

Chapter 30 7, 15, 17, 40, 47, 53, 63, 69.

7. $\mathcal{E} = -\frac{d\phi_B}{dt}$

(a)

$$B(t) = \frac{\mu_0}{2\pi} \frac{I}{r^2} = \frac{\mu_0}{2\pi} \frac{NI\pi R^2}{r^2}$$

$$\phi_B = \int B \cdot dA = \frac{\mu_0}{2\pi} \frac{NI\pi R^2}{r^2} \cdot \pi r^2 = \frac{\mu_0 \pi I R^2}{2} \frac{N^2}{r^2}$$

(b) $\mathcal{E} = -A \frac{dB}{dt} = -\frac{3}{2} \frac{\mu_0 \pi I R^2 v}{r^4}$

$\therefore \frac{dr}{dt} = v$

(c) counter clockwise sense.

15. $\mathcal{E} = -L \frac{di}{dt}$ $i(t) = \frac{\mathcal{E}}{R} (1 - e^{-\frac{t}{\tau}})$ $\tau = \frac{L}{R}$

(a) $U_B(t) = \frac{1}{2} L i^2(t)$ $\therefore L = -\frac{R \cdot t}{\ln(1 - \frac{R}{\mathcal{E}} i(t))}$

$\therefore L = 45.5 \text{ H}$

(b) $U_B = \frac{1}{2} L i^2(t) = 9.1 \text{ mJ}$

17. $\frac{di}{dt} = 21 \text{ A/s}$

$\mathcal{E} = 25 \text{ mV}$

$\mathcal{E} = M \cdot \frac{di}{dt}$ $\therefore M = 1.19 \text{ mH}$

(b) $M = 1.19 \text{ mH}$

$M_{21} = M = \frac{N_2 \phi_{21}}{i_1}$ $\therefore \phi_{21} = 1.61 \text{ mWb}$

40 (a) $B = \frac{\mu_0 i}{2\pi r}$ $\phi_B = \int B \cdot dA = \int_{r_0(t)}^{r_f(t)} \frac{\mu_0 i}{2\pi r} \cdot 2\pi r \cdot dr$

$\phi_B = \frac{\mu_0 i a}{2\pi} \ln \frac{r_f(t)}{r_0(t)}$ $\therefore \phi_B = 21 \text{ nWb}$

(b) $i(t) = 0.5b + vt$

$r_f(t) = 1.5b + vt$ $\therefore i = \frac{\mathcal{E}}{R} = 15 \mu\text{A}$

$\mathcal{E} = -\frac{\mu_0 a v}{2\pi} \ln \frac{1.5b + vt}{0.5b + vt} = 6.07 \text{ nV}$

47. (a) $d = 12 \text{ cm}$

$$\frac{dB}{dt} = -6.5 \times 10^{-3} \text{ T/s}$$

$$\oint \vec{E} \cdot d\vec{s} = E \cdot 4 = E \cdot 2\pi r = -\pi r^2 \cdot \frac{dB}{dt}$$

$$\therefore E = 137 \text{ } \mu\text{V/m}$$

(b) $r = 10.3 \text{ cm}$

$$E \cdot 2\pi r = -\pi r^2 \cdot \frac{dB}{dt}$$

$$\therefore E = 114 \text{ } \mu\text{V/m}$$

53 (a) $\frac{dB}{dt} = -1.25 \text{ T/s}$

(b) counter clockwise

$$\therefore \mathcal{E} = -2 \text{ m}^2 \times -1.25 \text{ T/s} = 2.5 \text{ V}$$

63

$$\mathcal{E}_{\text{net}} = 14.5 \text{ V}$$

$$L_{23} = \frac{1}{\frac{1}{L_2} + \frac{1}{L_3}} = 16 \text{ mH}$$

$$L_{\text{eq}} = 16 + 5 + 15 = 36 \text{ mH}$$

69.

$$N = 120 \quad \mathcal{E} = -N \frac{d}{dt} \int \vec{B} \cdot d\vec{A}$$

$$\mathcal{E} = NBA \omega \sin(\omega t)$$

$$\phi'(t) = \omega \quad \mathcal{E} = NBA 2\pi f \sin(2\pi f t)$$

$$\mathcal{E}_{\text{max}} = 2\pi f NBA = 8.63 \times 10^3 \text{ V}$$