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[연습문제 답안 이용 안내]

Chapter 01 연습문제 답안

1.1

(a) $\overrightarrow{R_{12}} = 5\vec{a}_x - 5\vec{a}_y + 3\vec{a}_z$

(b) 5

1.2

$\overrightarrow{R_{12}} = (x_2 - x_1)\vec{a}_x + (y_2 - y_1)\vec{a}_y + (z_2 - z_1)\vec{a}_z$

1.3

$\vec{C} = 2\vec{a_x} + \vec{a_y} + 4\vec{a_z}$

$\vec{a_C} = \frac{2}{\sqrt{21}}\vec{a_x} + \frac{1}{\sqrt{21}}\vec{a_y} + \frac{4}{\sqrt{21}}\vec{a_z}$

1.4

$\theta = 45^\circ$

1.5

$\vec{A} \cdot \vec{B} = 4 - 8 + 4 = 0 \quad \therefore \cos\theta = 0 \quad \therefore \theta = \frac{\pi}{2}$

1.6

$x = -2$

1.7

$\therefore A_x = -\frac{4}{3},\ A_z = -\frac{8}{3}$

1.8

$\therefore \vec{C} = 2\sqrt{6}\,\vec{a}_x + \sqrt{6}\,\vec{a}_y + \sqrt{6}\,\vec{a}_z$

1.9

$\vec{F_3} = -5\vec{a_x} - 8\vec{a_y} + 4\vec{a_z}$

1.10

$$\overrightarrow{a_B} = -\frac{1}{3}\overrightarrow{a_x} - \frac{2}{3}\overrightarrow{a_y} + \frac{2}{3}\overrightarrow{a_z}$$

1.11

$$\vec{F} \cdot \overrightarrow{a_B} = \frac{1}{\sqrt{30}}$$

1.12

투영의 크기 및 성분스칼라 값은

$$(\vec{A} \times \vec{B}) \cdot \vec{a}_C = 3.54$$

벡터 $\vec{C}$ 방향으로의 성분벡터는

$$[(\vec{A} \times \vec{B}) \cdot \vec{a}_C] \cdot \vec{a}_C = 2.5\vec{a}_x + 2.5\vec{a}_y$$

1.13

$$S = |\vec{A} \times \vec{B}| = \sqrt{5}$$

1.14

$$(\vec{A} \times \vec{B}) \times \vec{C} = -3\overrightarrow{a_x} - 2\overrightarrow{a_y} + 2\overrightarrow{a_z}$$

$$\vec{A} \times (\vec{B} \times \vec{C}) = \overrightarrow{a_x} - 2\overrightarrow{a_y}$$

1.15

$$\vec{A} \cdot \vec{B} \times \vec{C} = -5$$

$$\vec{A} \times \vec{B} \cdot \vec{C} = -5$$

1.16

증명 생략

1.17

약 17.5

1.18

(a) $12.56[\mathrm{m}^3]$

(b) $52.6[\mathrm{m}^2]$

(c) 약 $5.42[\mathrm{m}^2]$

1.19

$$\overrightarrow{a_L} = \frac{\rho\overrightarrow{a_\rho} - h\overrightarrow{a_z}}{\sqrt{\rho^2 + h^2}}$$

1.20

$$S = \int_0^{2\pi}\int_0^d \rho d\phi dz = 2\pi ad$$

$$V = \int_0^a\int_0^{2\pi}\int_0^d \rho d\rho d\phi dz = \pi a^2 d$$

1.21

점 $P(3, \frac{\pi}{2}, 4)$에서 위 벡터는 $\overrightarrow{R} = 3\overrightarrow{a_\rho} + 4\overrightarrow{a_z}$ 이다. 따라서 원통의 측면에 수직한 성분벡터는 $3\overrightarrow{a_\rho}$이며, 평행한 성분벡터는 $4\overrightarrow{a_z}$이다.

1.22

구 표면의 미소면적 $S = 64\pi[\mathrm{m}^2]$

구의 미소체적 $V = 85.3\pi[\mathrm{m}^3]$

1.23

$$V = \frac{8}{3}\pi[\mathrm{m}^3]$$

1.24

(a) $V \doteq 8.46[\mathrm{m}^3]$

(b) $S \doteq 7.25[\mathrm{m}^2]$

1.25

$$\overrightarrow{B} = -\rho\overrightarrow{a_\phi} + z\overrightarrow{a_z}$$

1.26

$$\overrightarrow{B} = \frac{x}{x^2+y^2+z^2}\overrightarrow{a_x} + \frac{y}{x^2+y^2+z^2}\overrightarrow{a_y} + \frac{z}{x^2+y^2+z^2}\overrightarrow{a_z}$$

Chapter 02 연습문제 답안

2.1

$Q_1 = Q_2 = 3[\mathrm{C}]$

2.2

$\overrightarrow{F_2} = 0.144\overrightarrow{a_x} + 0.108\overrightarrow{a_z}[\mathrm{N}]$

2.3

$\overrightarrow{E} = 1.2\overrightarrow{a_x} + 7.4\overrightarrow{a_y}[\mathrm{V/m}]$

2.4

$\overrightarrow{E} = 43.2\overrightarrow{a_x} + 57.6\overrightarrow{a_y}$

2.5

$\overrightarrow{E} = \frac{\rho_L}{2\pi\epsilon_0 R}\overrightarrow{a_R} = -172.8\overrightarrow{a_y} + 86.4\overrightarrow{a_z}[\mathrm{V/m}]$

2.6

$V = 1.884[\mathrm{V}]$

2.7

$\overrightarrow{E} = \frac{2}{\epsilon_0} \times 10^{-9}\overrightarrow{a_z}[\mathrm{V/m}]$

2.8

$\overrightarrow{E} = -\frac{4.5}{\epsilon_0} \times 10^{-6}\overrightarrow{a_y}[\mathrm{V/m}]$

2.9

$Q = 16[\mathrm{C}]$

2.10

$y = 2x$

2.11

$\frac{1}{\epsilon_0}$

2.12

(a) $24[\mu C] \times \frac{1}{4} = 6[\mu C]$

(b) $24[\mu C]$

(c) $12[\mu C]$

2.13

(a) $\psi = 20\pi = 62.8[\mu C]$

(b) $\psi = 10.5[\mu C]$

(c) $\psi = 31.4[\mu C]$

2.14

$\psi = 33.5\,[C]$

2.15

(a) $-0.9\overrightarrow{a_x} + 0.68\overrightarrow{a_y} + 1.1\overrightarrow{a_z}\,[nC/m^2]$

(b) $-0.57\overrightarrow{a_x} + 0.43\overrightarrow{a_y}\,[nC/m^2]$

(c) $-15\overrightarrow{a_x}[nC/m^2]$

2.16

$0.38\overrightarrow{a_x} + 0.51\overrightarrow{a_y}\,[nC/m^2]$

2.17

$4\pi[C\,]$

2.18

$15\overrightarrow{a_\rho}\,[C/m^2]$

2.19

$4\pi[\mathrm{C}] = 12.56[\mathrm{C}]$

2.20

(a) $\overrightarrow{D} = 0$

(b) $\overrightarrow{D} = 44.4\overrightarrow{a_r}[\mu\mathrm{C/m^2}]$

2.21

$\rho_v = 35[\mathrm{C/m^3}]$

2.22

약 $4[\mathrm{nC}]$

2.23

$z = -\frac{1}{2}$

2.24

$18[\mathrm{C}]$

2.25

$-200[\mathrm{pJ}]$

2.26

$V \doteq -3.13[\mathrm{V}]$

2.27

$V_{AB} = 17.98[\mathrm{V}]$

2.28

(a) $10[\mathrm{V}]$

(b) $10[\mathrm{V}]$

(c) $-2[\mathrm{V}]$

2.29

(a) $36[\mathrm{V}]$

(b) $-54[\mathrm{V}]$

(c) $6.17[\mathrm{V}]$

2.30

$\vec{E} = -6\vec{a_x} + 12\vec{a_y} + 8\vec{a_z}\ [\mathrm{V/m}]$

$\nabla \cdot \vec{D} = \rho_v = -53.1\ [\mathrm{pC/m^2}]$

2.31

$4[\mathrm{V/m}]$

2.32

$400[\mathrm{J}]$

2.33

$10[\mathrm{V}]$

2.34

(a) $V_a \doteq 1261[\mathrm{V}]$

(b) $V_a = 450[\mathrm{V}]$

(c) $V_a = 810[\mathrm{V}]$

2.35

$V \doteq 793[\mathrm{V}]$

2.36

$V_{12} = V_1 - V_2 = (p_{11} - 2p_{12} + p_{22})Q$

2.37

$10\epsilon_0$

2.38

$W = -9[\mathrm{mJ}]$

2.39

$$W = W_k + W_p = -\frac{e^2}{8\pi\epsilon_0 r}$$

Chapter 03 연습문제 답안

3.1

$N \doteq 6.25 \times 10^{18}$개

3.2

$I = 48[A]$

3.3

$\therefore \nabla \cdot \vec{J} = -\frac{\partial \rho_v}{\partial t}$: 전류밀도의 발산은 체적전하밀도의 시간적 변화율과 같다.

3.4

$J = 120 \times 10^{12}[\mathrm{A/m^2}]$

3.5

$R = 19.9[\Omega]$

3.6

$v = \frac{10^5}{1.602 \times 10^8} = 6.24 \times 10^{-5}[\mathrm{m/s}]$

3.7

$J = 100[\mathrm{kA/m^2}],\ \sigma = 0.42 \times 10^{-3}[\mathrm{S/m}]$

3.8

$P = 410[\mathrm{C/m^2}],\ \chi_e = 29$

3.9

$E = \frac{P}{\chi_e \epsilon_0} = \frac{150}{9 \times 8.854 \times 10^{-12}} = 1.88 \times 10^{12} V/m$

3.10

$E_{t1} = E_{t2},\ D_{n1} = D_{n2}$

3.11

$$\frac{\tan\theta_1}{\tan\theta_2} = \frac{\epsilon_1}{\epsilon_2}$$

3.12

$$\vec{E}_2 = -3\vec{a_x} + 4\vec{a_y} - \vec{a_z}[\mathrm{V/m}]$$

3.13

$$\vec{P_2} = \frac{3}{4}\vec{D}_2 = -79.5\vec{a_x} + 106.3\vec{a_y} - 26.6\vec{a_z}[nC/m^2]$$

3.14

증명 생략

3.15

$w_1 = 256.8[\mathrm{pJ/m^3}]$, $w_2 = 460.4[\mathrm{pJ/m^3}]$, $W_2 = 3.7[\mathrm{nJ}]$

3.16

$\theta_2 \doteq 40.9^\circ$

3.17

$\vec{P} \doteq 1.5[\mathrm{C/m^2}]$

3.18

n배

3.19

$$C = \frac{Q}{V_a} = 4\pi/\left[\left(\frac{1}{a} - \frac{1}{r}\right)\frac{1}{\epsilon_1} + \frac{1}{r\epsilon_0}\right]$$

3.20

$$R = \frac{1}{2\pi\sigma L}\ln\frac{b}{a}[\Omega]$$

3.21

$\therefore Q_1 = 1[\mathrm{C}]$

3.22

$R = 200[\Omega]$

3.23

$W = 24.2[\mathrm{mJ}]$

3.24

$V \doteq 41.42[\mathrm{V}]$

3.25

$V = -60[\mathrm{V}]$

3.26

$k = -\frac{5}{3}$

3.27

$\vec{E} = 3.08\vec{a_r} + 2.29\vec{a_\theta}[\mathrm{kV/m}]$

3.28

$\vec{E} = 24.9\vec{a_z}$

Chapter 04 연습문제 답안

4.1

$$\vec{H} = K_{\phi}\vec{a}_z$$

4.2

$$\vec{H} = \frac{a^2 I}{(z^2 + a^2)^{3/2}}\vec{a}_z$$

4.3

$$\vec{H} = \frac{I}{2\pi\rho}\vec{a}_{\phi} = \frac{30}{2\pi \times 5}\vec{a}_{\phi} = \frac{3}{\pi}\vec{a}_{\phi}[\mathrm{A/m}]$$

4.4

$$\vec{H} = \frac{I}{2\pi R}\vec{a}_R = 0.08\vec{a}_x - 0.06\vec{a}_z[\mathrm{V/m}]$$

4.5

$$\vec{H} = -0.83\vec{a}_x[\mathrm{A/m}]$$

4.6

$$H = 3[\mathrm{A/m}]$$

4.7

$$H = \frac{\sqrt{3}}{\pi}[\mathrm{A/m}]$$

4.8

$$H = \frac{\sqrt{3}}{6\pi}[\mathrm{A/m}]$$

4.9

(a) $H = 0.128[\mathrm{A/m}]$

(b) $\vec{H} = \frac{I}{2a}\vec{a}_z = 0.25a_z$

4.10

$$\frac{a}{b}=\frac{1}{4}$$

4.11

$$a=\frac{1}{2}[\mathrm{m}]$$

4.12

$$\vec{H}_{z=1}=5\vec{a}_x[\mathrm{A/m}]$$
$$\vec{H}_{z=-1}=0$$

4.13

(a) $-3<y<3$ 에서는 $\vec{H}=-2\vec{a}_z[\mathrm{A/m}]$

(b) $y<-3$ 의 경우 $\vec{H}=0[\mathrm{A/m}]$

(c) $y>3$ 의 경우 $\vec{H}=0[\mathrm{A/m}]$

4.14

$$H=\frac{NI}{d}a_z=\frac{250\times 4}{10}=100a_z[\mathrm{A/m}]$$

4.15

$$\vec{H}\doteq 5308[\mathrm{A\cdot t/m}]$$

4.16

증명 생략

4.17

증명 생략

4.18

$$|J|=\sqrt{2}[\mathrm{A/m^2}]$$

4.19

(a) $4\vec{a}_\phi[\mathrm{A/m^2}]$

(b) $-\frac{1}{4}\vec{a}_\phi[\mathrm{A/m^2}]$

4.20

증명 생략

4.21

증명 생략

4.22

$\nabla \times \vec{H} = \vec{J} \equiv 0$

4.23

(a) $a < \rho < b$: $\vec{H} = \frac{I}{2\pi\rho}\vec{a}_\phi \quad J = 0$

(b) $\rho < a$: $\vec{H} = \frac{I\rho}{2\pi a^2}\vec{a}_\phi, \quad \vec{J} = \frac{I}{\pi a^2}$

4.24

(a) $\vec{B} = 0.5[\mathrm{mT}]$

(b) $\Phi = 1[\mu\mathrm{Wb}]$

(c) $\Phi = 0.25[\mu\mathrm{Wb}]$

(d) $\Phi = \int \vec{B} \cdot d\vec{S} = \int_0^1 \int_a^\infty \frac{\mu_0 I}{2\pi\rho}\vec{a}_\phi \cdot d\rho dz\vec{a}_\phi \rightarrow \infty$ 발산

4.25

$\Phi = \frac{\mu_0 Ia}{2\pi}\ln 2$

4.26

0

4.27

$V_{m\,.ab} = -\int_b^a \vec{H} \cdot d\vec{L} = -\int_0^{-\frac{250\pi}{180}} 70 d\rho = -70 \times \frac{-250\pi}{180} = 305[A]$

4.28

$V_m = -\frac{I}{2\pi}\phi$, 자계는 P_1 점에서 P_2로 향한다.

4.29

(a) $\vec{B} = 4\vec{a}_x + \vec{a}_z [\mathrm{Wb/m^2}]$

(b) $\Phi = 4[\mathrm{Wb}]$

4.30

(a) $\vec{H} = \frac{4\rho}{\mu_0}\vec{a}_\phi$

(b) $\frac{16\pi}{\mu_0}[\mathrm{A}]$

(c) $40[\mathrm{Wb}]$

4.31

증명 생략

Chapter 05 연습문제 답안

5.1

$$\vec{F} = -6\vec{a_x} - 12\vec{a_y} - 6\vec{a_z}[\mathrm{N}]$$

5.2

$$v_0 = -\frac{3}{5}[\mathrm{m/s}]$$

5.3

$$\vec{F} = \frac{\mu_0 I_1 I_2 a}{2\pi}\left[\frac{1}{\rho + a} - \frac{1}{\rho}\right]\vec{a}_\rho$$

5.4

$$\vec{F} = -4\vec{a}_x[\mathrm{nN}]$$

5.5

$$2\sqrt{3}[\mathrm{N}]$$

5.6

$$\left(7.5\vec{a_x} - 1.5\vec{a_z}\right) \times 10^{-18}[\mathrm{N}]$$

5.7

$$\vec{F}_2 = \frac{\mu_0 I_1 I_2}{2\pi d}\vec{a}_y, \quad \vec{F}_1 = \frac{\mu_0 I_1 I_2}{2\pi d}(-\vec{a}_y)$$

5.8

(a) $\vec{F} = -16\vec{a_z} - 32\vec{a_y}[\mathrm{mN}]$

(b) $\vec{F} = 0$

5.9

(a) $\vec{T} = -8\vec{a_x} + 16\vec{a_y} + 16\vec{a_z}[\mathrm{mN \cdot m}]$

(b) $\vec{T} = -8\vec{a_x} + 16\vec{a_y} + 16\vec{a_z}[\mathrm{mN \cdot m}]$

5.10

(a) $\Delta F = 3.2a_x - 6.4a_z[\mathrm{N}]$

(b) $\Delta T = \Delta m \times B = -0.15a_x - 0.2a_y[\mathrm{N \cdot m}]$

5.11

(a) $\vec{M} = 2080[\mathrm{A/m}]$

(b) $M = 135[\mathrm{A/m}]$

(c) $M = 18.73[\mathrm{A/m}]$

5.12

(a) $H = 9.5[\mathrm{A/m}]$

(b) $H = 38.2[\mathrm{A/m}]$

5.13

$127.2[\mathrm{A/m^2}]$

5.14

$M \doteq 1.2 \times 10^6[\mathrm{A/m}]$

5.15

$B_2 = 10a_x - 2a_y + 3a_z[\mathrm{mT}]$

5.16

(a) $37.7a_x[\mu\mathrm{T}]$

(b) $B_{n1} = 5.2a_x - 13a_y[\mu\mathrm{T}]$

(c) $H_{t1} = \frac{B_{t1}}{\mu_0} = 2.6a_x + a_y[\mathrm{A/m}]$

(d) $H_2 = 2.7a_x + 0.74a_y[\mathrm{A/m}]$

5.17

$\theta_2 = \tan^{-1}\left(\frac{1}{4\sqrt{3}}\right) \doteq 8.2^\circ$

5.18

$$H = \frac{B}{\mu_0} = \frac{3.1 \times 10^{-3}}{4\pi \times 10^{-7}} \doteq 2468[A \cdot t/m]$$

5.19

(a) $V_{mg} = 5300$

(b) $V_{ms} = 44$

(c) $I = 3.56[\mathrm{A}]$

5.20

약 2배

5.21

자속은 $\frac{1}{1.5}$ 배

5.22

$V_{mg} = R_g \Phi = 4 \times 10^6 \times 4 \times 10^{-4} = 1600[A \cdot t]$

$V_{ms} = Hd = 200 \times 2\pi \times 0.1 = 125.6[A \cdot t/m]$

공극에서의 기자력이 매우 크다.

5.23

(a) $W_H = 5 \times 10^{-12}[\mathrm{J}]$

(b) $L = \frac{\mu_0}{8\pi} = 0.5 \times 10^{-7}[\mathrm{H/m}]$

5.24

(a) $L = 0.2[\mu\mathrm{H/m}]$

(b) $W_H = 4 \times 10^{-7}[\mathrm{J}]$

(c) $W_H \doteq 11 \times 10^{-7}[\mathrm{J}]$

5.25

증명 생략

5.26

$$M_{12} = \frac{\Phi_{12}}{I_1} = \frac{\mu\pi a^2 b^2}{2h^3}$$

5.27

$$L = 4\pi \times 10^{-2}[\mathrm{H}]$$

$$W_H = 2\pi[\mathrm{J}]$$

Chapter 06 연습문제 답안

6.1

$V_{emf} = 100[\mathrm{V}]$

6.2

$V_{emf} = -150[\mathrm{mV}]$

6.3

$E_{\phi} = -\frac{1}{2}kB_1 e^{kt}\rho$

6.4

$E = -\frac{1}{2}kB_0 e^{kt}\rho a_{\phi}$

6.5

$50[\mathrm{V}]$

6.6

$V_{emf} = -300\times 10^{-6}[\mathrm{V}]$

6.7

$18\sin 360t[\mathrm{mV}]$

6.8

$J_{\phi} = 3029\cos(2\pi\times 10^{6})t[\mathrm{A/m^2}]$

6.9

$V_{emf} = -B_0 v_0 L$

6.10

$\vec{E}_m = v_0 B_0 a_x$

$V_{emf} = -B_0 v_0 L$

6.11

$V_{emf} = 19.2\sin 10^6 t[\mathrm{V}]$

6.12

$\vec{E}_m = 80\vec{a}_y[\mathrm{mV/m}]$

$V_{emf} = -4.8[\mathrm{mV}]$

6.13

$480\sin\left(10^6 t - \frac{y}{2}\right)\sin\frac{y}{2}[\mathrm{V}]$

6.14

$J_d = 22\cos 10^5 t[\mathrm{mA/m^2}]$

6.15

$J_d = \frac{\partial D}{\partial t} = 10\omega\epsilon_0\cos(\omega t - 20y)a_x$

$H_z = \int 10\omega\epsilon_0\cos(\omega t - 20y)dy = -0.5\omega\epsilon_0\sin(\omega t - 20y)$

6.16

$f = \frac{\sigma}{2\pi\epsilon_0} \doteq 1.8\times 10^{15}[Hz]$

6.17

구리 : $f = 300MHz,\ \frac{\sigma}{\omega\epsilon} = 40.2\times 10^8$

바닷물 : $f = 300MHz,\ \frac{\sigma}{\omega\epsilon} = 7.5$

Chapter 07 연습문제 답안

7.1

$$E_{xs} = E_{x0} e^{-\alpha z} e^{-j\beta z}$$

7.2

$$\overrightarrow{v(t)} = 20\, e^{60^\circ}$$
$$\overrightarrow{i(t)} = 30\, e^{-60^\circ}$$

7.3

$$E_x = E_{x0}\cos(\omega t + \theta_x)$$

7.4

$$H_y = 20\cos(\omega t - 0.5x - \pi)$$

7.5

$$\nabla \times \vec{E}_s = -j\omega\mu\vec{H}_s$$
$$\nabla \times \vec{H}_s = \vec{J}_s + j\omega\epsilon\vec{E}_s$$

7.6

증명 생략

7.7

$$\vec{H} = \sqrt{\frac{\epsilon_0}{\mu_0}}\, E_{x1}\cos(\omega t - \beta z)\vec{a}_y + \sqrt{\frac{\epsilon_0}{\mu_0}}\, E_{x2}\sin(\omega t + \beta z)\vec{a}_x [\mathrm{A/m}]$$

7.8

$$v = 10^8 [\mathrm{m/s}],\ f = 10[\mathrm{MHz}]$$

7.9

$$v = \frac{1}{9}c,\quad \lambda = \frac{1}{9}\lambda_0,\quad \eta = \frac{1}{9}\eta_0$$

7.10

$$\vec{H}(x,t) = 0.2\,e^{-\alpha z}\cos\left(\omega t - 0.5x - \frac{\pi}{3}\right)\vec{a}_z$$

7.11

$$\epsilon_R = 9,\ \ f = 0.48\times 10^8[\mathrm{Hz}],\ \ \vec{H} = \frac{1}{2\pi}cos(\omega t - 3z)\vec{a}_y - \frac{2}{\pi}sin(\omega t - 3z)\vec{a}_x[\mathrm{V/m}]$$

7.12

$$f_c = 1.5[\mathrm{GHz}],\quad \tan\theta = 5\times 10^2$$

7.13

$$\delta_{f_1} = \frac{1}{10^3},\qquad \delta_{f_2} = \frac{1}{10^4},\qquad \delta_{f_3} = \frac{1}{10^6}$$

가 되어 표피두께는 $1/\sqrt{f}$ 에 반비례한다.

7.14

$\therefore e^{-4z} = 0.01$ 에서 $z \doteq 1.15[\mathrm{m}]$

7.15

$$\alpha = \frac{1}{\sqrt{3}}\beta = 0.346[\mathrm{Neper/m}],\quad \delta = \frac{1}{\alpha} = 2.89[\mathrm{m}]$$

7.16

손실탄젠트는 $\frac{\sigma}{\omega\epsilon} = 8.9\times 10^2$, $\delta = 0.25[\mathrm{m}]$, $\lambda = 1.6[\mathrm{m}]$, $v = 1.6\times 10^6[\mathrm{m/s}]$

7.17

$$\delta \doteq 0.13\times 10^{-4}[\mathrm{m}],\ \ H_y = 3\times 10^{-2}e^{-8\times 10^4 z}\sin(2\pi\times 10^6 t - 8\times 10^4 z)[\mathrm{A/m}]$$

7.18

(a) $E_x = 800\,e^{-2z}\cos(\omega t - 10z)$

(b) $\lambda = 0.628[\mathrm{m}]$, f $\doteq 4\times 10^8[\mathrm{Hz}]$

(c) $294[\mathrm{V/m}]$

7.19

(a) $v = 0.34 \times 10^8 [\mathrm{m/s}]$

(b) $\beta = 55.5[\mathrm{rad/m}]$

(c) $\lambda = 0.113[\mathrm{m}]$

(d) $\eta = 42.7[\Omega]$

(e) $E_x = 427\cos(6\pi \times 10^8 t - 55.5z)$, $H_y = 10\cos(6\pi \times 10^8 t - 55.5z)$

7.20

증명 생략

7.21

(a) $\epsilon_R \doteq 0.76$, $\eta = \sqrt{\frac{\mu_0 \mu_R}{\epsilon_0 \epsilon_R}} \doteq 498[\Omega]$

(b) $S_{zave.} = \frac{1}{2\eta} E_{x0}^2 \doteq 0.1[\mathrm{W/m^2}]$

7.22

$\vec{E}_{xsr} = -3e^{j3z}\vec{a}_x[\mathrm{V/m}]$, $\vec{E}_{xtr} = 6e^{-j6z}\vec{a}_x[\mathrm{V/m}]$

7.23

$$E_{xr} = \frac{100}{3}\cos\left(10^6 t + \frac{1}{3} \times 10^{-2} z\right)[\mathrm{V/m}] \quad , \quad H_{yr} = -\frac{100}{360\pi} cos\left(10^6 t + \frac{1}{3} \times 10^{-2} z\right)[\mathrm{A/m}]$$

$$E_{xt} = \frac{400}{3} cos\left(10^6 t - \frac{4}{3} \times 10^{-2} z\right)[\mathrm{V/m}], \quad H_{yt} = \frac{400}{720\pi} cos\left(10^6 t - \frac{4}{3} \times 10^{-2} z\right)[\mathrm{A/m}]$$

7.24

(a) $\omega t = 2\pi f t = 300\pi \times 10^9 t$, $\beta \doteq 10.6 \times 10^8 [\mathrm{rad/m}]$

(b) $\Gamma = -\frac{1}{2}$, $\tau = 1 + \Gamma = \frac{1}{2}$

7.25

(a) $E_{yi} = 30\sin(\omega t - \beta z)$

(b) $H_{xr} = -\frac{1}{4\pi}\sin(\omega t + \beta z)[\mathrm{A/m}]$

(c) 0

7.26

(a) $\Gamma = 0.5, \quad \tau = 1.5$

(b) 전계의 입사파 $E_{xi} = 200[\mathrm{V/m}]$

자계의 입사파 $H_{yi} = 4[\mathrm{A/m}]$

전계의 반사파 $E_{xr} = 100[\mathrm{V/m}]$

자계의 반사파 $H_{yr} = -2[\mathrm{A/m}] (\because \mathrm{a_x} \times -\mathrm{a_y} = \mathrm{a_z})$

전계의 투과파 $E_{xt} = 300[\mathrm{V/m}]$

자계의 투과파 $H_{yt} = 2[\mathrm{A/m}]$

(c) 전력밀도 $S_{iave.} = 400[\mathrm{W/m^2}],$

$S_{rave.} = 100[\mathrm{W/m^2}],$

$S_{tave.} = 300[\mathrm{W/m^2}]$

Chapter 08 연습문제 답안

8.1

$R_C = 1.5[\Omega]$

$\beta = 24.32[\mathrm{rad/m}]$

$v = \frac{\omega}{\beta} = 1.3 \times 10^8 [\mathrm{m/s}]$

8.2

$L = 6.25 \times 10^{-5}[\mathrm{H}],\ C = 2.78 \times 10^{-9}[\mathrm{F}]$

8.3

$V(z,t) = 2\,V_m \cos\beta z \cos\omega t$

8.4

$c = \frac{C}{L} = \frac{2\pi\epsilon}{\ln(b/a)},\quad l = \frac{\mu_0}{2\pi} ln \frac{b}{a}$

8.5

$c = 0.184[\mathrm{nF/m}]$

$l = 0.14[\mu\mathrm{H/m}]$

8.6

$g = r = 0,\ c = 8[\mathrm{pF/m}],\ l = 20[\mathrm{nH/m}]$

8.7

$g = 5 \times 10^{-4}[\mathrm{S/m}],\ c = 5.97[\mathrm{pF/m}],\ r = 3.2[\Omega/\mathrm{m}],\ l = 38.2[\mathrm{nH/m}]$

8.8

$v = 0.5 \times 10^8 [\mathrm{m/s}]$, $\beta = 4\pi[\mathrm{rad/m}],\ c = 3.33 \times 10^{-10}[\mathrm{F/m}],\ Z_C = 60[\Omega]$

8.9

$w = 3.8 \times 10^{-3}[\mathrm{m}]$

8.10

$c \doteq 26.54[\mathrm{pF/m}]$
$l \doteq 66.4[\mathrm{nH/m}]$

8.11

증명 생략

8.12

증명 생략

8.13

손실이 있을 때 $\alpha = 1.19 \times 10^{-2}[\mathrm{Np/m}], \beta = 3.44[\mathrm{rad/m}], \hat{Z}_C = 54.77 \angle -0.198^\circ [\Omega]$
$v = 1.83 \times 10^8[\mathrm{m/s}]$
손실이 없는 경우에는 $\alpha = 0, \beta = 3.44[rad/m], \hat{Z}_C = 54.77[\Omega], v = 1.83 \times 10^8[m/s]$이다.

8.14

$R_C = 80[\Omega], v = 62.5[\mathrm{m}/\mu\mathrm{s}], \Gamma_S = 0.3, \Gamma_L = -1$

8.15

$R_C = 80[\Omega], v = 62.5[\mathrm{m}/\mu\mathrm{s}], \Gamma_S = 0.3, \Gamma_L = -1$

8.16

$\hat{\Gamma}_L = 0.4 + j0.2$

8.17

$\hat{Z}_{in}(0) = (5.24 - j1.6) \times 10^4[\Omega]$

8.18

$\hat{Z}_{in}(0) = 53.3 - j51.5[\Omega]$

8.19

$$\hat{V}(0) = \hat{V}_m^+ [1 + \hat{\Gamma}(0)] = 2.14 \angle 120.13^\circ$$

$$\hat{V}(L) = \hat{V}_m^+ e^{-j\beta L} [1 + \hat{\Gamma}(L)] = 4.93 \angle -409.12^\circ$$

$$V(0,t) = 2.14\cos(6.28 \times 10^8 t + 120.13^\circ)$$

$$V(L,t) = 4.93\cos(6.28 \times 10^8 t - 49.12^\circ)$$

8.20

증명 생략

8.21

$$Y_{in} = Y_C \frac{Y_L + j Y_C \tan\beta L}{Y_C + j Y_L \tan\beta L}$$

8.22

$$V_{in} = 5\cos\left(\omega t + \frac{\pi}{6}\right)[\mathrm{V}]$$

8.23

(a) $\hat{Z}_{in} = 25[\Omega]$

(b) $\hat{I}_{in} = 4[\mathrm{A}]$

(c) $I(z = 1.5) = 2\sqrt{3} - j1[\mathrm{A}]$

(d) $I(z = 3) = -j2[\mathrm{A}]$

8.24

(a) $VWSR = 3 + 2\sqrt{2}$

(b) $\hat{Z}_L = 60 + j120[\Omega]$

8.25

(a) $\beta = \frac{\pi}{\Delta z} = 5\pi[\mathrm{rad/m}]$

(b) $\hat{\Gamma}_L = -j0.5$

(c) $\hat{Z}_L = 30 - j40[\Omega]$