Chapter 31 (29) Faraday

1 - $N = 300$

$r = 8\,cm$

$$\frac{\Delta B}{\Delta t} = \frac{dB}{dt} = \frac{(80-20)*10^{-3}}{(20-01*10^{-3}} = \frac{60}{20} = 3\ T/S$$

$$\mathcal{E} = N\frac{d\phi}{dt} = N * \frac{dB}{dt} * A = 300 * 3 * \pi (8*10^{-2})^2$$

$$\boxed{\mathcal{E} = 18\ Volts}$$

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2 - $N = 40$ $\quad R = 0.20\ \Omega$

$r = 4\,cm$ $\quad B = 50\sin(10\pi t)\ mT$

$t = 0.10$

$$\mathcal{E} = -N\frac{d\phi_B}{dt} = -N\frac{dB}{dt}\cdot A = -40 * -500\pi * \pi * (4*10^{-2})^2$$

$$\boxed{\mathcal{E} = 316*10^{-3}}$$

$$\frac{dB}{dt} = 50 * 10\pi * \cos(10\pi t) * 10^{-3}$$

$$dB \text{ at } t = 0.10 = -500\pi * 10^{-3}$$

$$\boxed{I = \frac{\mathcal{E}}{R} = \frac{316*10^{-3}}{0.2} \approx 1.6\ A}$$

3- $a = 20\ cm \rightarrow A = 0.04$

$\rightarrow B = 2\ T$

$\rightarrow \boxed{wt = 20^\circ} \rightarrow \frac{20 * \pi}{180} = \boxed{0.35\ rad/s^2}$

$w = 10^\circ * \frac{\pi}{180} = 0.175\ rad/s$

$\mathcal{E} = w B A \sin(wt) = 0.175 * 2 * 0.04 * \sin(0.35)$

$\boxed{\mathcal{E} = 4.8 * 10^{-3}\ Volt}$

ب- $R = 2\ m\Omega \quad L = 1.5 \quad D = 6\ cm \quad d = 1\ cm$

$\frac{dI}{dt} = 100\ A/s$

$\boxed{\mathcal{E} = \frac{\mu_0 L}{2\pi} \frac{dI}{dt} \ln\left(\frac{D}{d}\right)} = 5.4 * 10^{-5}\ Volt$

$\boxed{I = \frac{\mathcal{E}}{R} = 27\ mA}$

$\boxed{\text{الكتاب سؤال } 29.7}$

6 - $A(t) = (60 \times 10^{-2} + 20 \times 10^{-3} \times t)(40 \times 10^{-2} - 20 \times 10^{-3} \times t)$

$$\frac{dA}{dt} = -7.2 \times 10^{-3}$$

$$B = 0.5\ T$$

$\frac{d}{dx}$ آلة حاسبة

$$\mathcal{E}_n = -N \frac{d\Phi_b}{dt} = -N B \frac{dA(4)}{dt} = 3.6 \times 10^{-3}\ \text{Volt}$$

7 - $B(t) = 0.5t^2$ $A = (10 \times 10^{-2})^2 = 0.01$

$$\frac{dB}{dt} = t = 4$$ $N = 5$

$$\mathcal{E}_{(4)} = 5 \times \frac{dB}{dt} \times A \times \cos(60) = 0.1\ \text{Volt}$$

$$I = \frac{\mathcal{E}}{R} = \frac{0.1}{4} = 25\ mA$$

8 - $L = 24\ cm$ $A = (24 \times 10^{-2})^2$ $N = 2$

$\varnothing = 30°$ $\frac{\Delta B}{\Delta t} = \frac{dB}{dt} = \frac{6 \times 10^{-3}}{10 \times 10^{-3}} = 0.6\ T/S$

$$\mathcal{E}_n = -N \frac{dB}{dt} A \cos(\varnothing) = -2 \times 0.6 \times (24 \times 10^{-2})^2 \times \cos(30)$$

$$|\mathcal{E}_n| \approx 60\ mV$$

9 -

9 - $n = 1500$

$I = 4 + 3t^2$

$N = 300 \qquad A = 0.15 \qquad \underline{t = 2}$

$$B_{solenoid} = \mu_0 I n$$

$$\frac{dB}{dt} = \mu_0 * 1500 * 6t \rightarrow \underline{t = 2}$$

$$\mathcal{E} = -300 * \frac{dB}{dt} * 0.15 = -1 \text{ volt}$$

$$|\mathcal{E}| = 1 \text{ volt}$$

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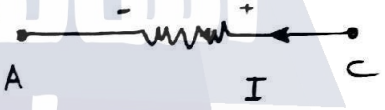
10 - by Faraday Law.

I From C → A



$N = 2 \qquad A = 0.2 \qquad B = 4 + 3t^2 \rightarrow t = 3$

$$|\mathcal{E}| = 2 * \frac{dB}{dt} * 0.2 = 2 * 6(3) * 0.2 = 7.2 \text{ Volt}$$

$$V_C - \mathcal{E} = V_A \rightarrow \boxed{V_A - V_C = -\mathcal{E} = -7.2 \text{ volt}}$$

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11 - $\mathcal{E} = BLV$

$a = 2m \qquad B = 6T$

$R = 40\,\Omega$

$F_g = F_b$

$$M_g = \vec{I}\vec{L}\vec{B}$$

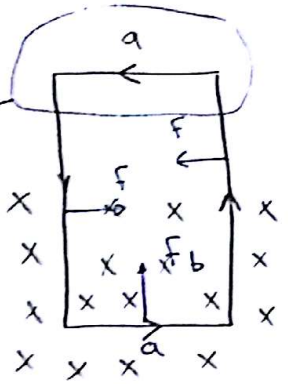
$$9.8 * 0.6 = \frac{\mathcal{E}}{R} * L * B$$

$$9.8 * 0.6 = \frac{B^2 L^2 V}{R}$$

$$V = \frac{9.8 * 0.6 * 40}{6^2 * 2^2}$$

$$\boxed{V \approx 1.6 \text{ m/s}}$$

11 -



لم يدخل المجال

$\Sigma f_x = 0$

$\Sigma f_y = 0$

$f_b = f_g$

على السلك اللي تحت

شرح سؤال 11

12 - $L = 20 * 10^{-3}$

$V = 3$

$B = 60\ \mu T$

$\theta = 30$

$$\mathcal{E} = BVL \sin\theta = 1.8 * 10^{-5}\ Volt$$

13 - $R = 2\ \Omega$ $B = 1.5$ $L = 60\ cm$ $V = 4.2\ m/s$

$$\mathcal{E} = LVB = 3.78\ volt$$

$$P = \frac{V^2}{R} = \frac{(3.8)^2}{2} = 7.1\ Watt$$

14 - $L = 0.1\ m$ $f_b = 0.6\ N$ $V = 2\ m/s$

$I = ?$ $R = 12$

$$\rightarrow f_b = \frac{B^2 L^2 V}{R} \rightarrow 0.6 = \frac{B^2 * (0.1)^2 * 2}{12}$$

$$\rightarrow B = 19\ T \qquad I = \frac{\mathcal{E}}{R} = \frac{BLV}{12}$$

$$I \approx 0.32\ A$$

15 - $L = 80\ cm$ $B = 0.3\ T$ $V = 50 * 10^{-2}\ m/s$

$R = 60 * 10^{-3}$

$$F_b = \frac{B^2 l^2 V}{R} = 0.48 \text{ to the left}$$

16 - $I = 50\ A$ $L = 50 * 10^{-2}$

$r(a) = 4 * 10^{-3}$ $V = 12\ m/s$

$$B = \frac{\mu_0 I}{2\pi a} = 2.5 * 10^{-3}\ T$$

$$\mathcal{E} = BVL = 15 \text{ m Volt}$$

17 - ??

18 - $\omega = 15\ rev/s * 2\pi = 94\ rad/s$

$B = 60 * 10^{-3}$

$R = L = 80\ cm$

at one end

$$\mathcal{E} = \frac{1}{2} \omega * B * R^2 = \underline{1.8 \text{ volts}}$$

19 - $\omega = 10\ rad/s$ $R = L = 80\ cm$

$B = 2 * 10^{-3}$ $\theta = 30°$

$$\mathcal{E} = \frac{1}{2} \omega B R^2 \sin(\theta) = 3.2 \text{ m Volt}$$

20 - $L = 2\,m$ $\quad \omega = 2\,rev/s * 2\pi = 4\pi\ rad/s$

$B = 8 * 10^{-3}$ * through the center

$R = \frac{L}{2} = 1\,m$

$$\mathcal{E} = \frac{1}{2} \omega B R^2 = 0.050 = 50\,mVolt$$

21 - $\omega = 2\,rad/s$ counter - clockwise

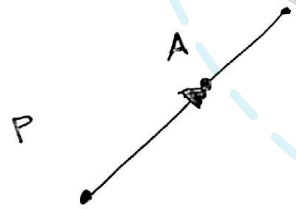
$B = 0.20\,T$ $\quad L = 0.4$

$$\mathcal{E}_{total} = \frac{1}{2} * \omega * B * (L)^2 = 0.032\,Volt$$

$$V_P - V_A = \frac{1}{2} \omega * B * (0.2)^2 = 0.008\,Volt$$

$$V_A - V_B = 0.032 - 0.008 = 0.024\,mVolt$$

22 -



$\omega = 2\,rad/s$

$B = 0.2$ $\quad L = 0.4$

$R = 0.2$

$$\mathcal{E} = \frac{1}{2} \omega B (0.2)^2 = 0.008\,Volt$$

$V_A - V_P = -8\,mV$

من الاتجاه

1 -

$R = 1000\ \Omega$

$I = \frac{1}{3} I_{max}$

$t = 30\ \mu S$

$I = I_{max}(1 - e^{-t/\tau})$

$\frac{1}{3} I_{max} = I_{max}(1 - e^{-t/\tau})$

$\frac{1}{3} = 1 - e^{-t/\tau}$

$\frac{2}{3} = e^{-t/\tau}$

$\frac{2}{3} = e^{\frac{-30 * 10^{-6}}{\tau}}$

$\tau = 7.4 * 10^{-5}$

$\tau = \frac{L}{R}$

$L = \tau * 1000$

$L = 74 * 10^{-3}\ H$

2 - $I = 15\ mA$ $L = 12 * 10^{-3}$ $R = 4000\ \Omega$

$\mathcal{E} = 240\ Volt$

$\frac{dI}{dt} = \frac{\mathcal{E} - IR}{L}$

$V_L = L * \frac{dI}{dt} = L * \frac{\mathcal{E} - IR}{L}$

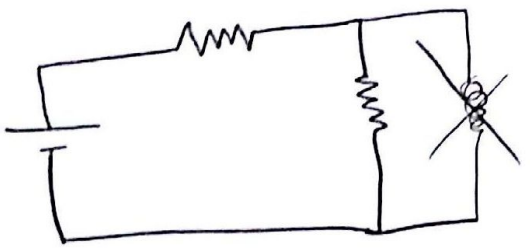
$V_L = 240 - 15 * 10^{-3} * 4000$

$V_L = 180\ volt$

3 - at $t = 0$

المحث عبارة عن مقاومة

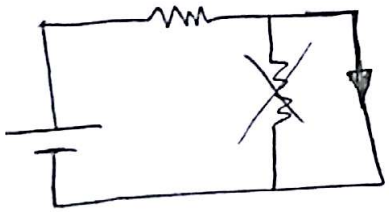
$I = \frac{300}{20 + 40} = 5\ A$



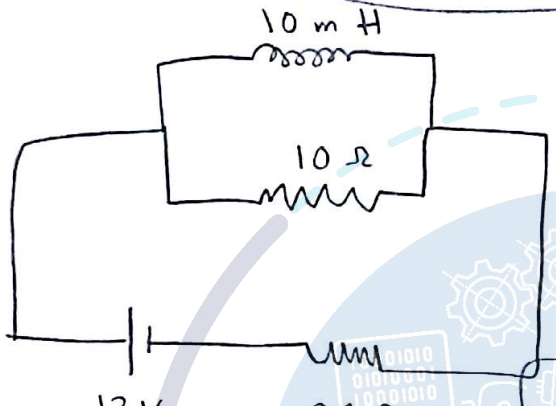
3 - at $t = \infty$

المحث سلك

$$I = \frac{300}{20} = 15\ A$$



4 -



$$I = 0.5$$

$$\frac{dI}{dt} = \frac{\mathcal{E} - IR}{L}$$

$$\frac{dI}{dt} = \frac{12 - 0.5 * 10}{10 * 10^{-3}} = 200\ A/s$$

5 - at $t = 0$ → $I = 0$ ← 0

$$V_{ab} = L\frac{dI}{dt} = \cancel{L} * \frac{\mathcal{E} - \cancel{IR}}{\cancel{L}} = \mathcal{E} = 240\ volt$$

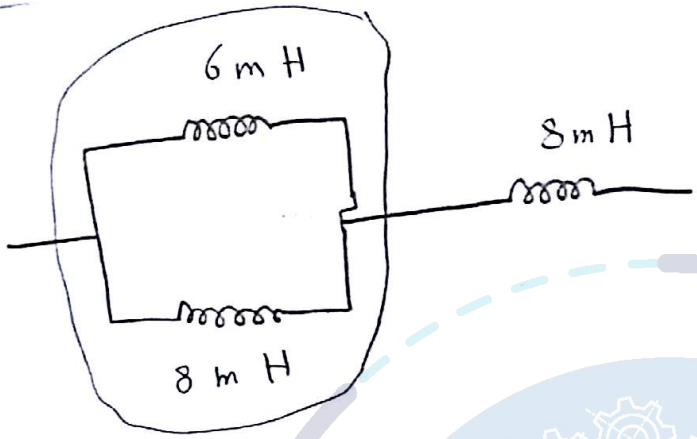
6 - $I = \frac{1}{2} I_{max}$ $\quad t = xT$

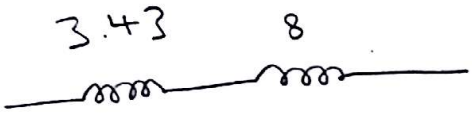
↳ how many time constants

$$\frac{1}{2} = 1 - e^{-x\,\cancel{t}/\cancel{t}} \Rightarrow \frac{1}{2} = e^{-x} \rightarrow \boxed{x = 0.69}$$

7 - $I = \frac{3}{4} I_{max}$ $\boxed{t = x\,\tau}$

$$\frac{3}{4} = 1 - e^{-x\,\tau/\tau} \Rightarrow \frac{1}{4} = e^{-x} \rightarrow \boxed{x = 1.38}$$





$$\frac{1}{6} + \frac{1}{8} = \frac{24}{7} = 3.43\ mH$$

$$3.43 + 8 = 11.4 \approx 11\ m H$$

9 - $u = \frac{B^2}{2\mu_0} = \frac{3^2}{2(4\pi * 10^{-7})} = 3.6 * 10^6$

$B = 3T$

10 - ?

11 - $R = 10\ \Omega$ $\quad \mathcal{E} = 6\ volt$

$L = 10\ m H$

a) $\tau = \frac{L}{R} = 1\ m S$

b) $\frac{99}{100} I_{max} = I_{max}(1 - e^{-t/\tau})$

$$\frac{99}{100} = 1 - e^{-t/1*10^{-3}}$$

$$e^{-t/1*10^{-3}} = \frac{1}{100}$$

$\boxed{t = 4.6\ m S}$