}{2\pi} \ln\left(\dfrac{a}{a-b}\right)$

$M = \dfrac{\mu_0 b}{2\pi} \ln\left(\dfrac{a}{a-b}\right) = 6{,}44\ nH$

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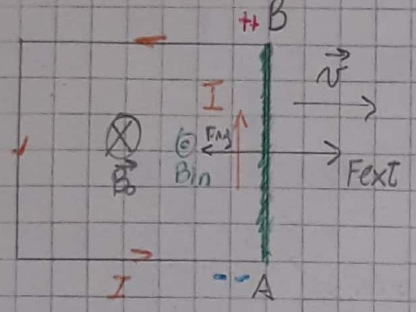
$L = 1{,}6m \quad B_0 = 4T \quad R = 14{,}6\,\Omega$ 2

4) $F_{mg} = I \cdot \vec{dl} \times \vec{B_0}$



La fuerza mg se genera gracias a la corriente inducida por la variación de flujo

$\Rightarrow F_{mg} = F_{ext} = 1N$

$I\,L\,B_0 = 1N \qquad \Rightarrow I = \frac{1N}{L\,B_0} = \frac{5}{32}\,A$

Como la potencia eléctrica es igual a la mecánica

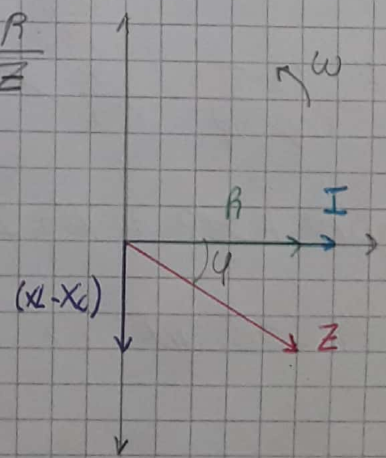
$\Rightarrow P_{el} = P_{mec} \qquad \Rightarrow \mathcal{E} \cdot I = F_{ext} \cdot v = I^2 R = F_{ext} \cdot v$

$\Rightarrow v = \frac{I^2 R}{F_{ext}} = 3{,}56\ m/s = \frac{(5/32\,A)^2 \cdot 14{,}6\,\Omega}{1N}$

5) $V_g = 220V \quad F = 80\,Hz \qquad R = 219\,\Omega \quad L = 0{,}07H$

$FP = 0{,}5 = \cos(\varphi) \qquad \cos(\varphi) = \frac{R}{Z}$

$\Rightarrow Z = \frac{R}{\cos(\varphi)}$



$Z^2 = R^2 + (X_L - X_C)^2$

$(X_L - X_C)^2 = Z^2 - R^2$

$|X_L - X_C| = \sqrt{Z^2 - R^2}$

$\underbrace{-X_L + X_C}_{\text{ya que } X_C > X_L} = \sqrt{Z^2 - R^2} \qquad \Rightarrow X_C = \sqrt{\frac{R^2}{\cos^2(\varphi)} - R^2} + X_L$

$X_C = \sqrt{\frac{219\,\Omega^2}{0{,}5^2} - 219\,\Omega^2} + 2\pi F L$

$180° \to \pi$

$360-47 = 313 \to$

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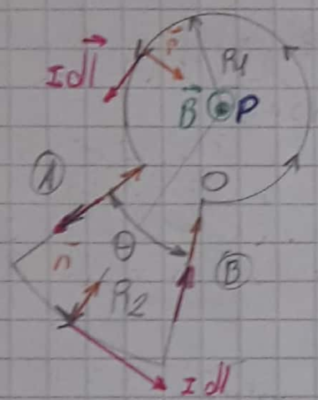
$X_C = 418{,}46\ \Omega \quad \Rightarrow X_C = \frac{1}{2\pi F C} \quad \Rightarrow C = \frac{1}{2\pi F X_C}$

$\Rightarrow C = 4{,}27\ \mu F$

7)



Por ley de Biot savart

$$d\vec B = \frac{\mu_0}{4\pi}\cdot\frac{I\,d\vec l \times \breve r_P}{|\vec r_P|^2}$$

en la sección A y B no se genera campo que incida en P

$$dB_{1p} = \frac{\mu_0}{4\pi}\,\frac{I.\overbrace{d\vec l}^{d\theta R_1}.\overbrace{|\breve r|}^{1}\ \operatorname{sen} 90}{R_1^2} \Rightarrow B_{1P} = \frac{\mu_0 I}{4\pi R_1}\int_0^{\frac{313\pi}{180}} d\theta$$

$$B_{1P} = \frac{\mu_0 I}{4\cancel{\pi} R_1}\cdot\frac{313\cancel{\pi}}{180} \Rightarrow B_{1P} = \frac{\mu_0 I}{R_1}\cdot\frac{313}{720}$$

$$\Rightarrow B_{2P} = \frac{\mu_0 I}{4\pi R_2}\cdot\int_{\frac{313\pi}{180}}^{2\pi} d\theta = \frac{\mu_0 I}{4\pi R_2}\left(2\pi - \frac{313\pi}{180}\right)$$

$$B_{2P} = \frac{\mu_0 I}{4\cancel{\pi} R_2}\cdot\frac{47}{180}\cancel{\pi} \Rightarrow B_{2P} = \frac{\mu_0 I}{R_2}\,\frac{47}{720}$$

$$B_P = B_{1P} + B_{2P} = \mu_0 I\left(\frac{1}{R_1}\,\frac{313}{720} + \frac{1}{R_2}\,\frac{47}{720}\right)$$

$B_P = 14\,532\ nT$

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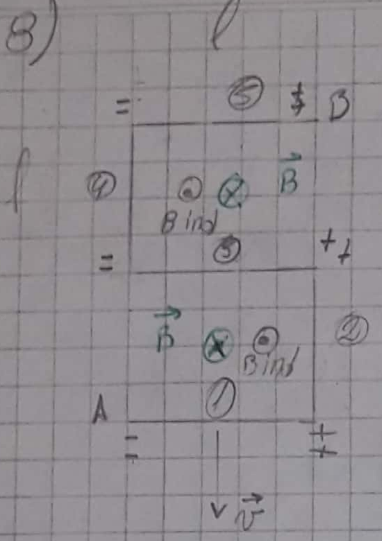
$B = 1{,}2\,T \quad v = 48\ m/s \quad l = 0{,}8\,m$ 3

8)



En ② y ④ no se induce fem ya que se consideran sin area (por lo tanto no tienen variación de flujo)

$$\phi = \int_S \vec{B} \cdot d\vec{S}$$

$$\mathcal{E} = \frac{d\phi}{dt} = \frac{\vec{B} \cdot d\vec{S}}{dt} = \frac{B\, l\, dx}{dt}$$

$$\mathcal{E} = B\, l\, v \quad \text{(en una barra)}$$

$V_A - V_B = +V_1 - V_3 + V_5 \Rightarrow$ como todos tienen la misma fem

$V_A - V_B = \cancel{\mathcal{E}} - \cancel{\mathcal{E}} + \mathcal{E} = \mathcal{E}$

$V_A - V_B = B\, l\, v = 46{,}08\ V$

9) $\eta_c = 1 - \frac{T_L}{T_H} = 1 - \frac{273\,K}{373\,K} = 0{,}268$ $W = 313\ kJ$ por ciclo

$\eta = \eta_c \cdot 0{,}386 = 0{,}1034$ A

$\eta = 1 - \frac{Q_L}{Q_H} = 0{,}1034 \Rightarrow Q_L = (1-\eta)\, Q_H$

$\eta = \frac{W}{Q_H} \Rightarrow Q_H = \frac{W}{\eta} \Rightarrow Q_L = (1-\eta)\frac{W}{\eta} = 2711{,}58\ kJ$

$Q_L = L_F \cdot m = 334\ \frac{kJ}{kg} \cdot m \Rightarrow m = \frac{Q_L}{L_F} = 8{,}12\ kg$

10) $i(t) = \frac{V}{R} \cdot \left[1 - e^{-t/\tau_L}\right]$ $\tau_L = \frac{L}{R} = \frac{0{,}0054}{146\,\Omega}$

$\tau_L = 34{,}24\ \mu s$

$i(0{,}9\,\tau_L) = \frac{62\,V}{146\,\Omega}\left[1 - e^{-0{,}9}\right] = 0{,}252\ A$

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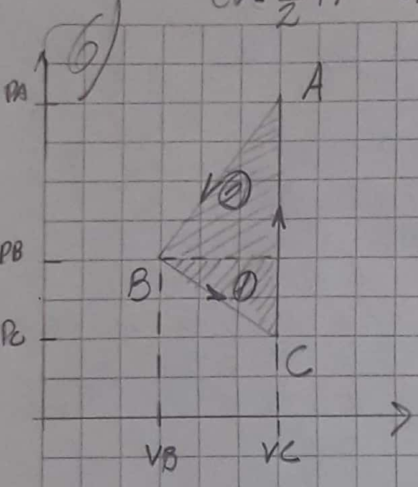
$CV = \frac{3}{2} R \quad Cp = \frac{5}{2} R \quad V_A = 41{,}4\,l \quad V_B = 13{,}9\,l \quad P_A = 158{,}5\ kPa \quad P_B = \frac{2}{3} P_A$

$P_C = \frac{1}{3} P_A$

6)



$$\Delta U_{cic} = Q_c - W_c = 0$$

$$\Rightarrow Q_c = W_c$$

$$W_c = W_1 + W_2 = \frac{(V_A - V_B) \cdot (P_B - P_C)}{2} + \frac{(V_A - V_B)(P_A - P_B)}{2}$$

$W_2 = 1307{,}625$ J

$W_1 = 435{,}875$

$$\Rightarrow W_c = 1743{,}5 \approx 1740\,J$$

$$\Delta U_{bca} = \Delta U_{AB} = CV\,n\,(T_B - T_A) = \frac{3}{2} \cancel{R} \cdot \cancel{n} \left(\frac{P_B\,V_B}{\cancel{n}\,\cancel{R}} - \frac{P_A\,V_A}{\cancel{n}\,\cancel{R}} \right)$$

$$\Delta U_{bca} = \Delta U_{AB} = \frac{3}{2} \left(P_B V_B - P_A V_A \right) =$$