

Chapter 20 (Bueche & Jerde) *Electromagnetic Induction*

P05. $\phi_B = BA \cos \theta = (0.600)(0.500 \times 0.0600) \cos 40^\circ = 1.38 \times 10^{-3}$ (Wb).

P08. (a) $\phi_s = B_s A_s = 0.030 A_s$ Wb; (b) $\phi_c = B_s A_s = 0.030 A_s$ Wb .

P11. $\Delta \phi = A(B-0) = \pi(0.250^2)(0.4) = 0.0785$ (Wb), so $\varepsilon = N \Delta \phi / \Delta t = 5(0.0785/0.200) = 1.96$ (V).

P16. $\varepsilon = B \Delta A / \Delta t = (8.00 \times 10^{-4})(100 \times 10^{-4}) / 0.120 = 6.67 \times 10^{-5}$ (V).

P18. $\Delta t = NBA / \varepsilon = 400(0.300)\pi(0.060^2) / 6000 = 2.26 \times 10^{-4}$ (s).

P27. $\ell = 25$ cm, $r = 1.0$ cm, $L = 0.2$ mH.
 $N = (L / \mu_0 \ell A)^{1/2} = 1423$, $N = n \ell = (1423)(0.25) = 356$.

P32. $\Delta I / \Delta t = \varepsilon / L = 0.020 / 0.040 = 0.50$ A/s .

P35. $\tau = L / R$, $L = \tau R = \tau (V / I_{max}) = (500 \times 10^{-6})(6.00 / 360 \times 10^{-3}) = 8.33$ (mH) .

P39. $R = 1$ Ω , $\varepsilon = 12$ V, $L = \mu_0 n^2 \ell A = 0.142$ mH & time constant $\tau = L / R = 1.42 \times 10^{-7}$ s. (a) $I = 0.630$ $I_f = 0.630(\varepsilon / R) = 7.56$ mA; (b) $I = 0.865$ $I_f = 10.4$ mA .

P43. $L = 24$ mH, $I = 3$ A & $A \ell = 3.0$ cm³.
 (a) $E = LI^2 / 2 = 0.108$ J; (b) $E / A \ell = B^2 / 2 \mu_0$,
 $B = (2 \mu_0 E / A \ell)^{1/2} = 0.300$ T .

P45. $R = 10$ Ω , $L = 20$ mH & $V = 12$ V. (a) $I_{max} = V / R = 1.20$ A, $E = LI_{max}^2 / 2 = 14.4$ mJ; (b) At $t = \tau$, $I = 0.630 I_{max} = 0.756$ A, $E = 5.72$ mJ; (c) At $t = 2\tau$, $I = 0.865 I_{max} = 1.04$ A, $E = 10.8$ mJ .

P48. $\ell = 1.0$ m, $B = 5.0 \times 10^{-5}$ T & $h = 15$ m. $v_{max} = (2gh)^{1/2} = 17.1$ m/s, $\varepsilon_{max} = Bv_{max} \ell = 0.857$ mV .

P51. $\ell = 1$ m, $B = 6.0 \times 10^{-3}$ T, $v = 1.6$ m/s & $\theta = 60^\circ$. $\varepsilon = Bv \ell \sin \theta = 8.31$ mV .

P53. $f = 120$ rev/s, $N = 300$, $A = 5.0$ cm² & $B = 0.040$ T. $V_0 = 2\pi f ABN = 4.52$ V.
 Thus $V = V_0 \sin(2\pi f t) = 4.52 \sin(240\pi t)$ V.

P58. $f = 120$ rev/s, $N = 500$, $A = 10$ cm \times 20 cm & $B = 0.8$ T. (a) $V_0 = 2\pi f ABN = 6032$ V; (b) $V = V_0 \sin[2\pi(120)(\pi/30)] = -2443$ V; (c) $\sin(2\pi f t) = 1 \Rightarrow t = 1/2f = 2.08 \times 10^{-3}$ s .

P62. $\varepsilon_B = 120$ V. $\varepsilon_{back} = 0$ & $I = 12$ A $\Rightarrow R = 120 / 12.0 = 10.0$ (Ω). $\varepsilon_{back} = \varepsilon B - IR = 120 - (4.00)(10.0) = 80.0$ (V).

P73. $I_1 = I_2 \equiv I$, $dI_1/dt = dI_2/dt = dI/dt$, $V = V_1 + V_2 = L_1 dI_1/dt + L_2 dI_2/dt = (L_1 + L_2) dI/dt \Rightarrow L_{eq} = L_1 + L_2$.

P74. $V_1 = V_2 \equiv V$, $dI_1/dt = dI_2/dt$, $I = I_1 + I_2$, $dI/dt = dI_1/dt + dI_2/dt = V_1/L_1 + V_2/L_2 = V(1/L_1 + 1/L_2) \Rightarrow 1/L_{eq} = 1/L_1 + 1/L_2$.