ANSWERS TO PROBLEMS IN

VACUUM-TUBE AND SEMICONDUCTOR ELECTRONICS

By

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Chapter 1

1-1 a 1.88×10^7 m/sec; b 3.26×10^5 m/sec.

1-2 a 8.52×10^{-10} sec; b 0.428 cm; c 285 volts.

1-3 a 1.065×10^{-9} sec; b 2.08×10^{-7} sec.

1-4 a 4.40×10^5 m/sec; b 0.732 cm; c 1.58×10^6 m/sec

1-5 a Yes; 625 volts.

1-6 a $x = \left(v_o - \frac{e}{m} \frac{E_m}{d\omega} \right) t + \frac{e}{m} \frac{E_m}{d\omega^2} \sin \omega t$;

b $\mathcal{E} = \left(\frac{v_o m E_m \omega}{ed} \right)^{1/2} \left(2 - \frac{v_o m d \omega}{e E_m} \right)^{1/2}$

1-7 a 3.0×10^{-8} sec; b 7.91×10^5 m/sec.

1-8 a 1.42 volts; b bottom; c 1.58×10^{-7} sec;
d - 4.09×10^6 m/sec.

1-9 0.354 cm.

1-10 $x = \frac{eE_o}{2md}(t - t_o)^2 - \frac{eE_1}{md\omega^2}(\sin\omega t - \sin\omega t_o) +$
$v_o(t - t_o) + \frac{eE_1}{md\omega}(t - t_o)\cos\omega t_o$

1-11 4.02×10^{-8} sec.

1-12 a 2.00 cm; b 45°.

1-13 a 5.84×10^{-9} sec; b 3.24 cm; c 0.24 cm.

1-14 $t = \frac{3d^{1/3}}{(2ek/m)^{1/2}}$

1-15 a 255,000 volts; b 2.24×10^8 m/sec.

1-16 4.92, 1.001.

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-17 $v = at/(1 + a^2t^2/c^2)^{1/2}$

$x = \frac{c^2}{a}\left[(1 + a^2t^2/c^2)^{1/2} - 1\right]$ where $a = e\mathcal{E}/m_o$

-18 a 1.82 volts; b 128 kv.

-19 4.46×10^{-4} m/sec.

-20 3.84 gauss.

-21 a x = 1.16 cm, z = 0; b $v_x = -2.97 \times 10^6$ m/sec, $v_y = -5.14$ m/sec, $v_z = 0$.

-22 a 0.338 cm; b 0.676 cm.

-23 3.10n milliweber/m^2.

-24 - 0.94, 2.50, - 1.18 cm.

-25 a 5.0°; b 0.80°.

-26 16.7, 33.4 gauss.

-27 1.43, 2.86, 4.29 amps.

-30 2.0×10^{-5} volts/m, 33.7 m/sec.

-31 a 0.845, 1.6, 0.153 cm; b 4.81×10^6 m/sec, 10.4×10^6 m/sec, 1.79×10^6 m/sec; c 0.998, 1.6, 0.216 cm; 4.68×10^6, 7.14×10^6, 2.10×10^6 m/sec.

-32 a 2×10^{-8} sec; b 0, 4, 3.82 cm; -3×10^6, 0, 0 m/sec.

-33 a x = 0.226 cm, z = 0.207 cm; b 0.348×10^6, 5.94×10^6, 3.98×10^6 m/sec.

-34 61.8 cm.

-35 122 gauss.

-36 $n\pi\mathcal{E} = Bv_o\cos\theta$ where n is an integer

-37 a 3.52×10^{-7} sec; b 5, 11.9, 3.10 cm; c 2.27×10^{-7} sec; 3.60, 5, 1.23 cm; d 4.91×10^{-7} sec; 5.82, 23.2, 5 cm.

-38 a 0.36 cm; b 3.54×10^{-9} sec.

-39 a 47.7 gauss, out of the plane of the paper; b 4.20×10^6 m/sec.

-40 a 1.75, 14, - 12.1 cm; b ions do not strike the plate; c 1.89, 22.5, - 14 cm.

-44 a $v_{oz} = -\mathcal{E}_x/B$; b $y = \frac{1}{2}(e/m)\mathcal{E}_y t^2$, $z = -\mathcal{E}_x t/B$; c parabola.

1-46 x = - 1.76 cm, y = 1.04 m.
1-47 b 13.2 n gauss.
1-48 0.27, 0.55, - 0.89 cm.
1-49 0.87 cm.

Chapter 2

2-1 a 6.50 X 10^{-4} m/sec; b 0.622 gauss; c 7.30 gauss.
2-2 a 3.66 cm; d 56.5 volts.
2-3 a 33.0 gauss; b 2.58 cm.
2-5 a y = 0.224 cm, z = 0.313 cm; b y = - 0.039 cm, z = 0.558 cm.
2-6 a 4.67 X 10^{8} cps; b 6.42 X 10^{-8}.
2-7 3.39 cm.
2-8 3.90 cm.
2-9 b 4.67 X 10^{8} cps.
2-11 7.2 %
2-14 a 1.21 cm; b 2.07 cm; c 1.04 cm.
2-17 1.79 cm.
2-18 0.49 cm
2-19 0.162 webers/m^2
2-20 a 3.40 X 10^{8} m/sec; b 2.25 X 10^{8} m/sec; c 1.51 .
2-22 a $B = m\mu/e\rho$; b $l=\rho$; c $t = w\rho/2\mu + D/\mu$; d $v=\mu$.
2-23 a 13.8 Mc; b 3.62 μsec; c 3.40 X 10^{7} m/sec, 39.1 cm.
2-24 a 19.4 Mc; b 19.7 Mev; c 154 kev.
2-25 a 5.38 Mev; b 430 ev; c 12,500.
2-27 a 5.30; b 7.38 cm; c 610 cps; d 1.86 X 10^{-9} sec; e 1.02 X 10^{5} m.

Chapter 3

3-2 4.70 X 10^{7} $(ohm-m)^{-1}$
3-3 0.10 $m^2/(volt-sec)$
3-4 a 1.78 X 10^{-4} m/sec; b 4.17 X 10^{-3} $m^2/(volt-sec)$
c 5.62 X 10^{7} $(ohm-m)^{-1}$

3-5 a 0.143 cm; b 1.88×10^{8} cm/sec.

3-8 a 0.25 ev; b 1 ev.

3-9 a No; b 1.68×10^{-8} sec; c 0.

3-11 a 2.00×10^{27} electrons/m^3; b 1.73×10^{27} electrons/m^3.

3-12 a 11.6 ev; b 5.50 ev.

3-14 4.45 ev.

3-15 a 21.4 % ; b 2,370° K.

3-16 28.7 %

3-17 0.40 volts.

3-18 0.235 .

3-19 1.00 cm.

3-21 a 0.21 μa; b 0.20 v accelerating; c 9.3×10^{-6}

3-22 3,240 volts/m.

3-23 a ≅ 0 ; b ≅ 0 ; c 2.2×10^{3} amperes/m^2; d 9.6×10^{10} amps/m^2.

3-26 5.3 %

3-27 7.7 %

3-29 a 51,000 ohm-cm; b 9.6 ohm-cm.

3-30 a 5.8×10^{12} electrons/cm^3, 1.06×10^{14} holes/cm^3, p-type; b $p = n = 2.5 \times 10^{13}$ cm^{-1}, intrinsic; c 1.43×10^{15} electrons/cm^3, 1.53×10^{15} holes/cm^3.

3-31 3.47×10^{17} holes/cm^3, 1.80×10^{9} electrons/cm^3

3-32 1.65×10^{14} electrons/cm^3, 3.78×10^{12} holes/cm^3

3-33 52.3 ma/cm.

Chapter 4

4-1 1,900° K.

4-2 1.03 amps.

4-3 11.5 watts, 0.575 amp, 50 ma/watt.

4-4 1,200° K, 0.98 amp.

4-5 2.10 ev.

4-6 4.50 ev.

4-10 159 volts, 28.3 ma, 80 ma.

4-11 1.57×10^{-6} coulombs/m^3

4-12 242 volts.

4-13 25 v, 2.5 ma; b 150 v, 20 ma; c 20 ma, 100 v, 200 v.

4-14 1.56, 1.46.

4-15 a 2,330 watts/m^2; b 32 ; c 545° K, 1270° K.

4-16 400 volts.

4-17 0.70 amp/m^2

4-18 a 153 ma; b 150 μa; c 150 μa.

4-19 a 1.91 watts; b 83 μa; c 83 μa.

4-20 26.7 ma.

4-21 a 57.5 ma; b 136 volts.

4-25 a ≅ 280 ohms, ≅ 190 ohms; b 500 ohms, 350 ohms.

4-26 a 105 ma, 34 v; b 190 ma, 51 v; c 240 ma, 60 v; d 0 ma, 0 v.

4-27 a 124 ma, 58 v; b 200 ma, 80v; c 350 ma, 120 v; d 0 ma, 0 volts.

4-29 a 1,000 ohms, 667 ohms; b 1410 ohms, 940 ohms.

Chapter 5

5-1 a - 0.060 volts; b - 68.3 ; c 0.455 ma, 21.7 ma, 1.01 amp.

5-3 a 0.018, 4.98 volts; b 228 μa.

5-4 a 5×10^{44} amp; b 27.7 ma.

5-5 a 29.8 ma; b- 10 μa; c 29.8 ma, - 20 ma.

5-6 a 33.6 ohms; b 3.88 Meg.

5-7 70.8 μμf.

5-9 a 7.75×10^{-6} m; b 1.33×10^{-6} m; c 7.68×10^{-7} m; d 18.3, 107, 185 μμf.

5-13 a 0.149 volts; b 0.463 volts.

5-16 8.34 μa.

5-17 1,415

5-18 a 10.7 % ; b 15.4 % .

Chapter 6

6-1 a 3.30 X 10^5 m/sec; b no emission; c 2.29 X 10^6 m/sec, 1.94 X 10^6 m/sec.
6-2 2.25 ev, 3.60 X 10^{-19} joules.
6-3 9.30 volts.
6-4 a 4.42 ev; b 2,800 A.
6-5 291 electrons.
6-6 1.17 μa.
6-11 a 104 ft-candles; b 2.7 Meg.
6-12 11.
6-13 5.95 .
6-14 a 33.6 gauss; b 1.43 cm.

Chapter 7

7-4 a 6.5 ma; b - 2.5 volts.
7-5 a - 6 volts; b 210 volts.
7-6 a 31 ma; b 2.5 K; c 2.8 millimhos.
7-7 a 1.31, 2.5 X 10^{-2} ; b 7.55 K, 2.64 millimhos.
7-8 a 7.3 K, 20.5, 2.8 m-mhos.
7-14 a 23.0, 8.5, 2.7 ma; b 250, 165, 115 volts; c 7.5 K; d 40 volts.
7-15 a 310, 370, 490 v; 3.20, 2.53, 2.00, 0, 0.20, 0.50 .
7-17 a 1.5 v; b 99.5 v; c 84.5 v; d - 1.5 v.
7-18 a 0, - 3.2 volts; b 170 volts.
7-20 a - 4.5 v; b - 33.3 v; c - 2 v.
7-22 0.70 K, 110 v.
7-23 a 6.2 ma; b 68.5 v.

Chapter 8

8-2 a 1.49 K; b 424 v; c 5.25 v rms; d 137.5° lag.
8-3 a 3.33 K, 10 ; b 950 v; c 14.5 /166° v.
8-6 - 18.7 .

8-7 - 1.11 .

8-8 1.57 /91.7° .

8-10 10.6 /-137.7° .

8-11 a 3 K; b 8.35 ; c 174° lagging.

8-12 10.15 volts.

8-13 33.1 μa.

8-15 $E_o = \dfrac{-\mu(\mu + 1)E_1 - \mu E_2}{R_L + (\mu + 2)r_p}$

8-16 a - 0.50; b 0.928 .

8-18 $- 0.477E_1 + 0.161E_2$

8-19 a 4.75 ; b 15 K.

8-24 b 13.5 Meg.

8-25 100.5 - j2.6 K.

8-30 a - 58.5 + j 8.78 , (1.32 + j 9.23) X 10^{-5} mhos; - 59.8 , j 9.45 X 10^{-8} mhos; b 75.7 K, 147 μμf; infinite, 151 μμf.

8-31 a Infinite, 38.5 μμf; 10.3 K, 28.0 μμf; b -20.8 Meg, 43.5 μμf; 8.83 K, 34.1 μμf.

8-32 5.22 K

8-33 e 0.0176 to 0.0557 μf; 1.56 to 0.52 K.

8-34 b $Y_i = Y_p + (1 + g_m R)Y_{LR}$; c $L_i = (1 + \alpha^2)/\omega\alpha g_m$, $R_i = r_p(1 + \alpha^2)/(1 + \alpha^2 + \mu)$; d $(L_i)_{max} = 2/\omega g_m$, $(R_i)_{max} = 2r_p/(2 + \mu)$; e 0.0578 to 0.0182 h; 1.56 to 0.52 K.

8-37 R between 1.58 and 7.9 Meg.

8-38 5 μa, 4.1 ma.

8-39 a 30 ft-c; b 5.0 ma; c outside the region $27.8° < \alpha < 152.2°$.

Chapter 9

9-2 c 0.138 μa, - 2.00 μa, - 0.116 v.

9-3 a 80 a,b0.164 v, 0.0624 v, - 0.0624v, - 0.164 v, 0.102 v; c 0.167, 0.110, - 0.110, - 0.167, 0.057 volts; d V_C, V_E and V_{CE} are unchanged; V_{CB}: - 0.0824, - 0.160 v; V_{EB}: -0.184, -0.217 v.

9-12 a - 2.05 v, - 20.5 μa, - 1.0 ma; b 24.2 .
9-13 a 3.7, 2.8 ma; b 1.2, 1.7 ma.
9-16 5.0 ma, 9.5 volts, 95 μa.
9-18 0.49, 8.31, 43.8; b 0.49, 1.20, 8.00 K.
9-19 a 3.31 ; b - 30 μa, -1.58 v, - 1.43 ma; c 3.92; - 1.59 v, - 1.42 ma, - 30μa.

Chapter 10

10-16 - 38.6 .
10-17 a 44.8 ohms, 1.80 K, 401 K; b 1.96 Meg, 40.8 K, 1.025 K.
10-18 20.6 K.
10-19 a 10.3 K; b 205 ohms.
10-20 a 4 ohms; b 200 ohms.
10-21 c 45; 60 K.
10-24 a 26.9 K; 26.5 K.
10-26 0.263 .
10-30 + 0.88; 1.0 Meg; - 3 ohms; 7.33; 120 K.
10-31 60; 0.984; 2.5 Meg; 1,250 ohms; 40 ohms; 40 K.
10-32 39.6 ohms; 3.9×10^{-4}; - 0.98; 0.5 μmhos.
10-34 $y_{11} = (r_e + r_d)/\Delta \quad y_{12} = -r_e/\Delta$
$y_{21} = (a_e r_d - r_e)/\Delta \quad y_{22} = (r_b + r_e)/\Delta$
where $\Delta = r_b(r_e + r_d) + r_e r_d(1 + a_e)$

Chapter 11

11-5 a 1 Meg; b 4.0 millimhos; d 3.4 millimhos.
11-6 a 5.5 m-mhos; b 2.73 K; c 66 ohms; d 23 K.
11-12 a 5.7 Mc; b 48 kc.
11-13 7.1×10^{-3} cm.

Chapter 12

12-1 3.23×10^{16} molecules/m^3.
12-2 490 mm Hg.
12-4 8.45×10^{20} molecules/m^3.

12-6 a 9.16 X 10^{-3} m; b 1.97 X 10^{4} collisions/sec; c 1.35 amps/m^2.
12-7 3.98 X 10^{6} collisions/sec.
12-8 72.
12-12 5,770 A.
12-13 1,560 A.
12-14 18,800, 6,600, 1,220, 1,030, 4,880 A.
12-15 a 22,200, 5,896 A; b 3.75 to 3.19 ev; 2.10 to 0 ev.
12-17 a 8.61 X 10^{5} m/sec; b no.
12-18 a 2.75 X 10^{6} m/sec; b 5.20 X 10^{15} cps.
12-19 a 24,800 volts; b 0.207 A.
12-20 1.11 X 10^{-18} joules.
12-21 1.51 X 10^{6} m/sec.
12-22 0.9 ev.
12-26 a 177.5 m^{-1}, 0.00091 ; b 3.94 cm, 630 volts.
12-31 4 X 10^{6} volts/m.
12-36 1.8 amp/m^2.
12-37 a 106 volts; b 1.10 μa; c 3.44 cm^2.
12-38 0.0143 cm.

Chapter 13

13-1 a 662 cps; b 174 volts; c 400 ohms.
13-3 a 15 v; b 0.005 μf; c 200 ohms.
13-5 8 volts; 90 μμf.
13-6 Greater than 0.05 lumens.
13-7 b 21 volts, 2.3 volts.
13-10 a 43 volts; c 1 % ; d 417 cps.
13-11 a 200 ma; b 800 ma.
13-12 a 1.88 K; b 20 ma; c 20.2 ma.
13-13 a 2 K; b 215 to 285 volts.
13-16 a 20 volts; b 376 cps; c 12.5 % .
13-17 a 0.19 Meg; b 1 K.
13-18 a 112.5 volts; b 250 volts.

13-19 a 38 μa; b 96 volts; c 81 volts; d 0.24

Chapter 14

14-1 a 0.354 amps; b 0.113 amps; c 0.177 amp; d -113 volts; e 37.7 watts; f 33.8 % ; g 20 % .

14-4 a 101 ma; b 50.5 ma; c 358 volts; d 20.4 watts; e 64.8 % ; f 25 % .

14-8 a 0.188 amp; b 0.298 amp; c - 94.3 v; d 156 v; e 46.3 watts; f 38.2 % .

14-9 a 0.33 amp; b 45°, 135°; c 0.055 amp; d 0.12 amp; e 0.045 watts; f 5.1 % .

14-10 a 7.65 ohms; b 4.17 % ; 17.3 ohms, 4.73 % ; 19.0 ohms, 5 % .

14-12 5.56 volts.

14-14 a E_m, $2E_m$; b $2E_m$, $2E_m$; c 0, $2E_m$.

14-15 b 0, $2E_m$, $2E_m$, $4E_m$.

14-18 a $I_{rms} = (E_m/R_L)\left(\frac{\pi - \varphi}{w} + \frac{\sin 2\varphi}{2w}\right)^{1/2}$

b $E_{rms} = (E_m/2)\left[(w + \varphi)/w - \sin 2\varphi/2w\right]^{1/2}$

c $P = (E_m^2/4wR_L)(w - \varphi + \frac{1}{2}\sin 2\varphi)$

14-19 a 1.98 amps; b 1.85 amps; c 1.98 amps.

14-20 a w/2 ; b 0.0992 amp; c 0.198; e 60°, 0.149 amp, 0 to 0.198 amp.

14-21 b 0.192 amp; c 199 volts.

14-22 b 0.674 amp; c 0 ; d 0.337 amp.

14-23 c R: 0 to infinity; 0 to 0.99 amp.

14-24 b R = 0; 1.49 amps; c 0.745 amp; d 12.1 K; e R infinite, 1.49 amps; 1.64 K, 0.745 amp.

14-25 b R infinite; 0.90 amp; c 306 volts.

14-26 a 70 volts; c 1.64 ma.

14-27 a 1.58 amps; b 1.65 amps; c 1.06 amps.

14-28 a 30°; c 0.158 amp.

14-29 a 4.10 amps; b 136 volts; c - 281 volts.

14-30 a 0.180 amp, 70.7 volts; b 0.168 amp; c -141.4 volts.

14-35 b 0.126 amp; c 0.135 amp, 155 v, 423 v.

14-37 b$_2$ $I_{rms} = (E_m/w^{1/2}R_L)\left\{\left[\frac{1}{2} + (E_o/E_m)^2\right](w - \varphi_o - \varphi) + (1/4)(\sin 2\varphi_o + \sin 2\varphi) - (2E_o/E_m)(\cos\varphi_o + \cos\varphi)\right\}^{1/2}$

b$_3$ $= (I_{dc}{}^2R_L)/(I_{rms}{}^2R_L + E_oI_{dc})$

14-38 b 2.53 amps; c 1,300 watts.

14-39 b 1.39 amp.

14-42 a 700 watts; b 7.50 watts; c 8,400 watts; d 8.7×10^{-4}.

14-44 a 1.25 amps; b 25 watts; c 422 watts; d 2.81 amps; e 397 watts.

14-45 a 14.3 amps; b 8.59 amps; c 229 volts; d - 128 volts; e 215 v; f 129 v; g 129 watts; h 1,110 watts; i 3,220 watts; j 34.4 % .

14-48 $(E_{dc} - E_o)(1 - 2\varepsilon^{-t/2RC})$ equals the rising portion of the voltage. E_{dc} is the d-c input voltage, E_o is the tube drop and R is the effective resistance reflected into each half of the output transformer. It is assumed that the input choke keeps the line current constant and that a steady voltage is reached in each half cycle.

14-49 c 306 volts; d 159 volts; f 326 v, 176 v.

Chapter 15

15-3 a 7.86 cps; b 267 kc; c 19.1; 25.6 dbv; d -21.45 e 36.8°.

15-4 a 36.4; 31.2 dbv; b 69.5 kc; c 0.0031 μf.

15-5 39.3 cps to 10.2 kc.

15-7 10.2 cps, 39.4 kc.

15-8 a 0.0621 μf; b 0.090 μf; c 317 kc; d 1,240.

15-9 a 1,270; 62.1 dbv; b 305 cps; c 600 cps; d 636 kc; e 324 kc.

15-10 a 11.5 K; b 10.1, 102; c 18.3 μμf; d 15.8 cps; e 895 kc, 1.69 Mc; f 31.3 cps, 855 kc.

15-11 I. a 2.94 K; b 15.9 cps; c 3.22 Mc.
II. a 23.3 K; b 15.8 cps; c 366 kc.

15-13 a 40.0 ohms, 54.6 ohms; c 1.35, 181; d 245.

15-14 4.0 cps, 0.30 cps, 10 kc.

15-15 a - 13.2, - 18.0; b - 13.2, - 43.2; c 569.

15-18 a 1.60 K; b - 11.9, - 5.11; c 9.3 μf.

15-19 a 24.2 K; b 60.5 K; c 131 ohms.

Chapter 16

16-3 a 20 ma rms; b 4.8 % ; c 44.5 ma.

16-4 a 7.7 K; b - 6 v; c 6.5 ma; d 11.8 % ; 9.25; infinite power gain.

16-6 a 301 v; b 8.4 v; c 72 v; d 12 v; e 75 ma.

16-7 14.6 %

16-13 a 4.22 watts, 14.0 watts, 15.0 % ; b 260 v; c 4.22 watts, 14.0 watts, 23.2 % .

16-14 a 1.2 watts, 15 %, 18 % ; b 2.0 watts, 3.1 % , 11 % .

16-20 a 4 : 1; 5.52 milliwatts; c 0.037 % ; d 8 : 1, 23.4 %.

16-21 a 3.8 watts; b ≅ 80 ma; c 20 watts.

16-22 c = 11 %, 0.5 %, 1 % ; ≅ 12 %, 8 %, 1 % .

16-23 21 %, 1.9 %, 0.95 %.

16-26 a 3.8 K; b 2.8 K.

16-27 a 3.0 K; b 4.6 watts; c 8.4 watts; d 35.4 % .

16-28 a 25.5 ma; b 34 ma; c 20 %, 1.9 %; d 2.3 watts; e 2.4 watts.

16-29 a 25.5 ma; b 28.8 ma; c 7 %, 11 %; d 4.4 watts; e 4.5 watts.

16-30 b 890 ohms, 330 v; 725 ohms, 250 v; c 30 v rms; d 3.28 watts; e 20 dbv, 38.1 dbp; 9.60 dbv, 14.5 dbp; 29.6 dbv, 52.6 dbp.

16-34 c 2.9 watts; d 0 ; e 72 ma; f 16 % .
16-35 c 3.5 watts; d 2.5 % ; e 40 ma; f 35 %.
16-37 c 9.0 watts; d 8 % ; e 75 ma; f 40 % .
16-38 a 24 ; b 6.4 % ; c 62 ma.
16-39 a 45 watts; b 5.7 ma rms; c 197 ma; d 57 % .
16-43 0.246 watts.
16-44 a 9.6 %, 1.3 %, 0.3 %; b 1.36 watts; c 39 % .
16-47 a 4.30 watts; b 39 % ; c 6.2 % .

Chapter 17

17-1 a 9.90 ; b 101, 0.0099 ; c 0.198 cps, 5.05 Mc.
17-2 a 2.19 v; b 0.196 v.
17-3 a -2.07×10^4 ; 1.41 K; b - 8.44 ; 1.41 K.
17-6 a $e_{pn} = (e_a)\left[r_p + (\mu+1)R_k\right] / \left[r_p + (\mu+1)R_k + R_L\right]$
b $e_{kn} = e_a R_k / \left[r_p + (\mu+1)R_k + R_L\right]$
c $e_{pn} = -(\mu+1)R_L e_k / \left[r_p + R_L + (\mu+1)R_k\right]$
$e_{kn} = (r_p + R_L)e_k / \left[r_p + R_L + (\mu+1)R_k\right]$
17-7 a 83.3 K; b + 48 v, - 202 v; c 8.47 Meg; d 10.3 kv.
17-8 a - 0.499 ; b 0.931 .
17-12 - 309 volts, 101 K.
17-13 - 0.367 mv.
17-14 a 50 K, 46.7 K; b 0.19 % .
17-18 a 3.17 ; b 6.67 K.
17-24 126.5 v, - 2 v, 1.9 ma.
17-25 3.6 ma, 201.9 v.
17-26 a 167 v.
17-27 a 12.7 ma; b 147 K; c $r_p/(\mu+2) = 404$ ohms.
17-29 b 67 ohms.
17-32 0.99 $\angle$ 90.57°
17-33 $e_o = -(E/RC)\left[t + (L/R)(\varepsilon^{-Rt/L} - 1)\right]$

Chapter 18

18-5 a $\beta = 1/\,3 + j(\omega RC - 1/\omega RC)$; c $f = 1/2\pi RC$; d 3

18-6 $\beta = 1/(1 - \alpha^2 - j\,3\alpha)$ where $\alpha = 1/\omega RC$

18-7 a $\beta = 1/\left[1 - 5\gamma^2 + j(6\gamma - \gamma^3)\right]$ where $\gamma = \omega RC$

b $Z_i = -(j/\omega C)\left[1 - 5\gamma^2 + j(6\gamma - \gamma^3)\right] / (3 - \gamma^2 + j\,4\gamma)$

c $f = 6^{1/2}/2\pi RC$; A > 29

18-13 a $\omega = (LC)^{-1/2}$; $A_{min} = (R_3 + R)/R_3$; b $A_{min} = 1/\beta$ where $\beta = (R_3)/(R_3 + R) - (R_2)/(R_1 + R_2)$

18-14 a 3,180 cps; b 3.12 K.

18-20 a $\omega^2 C_3(L_1 + L_2) = \dfrac{1 + r_2/R_o}{1 + \dfrac{(r_1L_2 + r_2L_1)(1 + \mu)}{R_o(L_1 + L_2)}}$

b $R_o = \dfrac{(\mu L_1 - L_2)L_2}{(r_1 + r_2)C(L_1 + L_2)}$ for small r_1 & r_2.

18-21 $\omega^2 = (L_2C_3)^{-1}$

18-22 c 1 % .

18-23 a 1.09 Mc; b 3.3 % ; c 410 .

18-27 3.41

18-29 0.134, 2.24, 0.368 .

Chapter 19

19-4 a 105° ; b 36°, 715 ma; c 93.8°, 58°, 1.75 amps

19-7 a $E_{dc} = E_m/(1 + I_{dc}/4fCE_m) - I_{dc}R$ where R is the resistance of the inductor; b $r = 2^{1/2}(X_C/X_L)$.

19-8 a 30.2 henrys; b 345 volts.

19-10 a 0.88 v; b 0.077 v; c 0.044 v.

19-13 a 244 v; 0.031; b 481 v; 0.0353; c 244 v; 6.5×10^{-4}; d 244 v; 1.42×10^{-5}; e 400 v; 1.6×10^{-4}.

19-14 $r = 2^{1/2}(X_C/R_L)(X_{C1}/X_{L1})$

19-15 368 v; 0.515

19-16 250 ohms, 10.0 henrys.

19-17 a1 270 v; a2 424 v; a3 270 v; a4 424 v; b1 270 v; b2 382 v; b3 270 v; b4 270 v; c1 const.; c2 incr.; c3 decr.; c4 from zero current to the critical current r increases. Beyond the critical current r remains constant; d 848 v for all cases.

19-18 316 v, 495 v.

19-19 382 v, 764 v.

19-20 + 316 v, - 990 v.

19-21 a - 424 v, + 424 v; b 848 v; c 270 v; d 402 v.

19-25 ≅ 15 volts.