VASTUSED

1.1. F = $9 \cdot 10^3$ N

1.2. m = 3,87 kg

1.3. $\frac{F_{el}}{F_{gr}} = 4 \cdot 10^{42}$ ($1 \cdot 10^{36}$); q/m = 0,86 $\cdot 10^{-10}$ C/kg

1.4. ca $2 \cdot 10^{15}$ N

1.5. v = 2,2 $\cdot 10^6$ m/s

1.6.

1.7. Laenguid q_1 ja q_2 ühendavale sirglõigule kaugusel $r_1 = d/(\sqrt{\frac{q_2}{q_1}} + 1) = 20\ cm$ laengust q_1.

1.8. a) $Q = -\frac{\sqrt{3}}{3}q$, b) $Q = -\frac{2\sqrt{2}+1}{4}q$

1.9. q = 2,5 $\cdot 10^{-8}$C

1.10. q = 3,3 $\cdot 10^{-8}$C

1.11. $r_1 = \frac{\sqrt{q_1}}{\sqrt{q_1} \pm \sqrt{q_2}} d$

1.12. E = 144 kV/m

1.13. $y = \pm\frac{d}{\sqrt{2}} = \pm 3{,}5\ cm$, kus y on punkti koordinaat laengukeskme suhtes

1.14. $E = 67\ kV/m$

1.15. $E = 16{,}7\ kV/m$

1.16. $E = 246\ V/m$

1.17. $E = 120\ kV/m$

1.18. $\vec{E} = \frac{1}{4\pi\varepsilon_0}\left[\frac{3(\vec{p},\vec{r})}{r^5} - \frac{\vec{p}}{r^3}\right]$

1.19. $E = \frac{\tau}{2\pi\varepsilon_0 R}$

1.20. $R \leq \frac{1}{1-\delta}\sqrt{\frac{\delta}{2}}$ = 4,18 cm

1.21. $E = \tau\ 1/2\pi\varepsilon_0 a\ \sqrt{4a^2 + l^2}$

1.22. $E = \sqrt{2}\frac{\tau}{4\pi\varepsilon_0 a}$

1.23. $E = \frac{q}{4\pi\varepsilon_0 l(l+r)}$

1.24. $F = \tau q \frac{1}{4\pi\varepsilon_0 a\sqrt{\frac{l^2}{4+a^2}}}$ =1,27 μN

1.25. $F = 8{,}1\frac{N}{m}$

1.26. $E = \frac{2\tau d}{\pi\varepsilon_0(4x^2+d^2)}$

1.27. E = 3,12 $\cdot 10^6$ V/m

1.28. $E_{max} = \frac{\tau}{\pi\varepsilon_0 a}$

1.29. E = 60,2 kV/m

1.30. E = 38 kV/m

1.31. a) $E = 0$; b) $E = 10^4\ V/m$; c) $E_{max} = 2{,}3 \cdot 10^4 V/m$

1.32. $F = \frac{q\tau}{4\pi\varepsilon_0 R}$

1.33. $E = \frac{q}{2\pi^2\varepsilon_0 R^2}$

1.34. $E = \frac{\tau_0}{4\varepsilon_0 R}$

1.35. $a)\ E = \frac{\sqrt{2}\tau}{4\varepsilon_0 R}\ ; b)\ E = 0$

1.36. $E = \frac{\sigma}{2\pi\varepsilon_0} ln\frac{R_2}{R_1} = 1{,}9 \cdot 10^4 V/m$

1.37. $E = \frac{q}{2\pi\varepsilon_0 R^2}(1 - \frac{h}{\sqrt{h^2+R^2}})$

1.38. $h \leq R\ \delta = 1{,}25\ cm$

1.39. $E = \frac{\sigma h}{2\varepsilon_0\sqrt{h^2+R^2}}$

1.40.

1.41. $E_{vahel} = 0$; $E_{väljas} = \frac{q}{\varepsilon_0 S}$

1.42. $\sigma_1 = 35{,}4\frac{nC}{m^2};\ \sigma_2 = -17{,}7\frac{nC}{m^2}$

1.43. $E = \frac{\sqrt{5}}{2} \cdot \frac{\sigma}{\varepsilon_0}$

1.44. $E_1 = 5{,}65\frac{kV}{m};\ E_2 = 9{,}80\frac{kV}{m}$

1.45. $F = 3{,}4\frac{N}{m}$

1.46. $q = 3 \cdot 10^{-9}\ C$

1.47. $E = \frac{\sigma}{4\varepsilon_0}$

1.48. $F = \frac{q^2}{32\pi\varepsilon_0 R^2}$

1.49. $F = \frac{q(q+2q_0)}{32\pi\varepsilon_0 R^2}$

1.50. $M = 9{,}36 \cdot 10^{-26}\ Nm$

1.51. $F_e = \frac{p_e q}{2\pi\varepsilon_0 r^3} = 6 \cdot 10^{-4}\ N$

1.52. $F = 4{,}5\ \cdot 10^{-4}\ N$

1.53. $F = 3\alpha p_e^2 / 4\pi^2\varepsilon_0 r^7$

1.54. a) $3{,}9\ \cdot 10^{-11} m;\ b)\ 4{,}12 \cdot 10^6\frac{V}{m};\ 2{,}06 \cdot 10^6\frac{V}{m};\ c)\ F_{max} = 6{,}6 \cdot 10^{-13}N;\ F_{min} = 3{,}3 \cdot 10^{-13}N;\ M_{min} = 0;\ M_{max} = 10^{-21}N \cdot m$

1.55. Kui x = 0 ja x = R/$\sqrt{2}$, siis F = 0; kui x = 1,1 R, siis maksimaalne tõukejõud; kui x = 0,29 R, siis maksimaalne tõmbejõud.

1.56. $\Phi_E = \frac{\tau h}{\varepsilon_0}$

1.57. $\Phi_E = \frac{q}{\varepsilon_0}\left[1 - \frac{1}{\sqrt{1+(\frac{R}{a})^2}}\right]$

1.58. $\Phi_E = \frac{\tau R}{2\varepsilon_0}$

1.59. R > 55 m

1.60. $E_1 = 0$; $E_2 = 270$ kV/m; $E_3 = -450$ kV/m

1.61. $E_1 = \frac{\rho r_1}{3\varepsilon_0} = 88$ kV/m; $E_2 = \frac{\rho R^3}{3\varepsilon_0 r_2^2} = 78\ kV/m$

1.62. Kera sees E = $\frac{\rho_0 r}{3\varepsilon_0}(1-\frac{3r}{4R})$, $E_{max}=\frac{\rho_0 R}{9\varepsilon_0}$; $r_{max}=2R/3$. Väljaspool kera $E=\frac{\rho_0 R^3}{12\varepsilon_0 r^2}$.

1.63. Elektriväli õõnsuses on homogeenne : $\vec{E}=\rho\vec{r}/3\varepsilon_0$.

1.64. Elektriväli on homogeenne : $\vec{E}=\rho\vec{d}/3\varepsilon_0$.

1.65. $\sigma=3\varepsilon_0 E\cos\vartheta$. Väljaspool kera ühtib väli sfääri keskel oleva dipooli elektriväljaga. Selle diipoli elektriline moment $\vec{p}=-4\pi\varepsilon_0 R^3\vec{E}$.

1.66. $E_s=\rho r/2\varepsilon_0$, $E_v=R_0^2\rho/2\varepsilon_0 r$.

1.67. $E_1=\rho r_1/2\varepsilon_0 = 6\,\pi\ MV/m$, $E_2=\rho R^2/2\varepsilon_0 r^2 = 15\,\pi\ MV/m$

1.68. Elektriväli õõnsuses on homogeenne : $\vec{E}=\rho\vec{r}/3\varepsilon_0$, kus $\vec{r}$ on suunatud õõnsuse telje poole.

1.69. $F=\tau^2 h/4\pi^2\varepsilon_0 R$.

1.70. $E_s=45kV/m$; $E_0=0$; $E_v=75\ kV/m$.

1.71. $A_1=9\cdot10^{-4}\ J$; $A_2=8{,}9\cdot10^{-4}\ J$.

1.72. $A=\frac{q_0}{2}\sqrt{\frac{q}{\pi\varepsilon_0}}(\sqrt{E_A}-\sqrt{E_B})$ = 72 nJ

1.73. $A=13\ mJ$

1.74. $r_{min}=q_1q_2(m_1+m_2)/2\pi\varepsilon_0 m_1 m_2 v_r^2$

1.75. $r_{min}=60\ cm$

1.76. $r=\frac{11e^2}{\pi\varepsilon_0 m v^2}=6\cdot10^{-15}$m

1.77. $x=0{,}57\ mm$; $v=13{,}3\cdot10^5\frac{m}{s}$

1.78. $\tau=1\ \mu C/m$

1.79. $A=4{,}7\ \cdot10^{-5}J$

1.80. $A=\frac{q\sigma_1R_1\ln\left(\frac{R_2}{R_1}\right)}{\varepsilon_0}=14{,}6\ mJ$; $F=q\frac{R_1\sigma_1+R_2\sigma_2}{\varepsilon_0(R_2+h)}=4{,}1\ N$

1.81. $A=-\frac{p_e q}{4\pi\varepsilon_0 R^2}$

1.82. $\varphi=\frac{q(6+\sqrt{3})}{6}\pi\varepsilon_0 a=7{,}7\ kV$

1.83. a) $E_A=30\ kV/m$, $E_B=3{,}75\frac{MV}{m}$;

b) $\varphi=-1{,}8\ kV$

1.84. $R=\frac{nd}{n^2-1}$, $a=\frac{d}{n^2-1}$.

1.85.

1.86. $\varphi=\frac{q}{4\,\pi\varepsilon_0 l}ln\frac{a+1}{a}$

1.87. $\varphi=\frac{q}{4\,\pi\varepsilon_0\sqrt{h^2+R^2}}$, $E=\frac{qh}{4\,\pi\varepsilon_0(h^2+R^2)^{3/2}}$, $\varphi_0=3000\ V$, $\varphi_{10}=1340\ V$

1.88. $\varphi_1-\varphi_2=\frac{q}{2\,\pi\varepsilon_0 R}(1-\frac{1}{\sqrt{1+\frac{a^2}{R^2}}})$.

1.89. $\varphi=\frac{q}{2\,\pi\varepsilon_0(R_1+R_2)}=18\ kV$

1.90. $\varphi=\sigma(\sqrt{h^2+R^2}-h)/2\varepsilon_0$

1.91. $q_{max}=75\cdot10^{-7}C$, $\varphi_{max}=450\ kV$

1.92. $R=15\ cm$

1.93. $n=2\cdot10^{10}$, $\Delta m=2\cdot10^{-17}\ g$

1.94. $\varphi = 2{,}9\ V$

1.95. q = $5{,}9 \cdot 10^5 C$; $\varphi = 830\ MV$

1.96. $q_2 = -2{,}1\ nC$

1.97. R = 1m

1.98. $\varphi = \frac{\rho(3R^2 - r^2)}{6\varepsilon_0}$

1.99. $U \approx \frac{d}{R}\sqrt{\frac{mg}{\pi\varepsilon_0}} \approx 38\ kV$

1.100. $U = \frac{\sigma}{\varepsilon_0}h_2$; $U' = \frac{\sigma}{\varepsilon_0}|h_2 - h_1|$

1.101. $A = 52\ \mu J$

1.102. $U_{12} = 75{,}4\ V$; $U_{23} = 226{,}1\ V$

1.103. a) E_1 = 11,3 kV/m; b) E = 5,65 kV/m; c) U = 56,5 V; d) v = $4{,}46 \cdot 10^6\ m/s$

1.104. U = 750 V; E_s = 150 /r^2 (V/m); E_v = 300/r^2 (V/m)

1.105. $E_s = \frac{U}{R_1 \ln\left(\frac{R_2}{R_1}\right)} = 25\frac{kV}{m}$; $E_v = 0$

1.106. $U = \frac{\sigma_1 R_1}{\varepsilon_0} ln\frac{R_2}{R_1} = 185\ V, E = \frac{R_1\sigma_1 + R_2\sigma_2}{\varepsilon_0 r} = \frac{1{,}2 \cdot 10^4}{r}\ (\frac{V}{m})$

1.107. $\varphi_1 - \varphi_2 = \frac{q}{2\pi\varepsilon_0 R} = 5{,}4\ kV$

1.108. $\Delta\varphi = 175\ V$

1.109. $E = ax$. Sellline valem kehtib elektrivälja jaoks ühtlaselt laetud kihis, mis on risti x-teljega, kui laengu ruumtihedus $\rho = \varepsilon_0 a$.

1.110. $\rho = 6\varepsilon_0 ax$

1.111. $\rho = 6\varepsilon_0 a$

1.112. $\varphi = -y(ax + bx) + const$

1.113. $\varphi = ay\left(\frac{y^2}{3} - x^2\right) + const$

1.114. $\varphi = axy + const$

1.115. a) $\vec{E} = -2ax\vec{\imath} + 2ay\vec{\jmath}$; b) $\vec{E} = -2a(y\vec{\imath} + x\vec{\jmath})$

1.116. $\vec{E} = -2\left(ax\vec{\imath} + ay\vec{\jmath} + bz\vec{k}\right)$, $E = 2\sqrt{a^2(x^2 + y^2) + b^2z^2}$;

a) pöördellipsoid, mille poolteljed on $\sqrt{\frac{\varphi}{a}}$ ja $\sqrt{\frac{\varphi}{b}}$;

b) kui $\varphi > 0$, siis ühekatteline hüperboloid; kui $\varphi = 0$, siis ringkoonus, kui $\varphi < 0$, siis kahekatteline hüperboloid.

1.117. $U = \frac{\sigma_2 - \sigma_1}{2\varepsilon_0}\left(d_0 + \frac{1-\varepsilon}{\varepsilon}d_2\right) = 1413\ V$, a) $E_0 = \frac{\sigma_2 - \sigma_1}{2\varepsilon_0} = 188\ kV/m$, b) $E_d = \frac{\sigma_2 - \sigma_1}{2\varepsilon_0\varepsilon} = 94\ kV/m$

1.118. U = 1750 V

1.119. $\sigma_p = 1{,}06 \cdot 10^{-4} C/m^2$

1.120. $\sigma_p{}' = 2{,}0 \cdot 10^{-5} C/m^2$, $\sigma_p{}'' = 1{,}38 \cdot 10^{-5} C/m^2$, $q_p' = q_p'' = 2{,}5 \cdot 10^{-6} C$

1.121. a) Kera sees $E = \rho r/3\varepsilon_0\varepsilon$, väljaspool $E = R^3\rho/3\varepsilon_0 r^2$, b) $\rho_p = -\frac{(\varepsilon-1)\rho}{\varepsilon}$, $\sigma_p = \frac{(\varepsilon-1)}{3\varepsilon}r$

1.122. $E = \frac{Ph}{4\varepsilon_0 R}$

1.123. $\sigma_{max} = 5{,}3 \cdot 10^{-8}\ C/m^2$

1.124. $\sigma_{pmax} = \varepsilon_0(\varepsilon - 1)\mathrm{E} = 3{,}5\ nC/\ m^2$, $q_p = \pi R^2\varepsilon_0(\varepsilon - 1)\mathrm{E} = 10\ nC$

1.125. $\vec{E}_s = -\frac{\vec{P}}{3\varepsilon_0}$, $\vec{E}_v = \frac{V}{4\pi\varepsilon_0}\left[\frac{3(\vec{P},\vec{r})}{r^5}\vec{r} - \frac{\vec{P}}{r^3}\right]$

1.126. $\vec{E}_0 = (\varepsilon + 2)\frac{\vec{E}}{3}$

1.127. $\vec{E} = 3\vec{E}_0/(\varepsilon + 2)$; $\vec{p} = \frac{3\varepsilon_0(\varepsilon-1)\vec{E}}{(\varepsilon+2)}$

1.128. $\vec{E} = 2\vec{E}_0/(\varepsilon + 1)$; $\vec{p} = \frac{2\varepsilon_0(\varepsilon-1)\vec{E}}{\varepsilon+1}$

1.129. $\beta = 76{,}1°$; $E = 5{,}2\ V/m$; $\sigma_p = 6{,}6 \cdot 10^{-11}\ C/m^2$

1.130. $\oint(\vec{E}, d\vec{S}) = \frac{(\varepsilon-1)\pi R^2 E_0 \cos\beta}{\varepsilon}$

1.131. $q_i = \pm\varepsilon_0 ES$

1.132. $q_i = \pm q/2$

1.133. Plaadi B küljel, mis on plaadile A lähemal, on $q = 1\ mC$, teisel küljel $q' = 3\ mC$.

1.134. $\sigma_1 = \sigma_4 = \frac{2}{3}\cdot 10^5\ C/m^2$; $\sigma_2 = \frac{1}{3}\cdot 10^5\ C/m^2$; $\sigma_3 = -\frac{1}{3}\cdot 10^5\ C/m^2$; kui $q_2 = -q_1$, siis $\sigma_1' = \sigma_4' = 0$ ja $\sigma'_2 = \frac{q}{S}$ ning $\sigma_3' = \frac{q}{S}$, kus $q = |q_1| = |q_2|$.

1.135. a) Kui q= const, siis $E = U/d$, $\sigma_{1C} = \sigma_{1D} = -\varepsilon_0\, U/d$, $\sigma_{2C} = \sigma_{2D} = \varepsilon_0\, U/d$, $U_{AC} = U_{CD} = U_{DB} = U/3$.

Kui C ja D hetkeks lühistada, siis $\sigma_{2C} = \sigma_{1D} = 0$, $\sigma_{1C} = -\varepsilon_0\frac{U}{d}$, $\sigma_{2D} = \varepsilon_0\frac{U}{d}$, $U_{AC} = U_{DB} = U/3$, $U_{CD} = 0$.

b) Kui U = const, siis $E = U/d$, $\sigma_{1C} = \sigma_{1D} = -\varepsilon_0\, U/d$, $\sigma_{2C} = \sigma_{2D} = U/d$, $U_{AC} = U_{CD} = U_{DB} = U/3$.

Kui C ja D hetkeks lühistada, siis $\sigma_{2C} = \sigma_{1D} = 0$, $\sigma_{2D} = \sigma_A = \varepsilon_0\ \frac{3}{2}\frac{U}{d}$, $\sigma_{1C} = \sigma_B = -\varepsilon_0\ \frac{3}{2}\frac{U}{d}$, $U_{AC} = U_{DB} = \frac{U}{2}$, $U_{CD} = 0$.

1.136. a) $E_{23} = \frac{\Delta\varphi}{d}$; $E_{12} = E_{34} = \frac{1}{2}E_{23}$; b) $|\sigma_1| = \sigma_4 = \frac{1}{2}\ \varepsilon_0\frac{\Delta\varphi}{d}$, $\sigma_2 = |\sigma_3| = \frac{3}{2}\varepsilon_0\frac{\Delta\varphi}{d}$.

1.137. E_1=135 kV/m, E_2=5,4 kV/m; $\varphi_1 = \varphi_2 = 9{,}45\ kV$

1.138. $\varphi_v = \frac{q}{4\pi\varepsilon_0 R_3}$; $\varphi'_v = 0$; $\varphi_s = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{R_1} - \frac{1}{R_2} + \frac{1}{R_3}\right)$; $\varphi'_s = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$.

1.139. $\varphi'_1 = 200\ V$

1.140. Punktides A ja B on väljatugevus 3 $\vec{E}$, punktides C ja D on väljatugevus 0.

1.141. $p_e = \frac{q^2}{32\pi^2\varepsilon_0\varepsilon R^4}$

1.142. $q = Q/2$

1.143. Suureneb 2 korda.

1.144. a) $\sigma_1 = -8{,}8 \cdot 10^{-7} C/m^2$; $\sigma_2 = -1{,}9 \cdot 10^{-7} C/m^2$; b) $q_i = -5 \cdot 10^{-9} C$

1.145. $\sigma = \frac{ql}{2\pi(h^2+r^2)^{3/2}}$

1.146. $E = \frac{q}{20\pi\varepsilon_0 h^2}\sqrt{26 - 2\sqrt{5}}$

1.147. a) $E = \frac{q}{2\pi\varepsilon_0 h^2}$, b) $E = \frac{2q}{9\pi\varepsilon_0 h^2}$.

1.148. $q = 4h\sqrt{\pi\varepsilon_0 kx}$

1.149. $F = \frac{(2\sqrt{2}-1)q^2}{8\pi\varepsilon_0 h^2}$, $E = 2(1-\frac{1}{5\sqrt{5}})\frac{q}{\pi\varepsilon_0 h^2}$

1.150. $F = 9{,}1 \cdot 10^{-3} N$

1.151. $A = \frac{q^2}{16\pi\varepsilon_0 h}$

1.152. $F = \frac{(2\sqrt{2}-1)q^2}{32\pi\varepsilon_0 h^2}$

1.153. $F = \frac{3p_e{}^2}{32\pi\varepsilon_0 h^4}$

1.154. a) $F = \frac{\tau^2}{4\pi\varepsilon_0 h}$; b) $\sigma = \frac{\tau h}{\pi(x^2+h^2)}$

1.155. a) $\sigma_0 = \frac{\tau}{2\pi h}$; b) $\sigma = \frac{\tau}{2\pi\sqrt{x^2+h^2}}$

1.156. a) $\sigma = \frac{qh}{2\pi(h^2+R^2)^{3/2}}$; b) $E = \frac{q}{16\pi\varepsilon_0 h^2(1+\frac{R^2}{4h^2})^{3/2}}$; $\varphi = \frac{q}{4\pi\varepsilon_0 R}\left(1-\frac{1}{\sqrt{1+\frac{4h^2}{R^2}}}\right)$.

1.157. $q_A = -\frac{q(d-x)}{d}$, $q_B = -\frac{qx}{d}$

1.158. $x_0 \cong 1\mu m$

1.159. $F = -Rdq^2/4\pi\varepsilon_0(d^2-R^2)^2$

1.160. $q' = \frac{1}{2}q$

1.161. $\varphi = \frac{q}{4\pi\varepsilon_0 r}$

1.162. a) $\sigma_p = hq(\varepsilon-1)/2\pi(\varepsilon+1)r^3$; b) $q_p = q(\varepsilon-1)/(\varepsilon+1)$

1.163. $F = \frac{q^2(\varepsilon-1)}{16\pi\varepsilon_0(\varepsilon+1)h^2}$

1.164. $\sigma_p = \frac{(\varepsilon-1)qh}{2\pi(\varepsilon+1)\varepsilon r^3}$

1.165. $\sigma_p = \frac{(\varepsilon-1)qh}{2\pi\varepsilon r^3}$

1.166. $C = \frac{4\pi\varepsilon_0\varepsilon R_1}{1+(\varepsilon-1)\frac{R_1}{R_2}}$

1.167. C = 0,39 pF

1.168. C = 105 pF, R = 945 mm

1.169. E = 44,5 kV/m, C = 1,48 pF

1.170. $\varphi = (C_1\varphi_1 + C_2\varphi_2)/(\varphi_1+\varphi_2)$

1.171. $C = \frac{C_1C_2}{C_1+C_2} = 1{,}2\ pF$

1.172. C = 800 pF

1.173. a) $C_{AB} = \frac{2\varepsilon_0\varepsilon S}{3d}$, b) $C'_{AB} = \frac{3\varepsilon_0\varepsilon S}{2d}$

1.174. $C = \frac{\varepsilon_0 S(2d_0+d)}{2d_0 d} = 7{,}9 \cdot 10^{-11} F$

1.175. $C = \frac{\varepsilon_0\varepsilon_1\varepsilon_2 S}{\varepsilon_1 d+(\varepsilon_2-\varepsilon_1)d_1}$

1.176. a) $C_j = \frac{2\varepsilon_0\varepsilon_1\varepsilon_2 S}{d(\varepsilon_1+\varepsilon_2)}$, b) $C_p = \frac{\varepsilon_0 S(\varepsilon_1+\varepsilon_2)}{2d}$

1.177. C = 44 pF

1.178. $C \approx 2\pi\varepsilon_0\varepsilon_a$

1.179. $C \approx 4\pi\varepsilon_0\varepsilon_a$

1.180. $C_{12} \approx \frac{\pi\varepsilon_0}{ln\frac{b}{a}}$

1.181. $C \approx 2\pi\varepsilon_0 / \, ln\frac{2b}{a}$

1.182. $U_1 = 7{,}5\ kV, \quad U_2 = 4{,}5\ kV$, q = 22,5 · $10^{-7} C$

1.183. U = 3500 V

1.184. $U_1 \leq \left(1 + \frac{C_1}{C_2}\right) = 9\ kV$

1.185. $C_{AB} = \frac{4C}{3}$

1.186. C = 1,63 μF

1.187. $C_x = \frac{C(\sqrt{5}-1)}{2} = 0{,}62\ C$

1.188. $U_1 = 3\ V, \quad U_2 = 1{,}5\ V, U_3 = 3\ V, \quad U_4 = 1{,}5\ V;\ U'_1 = 3{,}6\ V, \quad U'_2 = 1{,}8\ V,\ U'_3 = 3{,}6\ V, \quad U'_4 = 1{,}8\ V$

1.189. $C_{ag} = \frac{(-C_1+C_2+C_3)}{2}$, $C_{gf} = \frac{(C_1+C_2-C_3)}{2}$, $C_{af} = \frac{(C_1-C_2+C_3)}{2}$

1.190. U = 100 V

1.191. $\frac{E_2}{E_1} = 3/2$

1.192. F = 0,05 N; U = 1,3 MV; $\sigma = 49\ \mu C/m^2$

1.193. $\kappa = 5;\ \sigma_p = 4 \cdot 10^{-5}\ C/m^2$

1.194. E = 300 kV/m; $\sigma = 1{,}6 \cdot 10^{-5}\frac{C}{m^2};\ \sigma_p = 1{,}3 \cdot 10^{-5}\frac{C}{m^2}; \quad \kappa = 5$

1.195. a) Elektrivälja tugevus väheneb 2 korda, elektrinihe jääb muutumatuks.

b) Elektrivälja tugevus jääb muutumatuks, elektrinihe suureneb 2 korda.

1.196. a) $\Delta\sigma = \frac{\varepsilon_0(\varepsilon-1)U}{d} = 1{,}77 \cdot 10^{-5}\frac{C}{m^2};\ \sigma_p = \frac{\varepsilon_0(\varepsilon-1)U}{d} = 1{,}77 \cdot 10^{-5}\frac{C}{m^2}$;

b) $\Delta\sigma = 0$, $\sigma_p = \frac{\varepsilon_0(\varepsilon-1)U}{\varepsilon d} = 2{,}53 \cdot 10^{-6}\frac{C}{m^2}$.

1.197. $\Delta\sigma = \frac{\varepsilon_0(\varepsilon-1)U}{d}$

1.198. $U_2 = 1{,}8\ kV$

1.199. $U_2 = \frac{2U_1}{(\varepsilon+1)} = 60\ V$

1.200. a) $E_1 = \frac{2\varepsilon E_0}{\varepsilon+1}$, $E_2 = \frac{2E_0}{\varepsilon+1}$, $D_1 = D_2 = \frac{2\varepsilon_0\varepsilon E_0}{\varepsilon+1}$

b) $E_1 = E_0$, $E_2 = \frac{E_0}{\varepsilon}$, $D_1 = D_2 = \varepsilon_0 E_0$

1.201. $E_p = 25\ kV/m, E_{\tilde{o}} = 50\ kV/m$

1.202. $E_{\tilde{o}} = 175\ kV/m$

1.203. a) $E_1 = E_2 = E_0$, $D_1 = \varepsilon_0 E_0, D_2 = \varepsilon_0\varepsilon E_0$;

b) $E_1 = \frac{2E_0}{\varepsilon+1} = E_2, D_1 = D_2 = \frac{2\varepsilon_0 E_0}{\varepsilon+1}, D_2 = \frac{2\varepsilon_0\varepsilon E_0}{\varepsilon+1}$

1.204. $E_{vilk} = E_{vask} = 150\ kV/m$

1.205. $k = \frac{\varepsilon_1}{\varepsilon_1+\varepsilon_2}, \quad \frac{E_2}{E_1} = \frac{\varepsilon_1}{\varepsilon_2}, \quad E_2 = E_1$

1.206. $E = 136\frac{kV}{m}, C = 131\ pF$

1.207. $\frac{R_2}{R_1} = e$, kus e on naturaallogaritmi alus.

1.208. a) $U_1 = 3880\ V$, b) $U_2 = 9650\ V$

1.209. Läbilöögi saab esimene kiht pingel 44,5 kV.

1.210. $q = \frac{\varphi_1\varphi_2}{\varphi_1-\varphi_2}C_0$

1.211. $W_e = \frac{q_1q_2+q_1q_3+q_2q_3}{4\pi\varepsilon_0 a} = -63\ \mu J$

1.212. $W_e = 5{,}4 \cdot 10^{-4}\ J$

1.213. $W = \frac{-q^2}{8\pi\varepsilon_0 d}$

1.214. $v = \frac{e}{\sqrt{4\pi\varepsilon_0 md}} \approx 160\ m/s$

1.215. $v = \frac{e}{\sqrt{2\pi\varepsilon_0 md}} \approx 225\ m/s$

1.216. $\frac{W_2}{W_1} = \frac{C_1}{C_1+C_2}$

1.217. $\Delta W = -\frac{1}{2}\frac{C_1C_2}{C_1+C_2}U^2 = -0{,}03\ J$

1.218. $\Delta W = \frac{C_1C_2(\varphi_1-\varphi_2)^2}{2(C_1+C_2)} = 120\ \mu J$

1.219. $\Delta W = 3 \cdot 10^{-5}\ J$

1.220. $q = 2{,}7\ \cdot 10^{-6}\ C$

1.221. a) A = - ΔW, b) A = ΔW

1.222. A = $\frac{\varepsilon_0(d_2-d_1)SU^2}{2d_1^2} = 0{,}55\ mJ$

1.223. A = $\frac{q^2(d_0-d)}{2\varepsilon_0 S}$

1.224. A = $\frac{\varepsilon_0 S d_0 U^2}{2(d-d_0)^2} = 12\ mJ$

1.225. a) $\Delta W_1 = -3{,}2\ \cdot 10^{-5}J;\ A_1 = 3{,}2\ \cdot 10^{-5}J$;

b) $\Delta W_2 = 1{,}6\ \cdot 10^{-4}J;\ A_2 = 1{,}6\ \cdot 10^{-4}J$

1.226. a) $A_1 = \Delta W_1 = \frac{\varepsilon\sigma^2 pV}{2\varepsilon_0(\varepsilon-1)} = 9{,}8\ \cdot 10^{-5}J$;

b) $A_2 = \frac{\sigma^2 pV}{2\varepsilon_0(\varepsilon-1)} = 2{,}0\ \cdot 10^{-5}J$

1.227. C = $\varepsilon_0 S(\varepsilon+1)/2d$, $E_{\tilde{o}} = E_d = 2U/(\varepsilon+1)d$,

$\sigma_{\tilde{o}} = 2\varepsilon_0 U/(\varepsilon+1)d$, $\sigma_d = 2\varepsilon_0\varepsilon U/(\varepsilon+1)d$, $\Delta W = \frac{\varepsilon_0(1-\varepsilon)SU^2}{2(\varepsilon+1)d}$

1.228. $N = (\varepsilon_0 SU^2/2x^2) \cdot \frac{dx}{dt}$

1.229. F = $\frac{-q^2}{2\varepsilon_0\varepsilon S}$

1.230. $p_e = 3{,}2\ \cdot 10^4\ N/m^2$

1.231. $w_e = 2{,}5\ J/m^3$

1.232. $q = 1{,}77\ \cdot 10^{-7}\ C,\ E = 3{,}34\ \cdot 10^5\ V/m,\ w_e = 2{,}9\ J/m^3$

1.233. F = $\frac{q^2}{2\varepsilon_0 S} = 5{,}65\ \cdot 10^{-4}N$

1.234. $U = \sqrt{2F/\varepsilon_0 S} = 1065\ V$

1.235. F = $\varepsilon_0\varepsilon^2 SU^2/2(\varepsilon d_1 + d_2)^2$

1.236. $U = d\sqrt{2mg/\varepsilon_0 S} = 15\ kV$

1.237. $W_e = 0{,}18\ J$, $F_1 = 7{,}2\ N$, $F_2 = -1{,}8\ N$

1.238. $M = nq^2h/2\varepsilon_0\varepsilon R^2\alpha^2$, kus q on ühe plaadi laeng.

1.239. $w_e = 9{,}4 \cdot 10^{13}\ J/m^3$

1.240. $w_1 = 0,\ \ w_2 = 0{,}028\ J/m^3$

1.241. $\tau = 2{,}9 \cdot 10^{-7}\ C/m,\ \ \sigma_1 = 4{,}6 \cdot 10^{-6}\ C/m^2,\ \sigma_2 = 2{,}3 \cdot 10^{-6}\ C/m^2;\ W_e = 8{,}7 \cdot 10^{-5}$ J

1.242. $a)\ W_e = 3q^2/20\pi\varepsilon_0 R;$ b) $\frac{W'_e}{W''_e} = 1/5$

1.243. $W_e = \left(\frac{q^2}{8\pi\varepsilon_0\varepsilon}\right)\left(\frac{1}{a} - \frac{1}{b}\right) = 27\ mJ$

1.244. $W_e = -13{,}6\ eV$

1.245. $q = 4{,}1 \cdot 10^{-18}\ C$

1.246. $v = 1{,}54 \cdot 10^7 m/s$

1.247. $v = 1{,}46 \cdot 10^7 m/s$

1.248. $a = \frac{eU}{rm\ ln\left(\frac{r_2}{r_1}\right)} = 10^{15} m/s\ ,\ v = \sqrt{\frac{2eU\ ln\left(\frac{r_2}{r_1}\right)}{m\ ln\left(\frac{r_2}{r_1}\right)}} = 5{,}4 \cdot 10^6 m/s,\ W_{max} = 91\ eV$

2.1. $q = 15$ C

2.2. $q = 75$ C

2.3. $q = 0{,}27$ C

2.4. $E = \left(\frac{I}{2\pi\varepsilon_0 r}\right)\sqrt{\frac{m}{2eU}} = 1{,}7\ kV/m,\ \Delta\varphi = \left(\frac{I}{4\pi\varepsilon_0}\right)\sqrt{\frac{m}{2eU}} = 42V$

2.5. $i = \frac{\varepsilon_0(\varepsilon-1)\varepsilon_a}{d}$v $= 2\ nA$

2.6. $i = \frac{2\pi\varepsilon_0(\varepsilon-1)rvU}{d} = 0{,}11\ \mu A$

2.7. $i = \frac{qv}{d}$

2.8. $i = 2\pi\varepsilon_0 REV = 0{,}5\ \mu A$

2.9. $i_{max} = 2\varepsilon_0 E_m \cdot vd = 1\ mA;\ \varphi_{max} = RE_m = 4{,}5$ MV

2.10. $j_s = 3{,}8\ A/m^2,\ j_n = 1{,}9 \cdot 10^3\ A/m^2$

2.11. $q = \frac{\tau(U_2+U_1)}{2R} = 20$ C

2.12. $q = \frac{i_1 i_2 \tau \ln\left(\frac{i_1}{i_2}\right)}{i_1 - i_2} \approx 69C$

2.13. $t = RC\ ln\frac{U_0}{U_0-U} = 0{,}6\ \mu s$

2.14. $\rho = t_0/\varepsilon_0\varepsilon\ ln2 = 1{,}4 \cdot 10^{13}\Omega$m

2.15. $i = [(\eta - 1)\varepsilon/R]\mathrm{e}^{-\eta t/RC}$

2.16. $i = \frac{U_0}{R}\exp\left(-\frac{C_1+C_2}{C_1C_2R}t\right);\ Q = \frac{C_1+C_2}{2(C_1+C_2)}U_0^2$

2.17. $R = 5{,}4\ \Omega$

2.18. $n = \frac{R_0}{R} = 6$

2.19. $R_{AB} = 0{,}65\ \Omega$

2.20. $R_{AB} = \frac{5}{11}r$

2.21. $R_{AB} = 1{,}0\ \Omega$

2.22. $x_1 = 5{,}64$ cm, $\ R_1 = 1{,}13\ \Omega,\ x_2 = 44{,}36$ cm, $\ R_2 = 8{,}87\ \Omega$

2.23. $R_{AB} = 0{,}875\ \Omega$

2.24. $R_{AB} = 1{,}5\ \Omega$

2.25. $R_{AB} = 1{,}25\ \Omega$

2.26. $R_{2-8} = 1\ \Omega$, $R_{2-7} = 3/4\ \Omega$, $R_{4-6} = 3/2\ \Omega$

2.27. $R_{17} = 5/6\ \mathrm{R}$, $R_{12} = \frac{7}{12}\mathrm{R}$, $R_{13} = 3/4\ \mathrm{R}$

2.28. $r = R_0/\sqrt{3}$

2.29. $R = 3\ \Omega$

2.30. $R_{AB} = \left(1 + \sqrt{1 + \frac{4R_2}{R_1}}\right)\frac{\mathrm{R}_1}{2} = 6\Omega$

2.31. $R = 5{,}46\ \mathrm{r}$

2.32.

2.33. $R = 2{,}3\ \Omega$

2.34. $R = \frac{\rho}{2\pi l}\ln\frac{\mathrm{r}_2}{\mathrm{r}_1}$

2.35. $R = \frac{\rho}{4\pi}(\frac{1}{\mathrm{r}_1} - \frac{1}{\mathrm{r}_2})$

2.36. $i = \frac{UC}{\varepsilon_0\varepsilon\rho} = 975\ pA$

2.37. $R = \frac{\rho}{2\pi D} = 1{,}5 \cdot 10^2\ \Omega$

2.38. $\frac{\mathrm{d}r}{\mathrm{d}t} = \frac{1}{4\pi\varepsilon_0 R} = 10^{-4} m/s$

2.39. $R = \frac{\pi\rho(r_2 - r_1)}{\mathrm{S}\ln\frac{\mathrm{r}_2}{\mathrm{r}_1}} = 1{,}54 \cdot 10^{-5}\ \Omega$; $i = 319\ A$; $j = \frac{U}{\pi\rho x} = 64\ A/cm^2$

2.40. a) $j = \frac{2ahU}{\rho r^3}$; b) $R = \frac{\rho}{4\pi a}$

2.41. $R \approx \frac{\rho}{2\pi a}$

2.42. a) $j = \frac{Ud}{2\rho r^2}\ln\frac{\mathrm{d}}{\mathrm{a}}$; b) $R = \frac{\rho}{\pi}\ln\frac{\mathrm{d}}{\mathrm{a}}$

2.43. $i = \frac{UC}{\varepsilon_0\varepsilon\rho} = 1{,}5\ \mu A$

2.44. $i = \frac{US(\sigma_2 - \sigma_1)}{d\ ln\frac{\sigma_2}{\sigma_1}} = 5\ nA$

2.45. a) $R = \frac{2\pi a}{\mathrm{S}^2}$; b) $E = \frac{2\pi aI}{\mathrm{S}^2}$

2.46.

2.47. $j = 4{,}1\ A/mm^2$

2.48. $t \approx 1900°C$

2.50. $\alpha = 4{,}92 \cdot \frac{10^{-3}1}{K}\frac{l_{Fe}}{l_C} = 44{,}4$

2.51.

2.52. $U_1 = 6{,}54\ V$, $U_2 = 3{,}27\ V$, $U_1 = 2{,}19\ V$

2.53. $S = 1\ mm^2$

2.54. $tan\ \gamma = \frac{R^2}{\mathcal{E}}$

2.55. $tan\ \gamma = \frac{\mathcal{E}}{r}$

2.56. $\frac{dR}{di} = -\frac{(r_i + R_A + R)^2}{\mathcal{E}}$, s.t. takistuse mõõtmise täpsus on seda väiksem, mida suurem on R.

2.57. $R_{\check{s}} = 16{,}7\ \Omega$

2.58. a) $R_{\check{s}} = 0{,}1\ \Omega$; b) $R_e = 90\ \Omega$

2.59. $R_e = 10^{\,5}\Omega, \quad R_š = 0{,}1\ \Omega$

2.60. i = 6A

2.61. U = 1000 V

2.62. $r_1 = 290\ \Omega,\ r_2 = 1200\ \Omega,\ r_3 = 6000\ \Omega,\ r_4 = 7500\ \Omega$

2.63. $\alpha = 4{,}2\ \mu A/j$

2.64. $R_g = \frac{(R_1 - R_2)r}{R_2} = 20\ \Omega$

2.65. a) $U_1 = 45\ V,\ U_2 = 15\ V$;

b) $U_1 = 20\ V;\ U_2 = 40\ V;$

c) $U_1 = 60\ V,\ U_2 = 0$

2.66. $\varphi_1 - \varphi_2 = \frac{(\mathcal{E}_1 - \mathcal{E}_2)R_1}{R_1 + R_2} - \mathcal{E}_1 = -4V$

2.67. $U_v = 0{,}5\ V$

2.68. $\varphi_B - \varphi_A = 72{,}5\ V,\ \ \varphi_B - \varphi_C = 32{,}5\ V$

2.69. $U = 15\ V$

2.70. $U_{AB} = U_{BC} = 1{,}25\ V$

2.71. $U_{12} = 3\ V,\ \ U_{16} = 0{,}9\ V,\ U_{56} = 1{,}9\ V,\ U_{34} = 3{,}8\ V$

2.72. $\Delta\varphi = 0,\ \ \Delta\varphi' = 0,\ \ \Delta\varphi'' = 0\ v\tilde{o}i\ \Delta\varphi'' = \mathcal{E}$

2.73. $\mathcal{E}_2 < \frac{\mathcal{E}_1 r_2}{R + r_1}$

2.74. $R = r_2 - r_1;\ \Delta\varphi = 0$ selle vooluallika klemmidel, mille sisetakistus on r_2.

2.75. a) $2\mathcal{E}_2 > \mathcal{E}_1$,

b) $\mathcal{E}_1 > 2\mathcal{E}_2$,

c) $2\mathcal{E}_2 = \mathcal{E}_1$.

2.76. $U''_1 = 1{,}75\ V;\ \ U''_2 = -1{,}5\ V$

2.77. $U = 0$

2.78. $U_{AB} = 3{,}7\ V,\ U_{BC} = 10{,}6\ V,\ U_{AC} = 14{,}3\ V$

2.79. $U_V = -1{,}7\ V$, punkti C potentsiaal on suurem kui punktil A.

2.80. $tan\ \alpha = -\frac{\mathcal{E}}{{R_1}^2}$

2.81. i_A sõltub vähe R_x − st, kui

1) $R_x \gg R$, niisugusel juhul $i_A = \frac{\mathcal{E}}{r+R}$;

2) $r \ll R_x$, niisugusel juhul $i_A = \frac{\mathcal{E}}{R}$;

3) $r \ll R$, niisugusel juhul $i_A = \frac{\mathcal{E}}{R}$.

2.82. a) $R = \sqrt{3}r$;

b) $R = \frac{1}{\sqrt{3}}r$.

2.83. $i = \frac{\mathcal{E}(R_1+R_2)}{rR_1+rR_2+R_1R_2}$, $i_1 = \frac{\mathcal{E}R_2}{rR_1+rR_2+R_1R_2}$, $\frac{i'_1}{i_1} = \frac{rR_1}{R_2(r+R_1)} + 1$. Kui $r \ll R$, siis $\frac{i'_1}{i_1} = \frac{r}{R_2} + 1$

2.84. $U_V = 25\ V$

2.85. $U_1 = U\frac{lR_x}{R_0 lx - R_0 x^2 + Rl^2}$

2.86. $R = 29{,}97\ \Omega,\ \frac{\Delta R}{R} = 0{,}1\ \%,\ R' = 0{,}27\ \Omega,\ \frac{\Delta R'}{R'} = 10\ \%.$

2.87. $R = 3{,}01\ \Omega,\ \frac{\Delta R}{R} = 0{,}3\ \%,\ R' = 428\ \Omega,\ \frac{\Delta R'}{R'} = 30\ \%.$

2.88. $\frac{\Delta\mathcal{E}}{\mathcal{E}} = 0{,}5\ \%$

2.89. $R = 1300\ \Omega,\ r = 325\ \Omega,\ \ R_v = 13260\ \Omega$

2.90. $U = 51\ V$

2.91. $R_4 = \frac{U(R_1R_2+R_1R_3+R_2R_3)}{IR_2R_3-U(R_2+R_3)}$

2.92. Reostaadi takistus peab olema vähemalt 3 Ω ja taluma voolu 45 A.

2.93. $i_{max} = 10$ A

2.94. $r\frac{m}{n} = R$, mis võimalik, kui $Nr \geq R$. $i_{max} = \frac{m\mathcal{E}}{2R}$.

2.95. $r_{ekv} = 0{,}6\ \Omega,\ \ \mathcal{E}_{ekv} = 2{,}6$ V.

2.96. $i = 0{,}75\ A,\ U_V = 0$

2.97. $U_V = 0{,}75$ V, kui voltmeetri takistus on piisavalt suur.

2.98. $\varphi_B - \varphi_A = 0{,}35\ V$

2.99. $U_V = 0$

2.100. $U_a = 0,\ U_b = 0,\ U'_a = 0{,}75\ V, U'_b = 0{,}5\ V.$

2.101. $U_V = 1{,}2\ V,\ U'_V = 2{,}2\ V$

2.102. $i_1 = 2\ A,\ \ i_2 = 1\ A$

2.103. $i_{CD} = 0{,}5\ A$

2.104. $R_4 = \frac{U_{21}(R_1R_2+R_1R_3+R_2R_3)}{IR_2R_3-U_{21}(R_2+R_3)}$

2.105. $U = 6{,}8\ V$

2.106. $i = 0{,}02$; voolu suund vasakult paremale (joon. 2.52).

2.107. $i_1 = 1{,}05\ A;\ i_2 = 0{,}87\ A,\ U = 1{,}8\ V.$

2.108. $i_1 = 6{,}4\ A;\ i_2 = 5{,}8\ A,\ i_R = 0{,}6\ A.$

2.109. $i_1 = 1{,}28\ A;\ i_2 = 1{,}85\ A,\ i_3 = 0{,}57\ A.$

2.110. $i_1 = 1\ mA;\ \ \mathcal{E}_2(R_1 + R) = \mathcal{E}_1R$

2.111. $i_1 = 5/13\ A;\ i_2 = 1/13\ A,\ i_3 = 4/13\ A.$

2.112. $i_1 = 1{,}82\ A;\ i_2 = 2{,}01\ A,\ i_3 = 0{,}19\ A.$

2.113. $U_2 = 3\ V;\ i_3 = 1\ A, R_2 = 3\ \Omega;\ \ R_1\ ja\ R_2$ on suvalised.

2.114. $i_1 = i_3 = 4\ A,\ i_2 = 0,\ U = 4\ V$

2.115. $i_1 = 0{,}06\ A;\ \ \varphi_A - \varphi_B = 0{,}9\ V$

2.116. $i_1 = 0{,}8\ A;\ i_2 = 0{,}5\ A,\ i_3 = 1{,}3\ A.$

2.117. $i_1 = 1{,}5\ A;\ i_2 = 2{,}5\ A,\ i_3 = 4{,}0\ A.$

2.118. $\mathcal{E}_2 = \mathcal{E}_3(1 + R_2/R_3),\ \ i_1 = \mathcal{E}_1/R_1 - (\frac{\mathcal{E}_3}{R_1})(1 + R_2/R_3)$

2.119. $i_1 = 1{,}49\ A;\ i_2 = 0{,}65\ A,\ i_3 = 0{,}84\ A.$

2.120. $\varphi_A - \varphi_B = -\ 0{,}5\ V$

2.121. $i_1 = i_2 = \ i_3 = i_4 = 1\ A$

2.122. $i = \frac{8}{7}A$

2.123. $i_1 = 3\ A,\ i_2 = 0,\ \ i_3 = 1\ A,\ i_4 = 2\ A$

2.124. $r_x = \frac{r_x[Ur_4-i(Rr_3+Rr_4+r_3r_4)]}{Ur_3+i(Rr_3+Rr_4+r_2r_3+r_2r_4+r_3r_4)}$

2.125. $\mathcal{E}_2 = 2\ V$, vooluallika +poolus ühendada punktiga A.

2.126. $\mathcal{E} = [R_1(R_2R_5 + R_3R_5 + R_4R_5 + R_2R_4 + R_3R_4) + R_3(R_2R_4 + R_2R_5 + R_4R_5)]\frac{i_4}{R_3R_5}$

2.127. $R_{AB} = \frac{7}{5}\,r$

2.128. $i = 4{,}18\ A,\ i_1 = 1{,}64\ A,\ i_2 = 2{,}84\ A,\ i_3 = 0{,}18\ A,\ i_4 = 2{,}36\ A,\ i_5 = 1{,}82\ A$

2.129. $x = \frac{1}{2}$

2.130. $a \approx 224\ rbl$

2.131. $W_a = 18 \cdot 10^5 kWh$

2.132. $i = 16A,\quad Q = 570kJ, j = 55\ A/mm^2, n = 10^{22}1/s, u = 4{,}1 \cdot 10^{-3}m/s$

2.133. $t = 2200℃$

2.134. $\frac{P_{r_1}}{P_{r_2}} = 3/5$

2.135. Väiksemale võimsusele arvestatud lamp helendub intensiivsemalt.

2.136.

2.137. Potentsiaalide vahe lambil väheneb 22 V võrra.

2.138. $R = 14{,}4\ \Omega$

2.139. $R_x = 19\ \Omega$ või $1{,}3\ \Omega$

2.140. $R = 2\ \Omega$ ja $i = 0{,}5\ A$ või $R = 0{,}5\ \Omega$ ja $i = 1\ A$.

2.141. Järjestikuses lülituses 30 min, paralleelses lülituses 6 min 40 s.

2.142. n = 13,3 keerdu

2.143. $\frac{\Delta t}{\Delta \tau} = 0{,}009\frac{K}{s}$

2.144. $p = 1680\ W$

2.145. $N = 23$

2.146. $d = 3\ cm$

2.147. $i = 1{,}63\ A$

2.148. $t = 5 \cdot 10^{-5}s$

2.149. a) $U_1 \approx 95\ V, P_1 \approx 45\ W;\ \ U'_1 \approx 97{,}6\ V, P'_1 \approx 23\ W;\ i' \approx i/2;$
b) $U_2 \approx 100\ V, P_2 \approx 0{,}1\ W;\ \ U'_2 \approx 200\ V, P'_2 \approx 0{,}2\ W;\ i_2' \approx i_2$.

2.150. a) $A = Q = 2\ J;$ b) $A = 2\ J, Q = 0{,}7\ J;$ c) $A = -2\ J, Q = 0{,}6\ J$

2.151. $r = \sqrt{R_1R_2} = 4\ \Omega$

2.152. $\eta = 60\ \%,\ \ R_1 = 18\ \Omega,\ \ R_2 = \infty$

2.153.

2.154.

2.155.

2.156. $P_{max} = \frac{\mathcal{E}_{imax}}{4} = 15\ W$

2.157. $P_{max} = 9\ W$

2.158. $\mathcal{E} = 3{,}75\ V, P_{max} = 6{,}7\ W < 9\ W$

2.159. $P_{max} = 10\ W$

2.160. $R = 3r$

2.161. k = 42 %; $P_{max} = 6{,}45\ W$; k' = 56 %

2.162. $R = 1{,}5\ \Omega; i = 2{,}5\ A; P = 18{,}75$ W

2.163. $n = \sqrt{Nr/R} = 3$

2.164. $R = 6/5\ \Omega,\ P_{max} = 14{,}7\ W$

2.165. $l_1 = l\sqrt[3]{\frac{P_1}{P}\frac{U_1^2}{U^2}},\ \ r_1 = r\sqrt[3]{\frac{U^2}{U_1^2}\frac{P_1^2}{P^2}}$

2.166. $U = 4V,\ \ i = 0{,}55\ A$

2.167. $t = \frac{U^2 + R_0 k t_0}{R_0 k - U^2 \alpha}$

2.168. $Q = 100\ kJ$

2.169. $Q = 2480\ J$

2.170. $A = 2480\ J$

2.171. $A = \frac{IU}{3}t$

2.172. $Q = 475\ J$

2.173. $Q = 15{,}5\ J$

2.174. a) $Q = \frac{4q^2R}{3\Delta t};\ \ b)\ Q = R_q^2\ ln\ 2/2\Delta t$

2.175. $Q = \frac{CU^2R}{2(R_1+R_2)} = 80\ mJ$

2.176. a) $q = q_0 e^{-\frac{t}{\varepsilon_0 \varepsilon \rho}};$ b) $Q = \left(\frac{1}{a} - \frac{1}{b}\right) q_0^2/8\pi\varepsilon_0\varepsilon$

2.177. a) $q = q_0 e^{-\frac{\Delta t}{RC}} = 0{,}82\ mC;$ b) $Q = \left(1 - e^{-\frac{2\Delta t}{RC}}\right) q_0^2 = 82\ mJ$

2.178. a) $i = \left(\frac{U_0}{R}\right) e^{-\frac{2\Delta t}{RC}};$ b) $Q = 1/4CU_o^2$

2.179. $U = \frac{mv_0^2 l}{2ed} = 14\ \mu V$

2.180. $a = \frac{eU}{ml} = 1{,}8 \cdot 10^5 m/s^2$

2.181. $q = \frac{m}{e} \cdot \frac{ND^2\pi^2\nu}{R + 4\rho\frac{ND}{d^2}} = 1{,}1\ \cdot 10^{-10}\ C$

2.182. $v_0 = \frac{qeR}{ml} = 7{,}03\frac{m}{s}$

2.183. $v \approx 10^5 \frac{m}{s},\ \ u \approx 7 \cdot 10^{-5} m/s$

2.184. $n = \ 10^{20}\frac{1}{s},\ u = 4{,}15 \cdot 10^{-3} m/s$

2.185. $\frac{n_{Cu}}{n_W} = 1{,}35;\ \frac{\tau_{Cu}}{\tau_W} = 2{,}4;\ \frac{u_{Cu}}{u_W} = 0{,}74$

2.186. $t = \ln eS/i = 3\ Ms$

2.187. $s = \ln ev/j \approx 5 \cdot 10^6\ m,$ kus n on elektronide kontsentratsioon ja v nende soojusliikumise keskmine kiirus.

2.188. $K = 28{,}4 \cdot 10^{-7}\ kg \cdot m/s$

2.189. $t = 235\ a,\ F = 9{,}4 \cdot 10^4 N$

2.190. $N = 1{,}27 \cdot 10^{19}\frac{1}{s},\ E = 8{,}6 \cdot 10^{-2} V/m$

2.191. $\lambda = 390\ J/m \cdot s \cdot k$

2.192. $\Delta W = 1{,}1\ eV$

2.193. $n = 2{,}5 \cdot 10^{19} m^{-3}$

2.194. $t = 76{,}4\ ℃$

2.195. $i = 80\ \mu A$

2.196. $\Delta T = 0{,}7\ K$

2.197. $q = 1480\ C$

2.198. $u = 9{,}8 \cdot 10^{-5}\frac{m}{s},\ N = 3{,}94\ \cdot 10^{16} 1/s$

2.199. $W_{min} = 1eV,\ e_{max} = 3{,}2 \cdot 10^{15} m/s^2$

2.200. $a)\ \rho(x) = -\frac{4}{9}\varepsilon_0 a x^{-2/3}$; b) $j = \frac{4}{9}\varepsilon_0 a^{3/2}\sqrt{2e/m}$

2.201. $I_k = 0{,}14\ A$

2.202. $e\varphi = 3{,}1\ eV$

2.203. $\frac{j_W}{j_{Th}} = 10^{-4}$

2.204. $N = 5 \cdot 10^{18}\ 1/s,\ q = 3{,}2\ \cdot 10^{-19}\ C$

2.205. $d = 0{,}03\ mm$

2.206. $\frac{q}{m} = 3 \cdot 10^6\ C/kg$

2.207. $W = 1{,}8 \cdot 10^7\ J$

2.208. $H = 4{,}4\ kop$

2.209. $10{,}4\ \cdot 10^{-4}\ kg;\ 6{,}95 \cdot 10^{-4}\ kg;\ 13{,}2 \cdot 10^{-4}\ kg;\ 1{,}86 \cdot 10^{-5}\ kilomooli;$
$3{,}72 \cdot 10^{-5}\ kilomooli;\ 11{,}2 \cdot 10^{22}\ aatomit;\ 2{,}24 \cdot 10^{22}\ aatomit$

2.210. $m = 5{,}8 \cdot 10^{-6}\ kg$

2.211. $V = 2{,}09 \cdot 10^{-3}\ m^3$

2.212. $k = 0{,}987 \cdot 10^{-6}\ kg/C;\quad i = 0{,}84\ t$

2.213. $\alpha = 0{,}77$

2.214. $\sigma = 31{,}41\ 1/\Omega m$

2.215. $p_+ = 0{,}844,\ p_- = 0{,}156$

2.216. $p_+ = 0{,}5$

2.217. $\frac{k_+}{k_-} = 2{,}5$

2.218. $\mathcal{E} = 1{,}19\ V$

2.219.

2.220. $d = 0{,}1\ mm$

2.221. $\Delta\varphi = 67{,}8\ V$

2.222. $v_1 = 1{,}2 \cdot 10^4\ m/s,\ v_2 = 2{,}1 \cdot 10^6\ m/s$

2.223. $\Delta\varphi = 28{,}3\ V$

2.224. Ei suuda

2.225. $\delta = 10^{-6}\ cm^3/s,\ \frac{n_0}{n} = 101$

2.226. $\tau_2 = \frac{1}{\delta n_0} = 0{,}06\ s,\quad \tau_4 = \frac{3}{\delta n_0} = 0{,}18\ s$

2.227. $t = \frac{\eta - 1}{\sqrt{\Delta n \delta}} = 13\ ms$

2.228. $\sigma = \delta/4\ = \sqrt{\pi M/RT} \approx 2{,}5 \cdot 10^{-11} cm^2$, kus M on õhu mooli mass ja R – gaasi universaalkonstant.

2.229. Suureneb 8600 korda.

2.230. $t = 3{,}75 \cdot 10^{-4}\ s$

2.231. $u_+ = 1{,}08\ m/s,\ u_- = 1{,}62\ m/s$

2.232. $k = \omega_0 d^2\ /2U_0$

2.233. $E < \frac{\omega d m v_{en}}{2e} \approx 1{,}7 \cdot 10^2\ V/m$

2.234. $\rho = 2{,}6 \cdot 10^{13} \Omega m$

2.235. $\sigma = 11{,}8 \cdot 10^{-9} S/cm$

2.236. $n = 1{,}5 \cdot 10^{8} 1/cm^3$

2.237. $j = 4{,}8 \cdot 10^{-10} A/m^2$

2.238. $\Delta n = 1.2 \cdot 10^{9}\ 1/cm^3 s$

2.239. $U = 1{,}47\ \mu V$

2.240. $t = \frac{\varepsilon_0 \eta U}{e \Delta n d^2} = 4{,}6$ ööpäeva

2.241. $n_0 = 3{,}2 \cdot 10^{7} cm^{-3}$, $i = 3{,}3 \cdot 10^{-9} A$; $\frac{i}{i_k} = 34 \cdot 10^{-3}$, $t = 0{,}03 s$

2.242. Kui vool on küllastamata, siis $\frac{j_-}{j} = 0{,}58$; kui küllastunud, siis $\frac{j_-}{j_k} = 2/3$.

2.243. $n = \sqrt{\frac{j_k}{e \delta d}} = 4{,}4 \cdot 10^{12} m^{-3}$

2.244. $\alpha = \frac{p}{\lambda_0} \exp\left(-\frac{U_i p}{E \lambda_0}\right) = 74\ m^{-1}$

2.245. $j = e \nu_0 exp\ (\alpha d)$.

2.246. $j = e \Delta n\ (e^{\alpha d} - 1)/\alpha$

2.247. $U_k = (\frac{9 \varepsilon_0 k_+ U_k^2}{8j})^{1/3} \approx 5 \cdot 10^{-6} cm$

2.248. $E_r = \frac{e \alpha r_0}{3 \pi \varepsilon_0 r^2} e^{\alpha u t}$, kus r on kaugus laviini keskpunktist ja u – elektronide suunatud liikumise keskmine kiirus.

2.249. $\varphi = \frac{q}{4 \pi \varepsilon_0 r} \exp\ (-\frac{r}{r_D})$, kus $r_D = \sqrt{\frac{\varepsilon_0 kT}{2e^2 n}}$, milles n on laetud osakeste kontsentratsioon.

3.1 $B = 17{,}4 \cdot 10^{-5} T$

3.2 $B = \frac{\mu_0 di}{2 \pi r_1 r_2} = 2 \cdot 10^{-5} T$

3.3 3,87 cm juhtmest A vasakul ja 6,36 cm paremal.

3.4 Juhtmetega paralleelsetel sirgetel, mis asetsevad esimesest juhtmest kaugusel 0,88 cm ja 5,12 cm teiste juhtmete suunas.

3.5 Punktid, kus $B = 0$, asetsevad vooluga juhtmetega paralleelsel sirgel, mille kaugus juhtmest vooluga i_1 on 2 cm ja juhtmest vooluga i_2 – 1 cm.

3.6 $B = \frac{2 \mu_0}{\pi a} i = 8 \cdot 10^{-5} T$

3.7 $a = 2\ cm$

3.8 Kui $\alpha = \beta$, siis $B = \frac{\mu_0 i}{2 \pi r}(1 + \cos \alpha)$; kui $\alpha \neq \beta$, siis $B = \frac{\mu_0 i}{4 \pi r} \sqrt{6 + 4(\cos \alpha + \cos \beta) + 2 \cos\ (\alpha + \beta)}$

3.9 $B = \frac{\mu_0 i \sqrt{2}}{4 \pi r}$, kus r on punkti kaugus nurga tipust.

3.10 $B_1 = \frac{\mu_0 i}{2 \pi x}(\sqrt{2} + 1) = 9{,}7 \cdot 10^{-5} T$, $B_2 = \frac{\mu_0 i}{2 \pi x}(\sqrt{2} - 1) = 1{,}7 \cdot 10^{-5} T$

3.11 $B = 0$

3.12 $B = \frac{2 \sqrt{2} \mu_0 i}{\pi a} = 3{,}4 \cdot 10^{-5} T$

3.13 $B = \frac{2\mu_0 i}{\pi ab}\sqrt{a^2 + b^2}$

3.14 $B = \frac{2\mu_0 i}{\pi Dh}\sqrt{D^2 + h^2} \cdot \sqrt{4 + 2\sqrt{2}}$

3.15 $B = 0$

3.16 $B = \frac{9\mu_0 i}{2\pi a}$

3.17 $B = 0$

3.18 $B = 0$, sõltumata liugkontakti asendist.

3.19 $B = 4B_1$

3.20 $B_1 = \frac{\mu_0 i}{2}\left[\frac{1}{R} + \frac{R^2}{(R^2+4a^2)^{\frac{3}{2}}}\right] = 3{,}3 \cdot 10^{-5}T,\ B_2 = \frac{\mu_0 i R^2}{(R^2+a^2)^{\frac{3}{2}}} = 1{,}5 \cdot 10^{-15}T$

3.21 $\delta_1 = 25°,\ \ \delta_2 = 65°$

3.22 $i \approx 1\ A$

3.23 a) $B = \frac{\mu_0 i}{4\pi R}\pi$; b) $B = \frac{\mu_0 i}{4\pi R}(\frac{3}{2}\pi + 1)$; c) $B = \frac{\mu_0 i}{4\pi R}(\pi + 2)$

3.24 $B = \frac{\mu_0 i}{2\pi R}[\pi - \varphi + tg\varphi] = 2{,}8 \cdot 10^{-5}\ T$

3.25 $B = \frac{\mu_0 i}{\pi R}(arcsin\frac{a}{R} + \frac{\sqrt{R^2-a^2}}{a})$

3.26 $B = \frac{\mu_0 i}{2R}(\sqrt{3}+1)\sqrt{2}$

3.27 $i = \frac{2RB_h}{\mu_0 N}tg\alpha$

3.28 $\varphi = arctg\frac{\mu_0 CUnN}{2RB_h} = 13{,}5°$

3.29 $R = 3{,}7\Omega$

3.30 $i_2 = \frac{i_1 R_2}{2R_1}(ctg\ \varphi_1 - ctg\varphi_2);\ B_h = \frac{\mu_0 i_1}{4R_1}(ctg\ \varphi_1 + ctg\varphi_2)$

3.31 $B = \frac{\mu_0 j_1}{2}$

3.32 $\sigma_{max} = 2\varepsilon_0 E_0 = 35\mu C/m^2;\ B = \frac{\mu_0 \sigma_{max} v}{2} = 3{,}3 \cdot 10^{-10}\ T$

3.33 $B = \mu_0 j_1$

3.34 $B = \frac{\mu_0 i}{\pi^2 R}$

3.35 $B_1 = 12{,}5 \cdot 10^{-5}\ T,\ \ B_2 = 20{,}0 \cdot 10^{-5}\ T$

3.36 Kui $r << R_1$, siis $B = 0$; kui $R_1 \le r \le R_2$, siis $B = \frac{\mu_0 i}{2\pi(R_2{}^2 - R_1^2)}(r - \frac{R_1^2}{r})$;

kui $r > R_2$, siis $b = \frac{\mu_0 i}{2\pi r}$

3.37 $B_1 = 2 \cdot 10^{-5}\ T,\ \ B_2 = 0$

3.38 $\Phi_B = \frac{\mu_0 i}{4\pi} = 10^{-7}\frac{Wb}{m}$

3.39 $\Phi = \frac{\mu_0 il}{2\pi} ln\frac{R_2}{R_1} = 1{,}6 \cdot 10^{-5}Wb$

3.40 $\vec{B} = \frac{\mu_0}{2}[\vec{j}, \vec{a}]$; kui $\vec{a} = 0, siis\ \vec{B} = 0$

3.41 $\vec{B} = \frac{\mu_0}{2}[\vec{j}, \vec{r}]$; $\vec{B} = \frac{\mu_0}{2}[\vec{j}, \vec{r}]\frac{R^2}{r^2}$

3.42 $B_1 = 6{,}28 \cdot 10^{-3}\ T,\ \ B_2 = 3{,}14 \cdot 10^{-3}\ T$

3.43 $\Phi_B = \frac{\mu_0 ni}{2}S$

3.44 $\frac{d}{l}\sqrt{\sqrt{\frac{1}{1-\delta}}-1}=0{,}07$

3.45 a) $B=\frac{\mu_0 ni}{2}\left[1\mp\frac{1}{\sqrt{1+(\frac{R}{x})^2}}\right]$, kus + märk vastab punktile solenoidi sees ja – märk sellest väljaspool;

b) $x_0=5R$

3.46 $l\geq\frac{d}{\sqrt{\sqrt{\frac{1}{1-\delta}}-1}}=2m$

3.47 $B_1=\mu_0\tau\nu=12{,}6\cdot10^{-10}\,T;\ \ \mathrm{B}_2=6{,}3\cdot10^{-10}\,T$

3.48 $B=\frac{\mu_0 Ni}{2(R_2-R_1)}ln\frac{R_2}{R_1}$; $P_m=\frac{\pi Ni}{3}(\mathrm{R}_2^2+\mathrm{R}_1\mathrm{R}_2+\mathrm{R}_1^2)$

3.49 $B=\mu_0\sigma\omega R/2\,;\quad P_m=\pi\sigma\omega R^4/4$

3.50 $B_1=0\,;\ \mathrm{B}_2=5\cdot10^{-3}\,T\,;\ B_3=4{,}35\cdot10^{-3}\,T$

3.51 $B_{max}=4{,}8\cdot10^{-3}\,T,\ \ B_{min}=3{,}0\cdot10^{-3}\,T\,;\Phi=56{,}4\cdot10^{-7}Wb$

3.52 $P_m=\frac{Nd^2i}{2}=0{,}5\,A\cdot m^2$

3.53 $P_m=\frac{q\omega R^2}{5},\quad P_m/L=\frac{q}{2m}$

3.54 $\alpha=78{,}5°$

3.55 $F=24\,N$

3.56 $F_1=0{,}14\,N,\ F_2=0{,}17\,N$

3.57 $d=\frac{\mu_0 i_1 i_2}{2\pi P}l$

3.58 $x_1=\frac{d}{2}+\sqrt{\frac{d^2}{4}-\frac{\mu_0 l i_1 i_2}{4\pi k}},\ \ x_2=\frac{d}{2}+\sqrt{\frac{d^2}{4}+\frac{\mu_0 l i_1 i_2}{4\pi k}}$

3.59 $\varphi=\arcsin\frac{iB}{\rho gS}=22°$

3.60 $M=\frac{iBR^2}{2}=62{,}5\ \cdot10^{-5}N\cdot m$

3.61 $B=\frac{\mu_0 i}{4R},\quad F=2iBR$

3.62 $F=\frac{\mu_0 i_1 i_2}{2\pi b}ln\frac{b+a}{a}$

3.63 $F=\frac{\mu_0 i^2}{\pi^2 R}$

3.64 $B=\frac{\pi\sigma d^2}{4Ri}=8\,kT$

3.65 $p=\frac{\mu_0 i^2}{8\pi^2R^2}$

3.66 $p=\frac{B^2}{2\mu_0}$

3.67 $F=\frac{\mu_0 i_1 i_2}{2\pi}\ln\frac{r_0+1}{r_0}=2{,}2\cdot10^{-4}N$

3.68 $F=\frac{\mu_0 i_1 i_2 l}{2\pi(r_2-r_1)}\ln\frac{r_2}{r_1}=5{,}3\cdot10^{-5}N$

3.69 $F_b'=4\cdot10^{-6}N,\ F_b''=4/3\cdot10^{-6}N,\ \ F_a=1{,}1\cdot10^{-6}N,\ \ F=8/3\cdot10^{-6}N.$

3.70 a) $F=\frac{\mu_0 i_1 i_2 ab}{2\pi c(c+b)}$, b) $M=0$, c) $\Phi_M=\frac{\mu_0 i_1 a}{2\pi}ln\frac{c+b}{c}$

3.71 $M_1=4{,}5\cdot10^{-4}N\cdot m,\ \ M_2=3{,}5\cdot10^{-4}N\cdot m$

3.72 $\alpha = arctg\frac{iB}{2DSg} = 15°$

3.73 a) $M = 24 \cdot 10^{-10} N \cdot m$; b) $M = 12 \cdot 10^{-10} N \cdot m$

3.74 12°15' ; $4{,}7 \cdot 10^{-7} A$

3.75 $i = \frac{6\pi r^4 \alpha}{2lNSB} = 5 \cdot 10^{-8} N$

3.76 $M = 0{,}01\ N \cdot m$

3.77 $\varphi = arctg\frac{2P_m B}{mgl} = 56{,}8°$

3.78 $T = 2\pi\sqrt{\frac{I}{Ba^2 Ni}}$

3.79 $B_S = \frac{T_1^2}{T_2^2} B sin\alpha$

3.80 $B_h = 1{,}8 \cdot 10^{-5}\ T$

3.81 $i = \sqrt{k\alpha/\mu_0 nNS cos\alpha} = 1A$

3.82 $i = \sqrt{\frac{PL}{\mu_0 nNS}}$

3.83 $\frac{dB}{dh} = \frac{mg}{i\pi R^2} = 3{,}1\ T/m$

3.84 $F = \frac{3\mu_0 \pi R^4 i^2}{2x_0^4} = 24 \cdot 10^{-6}\ N$

3.85 $A = 5 \cdot 10^{-2} J$

3.86 $A = 8{,}3 \cdot 10^{-5} J/m$

3.87 $i = 25\ A$

3.88 $A = 7{,}2 \cdot 10^{-7} J$

3.89 $A = 0{,}12\ J$

3.90 $A_1 = A_2 = 2{,}5 \cdot 10^{-3} J, \quad A_3 = 5 \cdot 10^{-3} J$

3.91 $A = 32\ \cdot 10^{-3}\ J$

3.92 a) $A = 1{,}2 \cdot 10^{-7} J$; b) $A = 3{,}2 \cdot 10^{-7} J$

3.93 $A = 4{,}5 \cdot 10^{-7} J$

3.94 $P = \pi R^2 i\nu B = 7{,}9 \cdot 10^{-3}$W

3.95 $\omega = \sqrt{\frac{2(M\alpha - 2iSB)}{I}} = 23{,}2$ rad/s

3.96 $v = 1{,}45 \cdot 10^{-1}$m/s

3.97 $A = \frac{\mu_0 i_0 iS}{4R}\left(4 + \sqrt{2}\right) = 3{,}4 \cdot 10^{-11} J$

3.98 $A = \frac{\mu_0 p_{m1} p_{m2}}{2\pi}\left[\frac{1}{x_0^3} - \frac{1}{(x_0 + a)^3}\right] = 4{,}8 \cdot 10^{-10} J, \quad F = \frac{3\mu_0 p_{m1} p_{m2}}{2\pi x_0^4} = 5{,}8 \cdot 10^{-9} N$

3.99 $\mathcal{E} = 0{,}03V$

3.100

3.101 $\mathcal{E} = 0{,}5e^{-t}\ (V)$

3.102 $A = 0{,}04\ eV$

3.103 $\nu = 478\ p/min$

3.104 $i_A = 0{,}8\ A;\ i_B = 0{,}2\ A$

3.105 $U_I = 10\ V, U_{II} = 20\ V$

3.106 $\mathcal{E}_0 = \frac{\pi N a^2 B_0 \omega}{3}$

3.107 $U = 0{,}15\ V$

3.108 $U = 40\ mV$

3.109 Sõltuvalt juhtme liikumise suunast $i_1 = 4\ A$ või $i_1 = 12\ A$. Paigalolevas juhtmes $i_2 = 8\ A$. Juhtme seismajäämisel vool väheneb 2 korda või suureneb 1,5 korda.

3.110 $F = 10\ N,\ P = 250\ W$

3.111 $U = 1\ mV$

3.112 $i = \frac{vB}{\rho_l(1+\frac{1}{sin\alpha})}$

3.113 $\mathcal{E} = 2vB\sqrt{vt(2R - vt)}$

3.114 $\mathcal{E} = \sqrt{\frac{8w}{a}}By$

3.115 $i = 0{,}12\ \mu A$

3.116 $\Delta S = \frac{mRv_0}{B^2d^2},\ \ Q = \frac{mv_0^2}{2}$

3.117 $i = \frac{\mu_0 Ivd}{2\pi Rx}$

3.118 $\mathcal{E} = \frac{\mu_0 abi}{2\pi} \cdot \frac{v}{(a+x)x}$

3.119 $a)\ \frac{\mu_0 Iv}{2\pi R} ln\frac{b}{a};\ \ b)\ F = \frac{v}{R}(\frac{\mu_0 I}{2\pi}\ ln\frac{b}{a})^2$

3.120 $\mathcal{E} = \frac{3}{2}\omega l\frac{dB}{dt}t^2 = 12\ mV$

3.121 $v = \frac{mgR}{B^2l^2}(1 - e^{-\frac{B^2l^2t}{mR}})$

3.122 $v = \frac{mgR}{B^2d^2 - mgk}$; ühtlane liikumine ei ole alati saavutatav.

3.123 $a = \frac{mg}{m+CB^2l^2}\ ,\ i = \frac{CBlmg}{m+CB^2l^2}$

3.124 $q = \frac{\mu_0 ibS}{4\pi\rho(a+b)} \ln\frac{d+a}{d-a}$

3.125 $\mathcal{E} = 20\ mV$

3.126 $U = \pi vB[x^2 - (1-x)^2],\ \ U = \begin{cases} \pi vBl^2,\ kui\ x = l \\ 0, kui\ x = \frac{l}{2} \\ \frac{\pi vBl^2}{2}, kui\ x = \frac{3}{4} \end{cases}$

3.127 $i = 314\ mA$

3.128 $\mathcal{E} = \pi vr^2B,\ q = \frac{\pi Nr^2B}{R},\ Q = \frac{\pi^2 nNr^4B^2}{R}$

3.129 $U = \frac{Bl\sqrt{2gl}}{2} = 0{,}16\ \mu V$

3.130 $\mathcal{E} = \frac{\omega d^2B}{2}$

3.131 $\mathcal{E}_i = abB_0[\omega' cos\omega t\ sin(\omega' t - \varphi) + \omega\ sin\omega t \cos(\omega' t - \varphi)],\ \ \mathcal{E}_{i'} = ab\omega B_0\ sin2\omega t,$ $\mathcal{E}_{i''} = ab\omega B_0\ cos2\omega t$

3.132 $Q = \frac{NBS}{R} = 3 \cdot 10^{-4}\ C$

3.133 $q = 10^{-4}\ C$

3.134 $N = \frac{\mu_0 HrS}{2\rho e}$

3.135 $q = \frac{mR_h}{4\pi\rho D} =\ 0{,}053\ C$, kus ρ on vase eritakistus ja D - tihedus

3.136 $Q = \frac{a^2\tau^3}{3R}$

3.137 $E = \begin{cases} \frac{1}{2}\mu_0 n\frac{di}{dt}, kui\ a < r \\ \frac{1}{2}\mu_0 n a^2\frac{di}{dt}\cdot\frac{1}{r}, kui\ a > r \end{cases}$

3.138 $i = 0{,}2\ A$

3.139 $\vec{\omega} = -\frac{q}{2m}\vec{B}(t)$

3.140 $i = \frac{kh}{4\rho}(b^2 - a^2)$

3.141

3.142 N =1000

3.143 $L = \frac{\mu_0 R^2 s^2}{4\pi\rho^2 l} = 5{,}5\ \cdot 10^{-5} H$

3.144 $\tau = \frac{\mu_0 m}{4\pi\rho\delta l} \approx 0{,}7\ ms$

3.145 $L = 1mH$

3.146 $L = \frac{\mu_0 N^2 a}{2\pi} ln\frac{b+a}{b}$

3.147 $L = \frac{\mu_0}{2\pi} ln\frac{b}{a} = 4{,}6\ \cdot 10^{-7} H/m$

3.148 $L = \frac{\mu_0 l}{2\pi} ln\frac{b}{a}$

3.149 $L = \frac{\mu_0}{\pi} ln\frac{d-a}{a}$

3.150 $L_1 = 0,\ L_2 = 0{,}2\ H,\ \ L_3 = 0{,}05H$

3.151 $\mathcal{E}_e = 0{,}16\ V$

3.152 $i = \frac{\mathcal{E}}{L}t$

3.153 $t = \frac{L}{R} ln\frac{1}{1-\frac{Ri}{\mathcal{E}_1}} = 13\ ms$

3.154 $U_{AB} = 0{,}9 + 2t(V)$

3.155 $a) i_2 = 0{,}4\ A,$ b) $i_2' = 7{,}6\ A,$ c) $i_2'' = 0{,}4\ A$

3.156 $i_2 = \frac{\mathcal{E}}{R}(1 - e^{-\frac{R}{2L}t})$

3.157 $i_1 = \frac{\mathcal{E}L_2}{(L_1+L_2)R},\ \ i_2 = \frac{\mathcal{E}L_1}{(L_1+L_2)R}$

3.158 $Q = \frac{\mathcal{E}^2 L}{2R(R+R_0)} = 3\mu J$

3.159 $\tau = 3\cdot 10^{-4}\ s,\ Q = 4{,}9\cdot 10^{-5} J$

3.160 Lüliti suletakse: $i_1 = \frac{\mathcal{E}(R+r)}{Rr}[1 - \frac{\mathrm{R}}{\mathrm{R+r}}\mathrm{e}^{-\frac{\mathrm{rR}}{(\mathrm{R+r})\mathrm{L}}\mathrm{t}}],\ U = 24(1 - e^{-2{,}4t})\mathrm{V}$

Lüliti avatakse: $i_1 = \frac{\mathcal{E}}{R}(1 + \frac{\mathrm{R}}{\mathrm{r}}\mathrm{e}^{-\frac{\mathrm{R}}{\mathrm{L}}\mathrm{t}}),\ U = 24(1 + 99e^{-240t})$ (V)

Vahetult pärast lüliti avamist: $U \approx 2400\ V$

3.161 $M = \sqrt{L_1 L_2}$

3.162 $L_{12} = 0{,}6\ H$

3.163 $M = 1{,}5\ mH, L = 5{,}0\ mH$

3.164 $L_{12} = \frac{\mu_0 b}{2\pi}\ln(1 + \frac{a}{x})$

3.165 $L_{12} = \frac{\mu_0 Nh}{2\pi}\ln(\frac{b}{a})$

3.166 $L_{12} = \frac{\mu_0 \pi a^2}{2b}$, $\Phi_{12} = \frac{\mu_0 \pi a^2}{2b} i$

3.167 $P_m = \frac{2aRq}{\mu_0 N}$

3.168 $L_{12} = \frac{\mu_0 \pi R^4}{2h^3}$

3.169 $i_2 = \frac{L_{12}\alpha}{R}\left(1 - e^{-\frac{R}{L_2}t}\right)$

3.170 $Q = \frac{{\mu_0}^2 \pi^3 a h N^2 D^3 \nu^2 I_e^2}{4\rho H^2} = 100\,J$

3.171 $Q = \frac{{\mu_0}^2 \pi^3 h N^2 D^4 \nu^2 I_e^2}{32\rho H^2} = 980\,J$

3.172 $\mu = 700$

3.173 $\kappa_m = 700$

3.174 $N_2 - N_1 = 399000$

3.175 *a*) $\Phi_1 = 1{,}2 \cdot 10^{-3} Wb$; μ_1=1500;

b) $\Phi_2 = \Phi_1$(*või* 0); μ_2=μ_1;

c) $\Phi_3 = 1{,}35 \cdot 10^{-3} Wb$ (või 0); μ_3=850

3.176 $H = 1500\frac{A}{m}$, $B = 1{,}2\,T$, $\mu = 600$, $J = 1{,}0 \cdot 10^6 A/m$

3.177 $B_j = \frac{R}{S}(q - q') = 0{,}8\,T$, $J_j = \frac{R}{\mu_0 S}(q - q') = 6 \cdot 10^5 A/m$

3.178 $i = 2{,}0\,A$

3.179 $B_{Fe} = B_{õ} = 1{,}0\,T$

3.180 $i_2 = 7{,}7\,A$

3.181 $W_m = \frac{\mu_0 R^2 \tau^2 \omega^2}{8\pi}$

3.182 $\frac{W_m}{W_e} = 1{,}1 \cdot 10^{-15}$

3.183 *a*) $\mathrm{L}_j = 2L$, *b*) $L_p = \frac{L}{2}$

3.184 $W_m = 25 \cdot 10^{-3} J$; ühe pooli väljalülitamisel energia väheneb 4 korda.

3.185 $W_m = 0{,}17\,J$

3.186 $n = 1700\,korda$

3.187 $W_m = \frac{N\Phi_i}{2} = 0{,}5\,J$

3.188 $W_m = \pi^2 r^2 R^2 BH = 0{,}5\,J$

$L = \frac{\pi DS}{d^2}\frac{B}{H} = 2{,}2\,H$, $W_m = \frac{\pi DSBH}{2} = 0{,}4\,J$

3.189 a) $\frac{W_{mõ}}{W_{mm}} = \frac{\mu b}{\pi D} = 3$; b) $L = \frac{\mu_0 N^2 S}{b + \frac{\pi D}{\mu}} = 0{,}15\,H$

3.190 $B = 0$

3.191 $i_{nihke} = \frac{q}{\varepsilon_0 \varepsilon \rho}$

3.192 Peale juhtivusvoolu tuleb arvestada nihkevoolu.

3.193 $E = \frac{I_m}{\varepsilon_0 \omega S} = 700\,V/m$

3.194 $H = \frac{\varepsilon_0 \varepsilon \omega U_m r}{2d} \cos \omega t$

3.195 $H = H_m \cos(\omega t + \alpha), kus\ H_m = \frac{U_m r}{2d}\sqrt{\sigma^2 + (\varepsilon_0 \varepsilon \omega)^2}$ ja $tg\,\alpha = \varepsilon_0 \varepsilon / \sigma$

3.196 $H = \frac{i}{2\pi r}(1 - \frac{r^2}{R^2})$, kus r on kaugus kondensaatori teljest

3.197 Kui $r < R$, siis $j_{nihke} = \frac{\varepsilon_0 \ddot{B}}{2} r$; kui $r > R$, siis $j_{nihke} = \frac{\varepsilon_0 \ddot{B}}{2r}$, kus B on magnetilise induktsiooni hetkväärtus kaugusel r.

3.198 $s = 0{,}5\ cm$

3.199 $\frac{\Delta x_1}{\Delta x_2} = 1$

3.200 $E = \frac{4Ud}{l(l+2D)}$

3.201 $x = 1{,}2\ mm$

3.202 $\alpha = arctg\frac{ebE}{mv_0^2} = 11°$

3.203 $tg\alpha = \frac{kb^2}{4}\sqrt{\frac{m}{2eU^3}}$

3.204 $v = \sqrt[3]{\frac{9eRh}{2m}} = 16$ km/s

3.205 $H_{max} = 1{,}3 \cdot 10^4\ A/m$

3.206 $W_t = 0,\ W_n = 7 \cdot 10^{15}\frac{\mathrm{m}}{\mathrm{s}^2}$

3.207 Trajektooriks on ringjoon, mille raadius R =10 m

3.208 $R = 12\ mm,\ p = 5{,}7 \cdot 10^{-22} Ns\ ,\ \nu = 4{,}6\ MHz$

3.209 $v = 5 \cdot 10^6\ m/s$

3.210 $T = 3 \cdot 10^{-9}$s

3.211 $l = \frac{m^2v^2}{eB}$

3.212 $p_m = \frac{mv^2}{2B}$

3.213 $\frac{p_m}{l} = \frac{e}{2m}$

3.214 a) $\frac{r_p}{r_e} = 1840$; b) $\frac{r_p}{r_e} = 43$

3.215 $\nu = 10MHz$

3.216 $t = \frac{\pi mW}{q^2UB} = 8{,}2\ \mu s$

3.217 $U \geq \frac{2\pi^2\nu^2 mR\Delta R}{e} = 0{,}1$ MV

3.218 a) $W = \frac{(\mathrm{reB})^2}{2\mathrm{m}} = 12$ MeV; b) $\nu = \frac{1}{\pi r}\sqrt{\frac{\mathrm{W}}{2\mathrm{m}}} = 20$ MHz

3.219 $v = 1{,}6 \cdot 10^7\ m/s$

3.220 $F = \frac{mEi}{eB} = 2 \cdot 10^{-5}\ N$

3.221 $d = \frac{2mv}{eB}(1 - \cos\delta) = 0{,}6\ m\ m$

3.222 $\frac{q}{m} = \frac{2\Delta xE}{a(a+2b)B^2}$

3.223 a) Kiir kaldub ida suunas; b) $w = 6{,}3 \cdot 10^{14}\ m/s^2$; c) $\Delta x = 3mm$

3.224 $U = \left(qB\sqrt{\frac{2W}{m}} - \frac{4W}{r_1+r_2}\right)\frac{r_1+r_2}{2q}\ln\frac{r_2}{r_1}$, kus q on α-osakese laeng ja m – mass.

3.225 $\alpha = 2\,arctg\,\frac{er_0B}{mv_0}$

3.226 $\alpha = arcsin\,Bd\sqrt{\frac{q}{2mU}} = 30°$

3.227 Trajektooriks on kruvijoon, mille raadius $r = 3{,}5\ cm$, kõverusraadius $r_k = 14$ cm ja samm $h = 38\ cm$.

3.228 Trajektooriks on kruvijoon, mille raadius $r = \frac{bE}{v_0B} = 4\ cm$ ja samm $h = \frac{2\pi mv_0}{eB} = 2{,}4\ cm$.

3.229 $i = \frac{2\pi\sqrt{\frac{2Um}{e}}}{\mu_0 nl} = 2{,}5\ A$

3.230 $\frac{e}{m} = \frac{8\pi^2U}{\mu_0{}^2n^2i^2l^2} = 1{,}77\cdot10^{11}\ \frac{C}{kg}$

3.231 $y_n = \frac{2\pi^2mEn^2}{qB^2}$, $tg = \frac{v_0B}{2\pi En}$

3.232 $a = 2r\left|sin\frac{\varphi}{2}\right|$, kus $r = \frac{mvsin\alpha}{eB}$ ja $\varphi = \frac{eBl}{mvcos\alpha}$

3.233 $r_{max} = ae^{v_0/b}$, kus $b = \frac{\mu_0}{2\pi}\frac{e}{m}\,i$

3.234 $x = a(\omega t - sin\omega t)$, $y = a(1 - cos\omega t)$, kus $a = \frac{me}{bB^2}$ ja $\omega = \frac{qB}{m}$.
Trajektooriks on tsükloid, mille samm $h = 8mE/qB^2$ ja harja kõrgus on 2a.

3.235 $U = 2\frac{e}{m}(\frac{\mu_0 i}{4\pi})^2\,ln\,\frac{b}{a}$

3.236 $B < \frac{2b}{b^2-a^2}\sqrt{\frac{2m}{e}U}$

3.237 $v = \frac{qrB}{2m}$, $\rho = \frac{r}{2}$

3.238 $N = 5\cdot10^6$ tiiru, $l = 8\cdot10^3 km$

3.239 $B = \frac{B_k}{2}$

3.240 $W_0 = \frac{2\pi er^2B}{\Delta t} = 100\ eV$

3.241 $p = \frac{iB}{a}$

3.242 $U = 7\ \mu V$

3.243

3.244 $P = \pi viBr^2 = 20\ mV$

3.245 $p = \frac{1}{2}\mu_0 n^2 i^2$

3.246 $i = \sqrt{\frac{2F_k}{\mu_0 nR}}$

3.247 $R = \frac{\rho d}{S}$, $P_{max} = \frac{B^2Sv^2d}{4\rho}$

3.248 $U_H = \frac{\mu_0 i^2}{4\pi^2 enR^2} = 0{,}22\ pV$

3.249 $n_e = 2{,}5 \cdot 10^{28}\ 1/m^3 \cong n_A$

3.250 $k = 3{,}2 \cdot 10^{-3} \frac{m^2}{V} \cdot s$

4.1 $L = 12{,}7\ mH$

4.2 $\Delta\nu = 160\ kHz - 460\ kHz$

4.3 $T = 2\ ns,\ \ L = 0{,}34\ H,\ \ i = 28 \cdot 10^{-3}\cos(10^5 \cdot \pi t + \frac{\pi}{2})$

4.4 $I_m = \frac{U_m}{\sqrt{\frac{L}{C}}} = 0{,}45\ A$

4.5 $T = 5\ ms,\ \ C = 0{,}63\ \mu F,\ U_m = 25\ V,\ W_e = W_m = 2{,}1 \cdot 10^{-4}\ J$

4.6 $W_m = 6{,}2 \cdot 10^{-2} J$

4.7 $u^2 + \frac{L}{C} i^2 = U_C^2$

4.8 $i = I_m \sin\omega t,\ \ kus\ I_m = \frac{U_0}{\sqrt{\frac{L}{C}}};\ \ \mathcal{E}_e = \frac{U_0}{\sqrt{2}}$

4.9 $T_0 = 0{,}7\ ms,\ I_m = 8\ A$

4.10 $A = W(\eta^2 - 1)$

4.11 $\delta = 0{,}62$

4.12 Praktiliselt ei muutu.

4.13 $T = 8\ ms,\ \delta = 0{,}7,\ u = 80e^{-87t}\cos 800t(V)$

4.14 Võnkumised tekivad vaid kondensaatorite järjestikuse ühenduse korral.

4.15 $\delta \approx 0{,}22,\ \ R \approx 11{,}2\ \Omega$

4.16 $n = 1{,}04\ korda$

4.17 $W_0 = 3{,}8 \cdot 10^{-5} J,\ \ W = 5{,}1 \cdot 10^{-6} J$

4.18 $\nu = \frac{R}{0{,}74 \cdot 2\pi L} = 5\ Hz$

4.19 $Q = 2{,}45,\ \ \frac{\Delta Q}{Q} = 2\%$

4.20 $\tau = \frac{Q}{\pi\nu} \ln\eta = 0{,}5\ ms$

4.21 $N = \frac{\sqrt{\frac{4L}{R^2C} - 1}}{2\pi} = 16$

4.22 $x \approx \frac{1}{8Q^2} = 0{,}5\%$

4.23 $\frac{W''}{W'} = e^{-\frac{4\pi\nu_0}{\sqrt{4Q^2+1}}} = 4{,}3\%$

4.24 $t \approx \frac{Q ln\eta}{2\pi\nu_0} = 1{,}0\ ms$

4.25 $\omega = \sqrt{\frac{1}{LC} - \frac{1}{4R^2C^2}},\ \ \ R > \frac{1}{2}\sqrt{\frac{L}{C}}$

4.26 $\omega = \sqrt{\frac{1}{LC} - \frac{1}{4R^2C^2}}$, $Q = \frac{1}{2}\sqrt{\frac{4R^2C}{L} - 1}$

4.27 $Q \approx \frac{U_0^2}{2P_k}\sqrt{\frac{C}{L}} = 100$

4.28 $P_k = 0{,}2\ mW$

4.29 $P = \frac{U_0^2 RC}{2L} = 10^{-5} W$

4.30 $I_m = 3{,}2\ A$

4.31 $I_e = 0{,}25\ A$, $I_k = 0{,}125\ A$

4.32 a) $I_e = \frac{2}{\sqrt{3}} I_k$; b) $I_e = \frac{\pi}{\sqrt{8}} I_k$

4.33 I_{ef} =18 mA, $I_k = 10\ mA$

4.34 I_a =3,2 A, $I_v = 5\ A$

4.35 U_k =45 V, $U_k' = 141\ V$

4.36 $\tau_1 = 8{,}8\ tundi$

4.37 a) $U_m = 157\ V$; b) $U_m = 314\ V$

4.38 $I_k = 0{,}127\ A$

4.39 $U_{AB} \approx 2U_m$, kus U_m on rakendatud pinge amplituudväärtus.

4.40 $Z = 137\ \Omega$

4.41 $tg\varphi = \frac{\mu_0 \pi^2 \upsilon_a}{4\rho n}$

4.42 $L = 0{,}15\ H$

4.43 $L = 0{,}026\ H$; $\varphi = 53{,}7\ °$

4.44 $I_e = 7{,}1\ A$; $U_e = 64\ V$; $u = 90\ sin\ (500t + 56{,}3°)$; $P = 252\ W$

4.45 $P_1 = 390\ W$, $P_2 = 260\ W$, $P = 650\ W$, $U = 127\ V$

4.46 $R = 45\ \Omega$, $P = 180\ W$

4.47 $P_1 = 100\ W$, $P_2 = 60\ W$

4.48 $L = 0{,}073\ H$, $r_d = 15{,}6\ \Omega$, $P_d = 390\ W$

4.49 $P_d = \frac{1}{2R}(U^2 - U_1^2 - U_2^2)$

4.50 $U_R = 75\ V$; $U_C = 80\ V$

4.51 $\varphi = 60°$

4.52 $\varphi_1 = 48{,}4°$; $\varphi_2 = 3{,}2°$

4.53 $u' = U_m + U_C \cos(\omega t - \varphi)$, kus $U_C = U_m/\sqrt{1 + (\omega CR)^2}$ ja $tg\varphi = 1/\omega CR$;
$CR = \sqrt{\eta^2 - 1/\omega} = 22$ ms

4.54 $U_e = 100\ V$; $I_e = 6{,}2\ A$; $i = 8{,}8\ sin\ (628t + 79{,}3°)$; $P = 115\ W$

4.55 $C = 5{,}5\ \mu F$, $\varphi = 69{,}2°$

4.56 $R = 18{,}4\ \Omega$; $C = 65\ \mu F$

4.57 $I = 0{,}28\ A$, $\varphi = -88{,}5°$

4.58 $L = 1\ H$

4.59 $X_C = 8\ \Omega$, $C = 400\ \mu F$

4.60 I_m =4,5 A, $\varphi = -63°$ (vool on pingest faasis ees), $U_C = 650\ V$; $U_L = 480\ V$

4.61 $U_L = 156\ V$, $U_C = 216\ V$, $U_r = 36\ V$

4.62 $R_d = 10{,}9\ \Omega$, $P_R = 846\ W$, $P_d = 925\ W$, $\cos\varphi = 0{,}875$

4.63 $P' = 446\ W$; $P_{näiv} = 1470\ W$; $P'' = P''_{näiv} = 4840\ W$; $C = 100\ \mu F$

4.64 $R = 54{,}4\ \Omega$; $C = 100\ \mu F$

4.65 $\Delta P = \frac{P^2}{U^2 cos^2\varphi} R = 3{,}2\ kW$

4.66 Kui |X| $> R_0$, siis $P_2 > P_1$;
kui |X| $< R_0$, siis $P_2 < P_1$

4.67 I_e =9,8 A; $u_R = 138\ sin(314t - 63{,}4°)$;
$u_L = 690 sin(314t - 18{,}4°)$;
$u_C = 414\ sin(314t - 108{,}4°)$; $P = 960\ W$; $P_{näiv} = 2146\ W$; $P_{reakt} = 1910\ VAR$

4.68 $\nu = 38{,}7\ Hz$; I_e =21,9 A; $U_{eL} = 848\ V = U_{eC}$

4.69 $\omega_r = 10^5 rad/s$; I =1,5 A; $U_R = 30\ V$, $U_L = 150\ V$; $U_C = 150\ V$

4.70 $\omega = \sqrt{\omega_0^2 - 2\beta^2}$, kus $\omega_0 = \frac{1}{\sqrt{LC}}$ ja $\beta = \frac{R}{2L}$

4.71 $\omega = \frac{\omega_0^2}{\sqrt{\omega_0^2 - 2\beta^2}}$, kus $\omega_0 = \frac{1}{\sqrt{LC}}$ ja $\beta = \frac{R}{2L}$

4.72 I =18,1 A; i =25,6 sin 314 t

4.73 I_1 =12,7 A; I_2 =5 A; I =13,6 A; i =19,2 sin (1256 t −21,6°)

4.74 $\nu = 50\ Hz$

4.75 $L_1 = 0{,}35\ H$, $R_1 = 138\ \Omega$

4.76 $P = \frac{R}{2}(I^2 - I_1^2 - I_2^2)$

4.77 I_1 =12,7 A = I_2; I =17,9 A; $P = 4{,}8\ kW$

4.78 $Z = \frac{R}{\sqrt{1+\omega^2 C^2 R^2}}$

4.79 I_C =0,96 A; I_D =0,56 A; I =0,51 A

4.80 I_C =0,33 A; I_{LR} =0,30 A; I =0,03 A

4.81 $Z = 527\ \Omega$

4.82 $I_2 = 4\ A$

4.83 $C = 10\ \mu F$, $I = 0{,}06\ A$, $I_C = 0{,}399\ A$, $I_L = 0{,}404\ A$

4.84 $C = 6{,}6\ \mu F$; $Z = 12$ kΩ

4.85 $\nu = 5\ kHz$, $I_C = 7{,}04\ A$, $I_L = 6{,}95\ A$

4.86 $\Delta\lambda = -50\ m$

4.87 $\tau = \frac{2d}{C ln\frac{\varepsilon_1}{\varepsilon_2}}(\sqrt{\varepsilon_1} - \sqrt{\varepsilon_2})$

4.88 $\frac{j_{m\ juht}}{j_{m\ nihke}} = \frac{\sigma}{2\pi\varepsilon_0\varepsilon\nu} = 2$

4.89 $\vec{H} = \frac{1}{k}\sqrt{\frac{\varepsilon_0}{r_0}}[\vec{k}, \vec{E}_m]\cos(ckt)$

4.90 a) $\vec{H} = \vec{e}_z E_m \sqrt{\frac{\varepsilon_0}{\mu_0}} \cos kx = -30\vec{e}_z$; b) $\vec{H} = \vec{e}_z E_m \sqrt{\frac{\varepsilon_0}{\mu_0}} \cos(ckt_0 - kx) = -0{,}18\vec{e}_z$

4.91 $U_x = U_m cos\frac{n\pi x}{l}$; $I_x = I_m sin\frac{n\pi x}{l}$, $\nu_n = \frac{nc}{2l}$, kus n = 1, 2, 3..., ja c – elektromagnetlaine levikukiirus.

4.92 $U_x = U_m cos\frac{n\pi x}{l}$; $I_x = I_m sin\frac{n\pi x}{l}$, $\nu_n = \frac{nc}{2l}$, kus n = 1, 2, 3..., ja c – elektromagnetlaine levikukiirus.

4.93 $U_x = U_m \cos\left(\frac{2n+1}{2} \cdot \frac{\pi x}{l}\right)$; $I_x = I_0 sin\left(\frac{2n+1}{2} \cdot \frac{\pi x}{l}\right)$, $\nu_n = \frac{c}{\lambda} = \frac{(2n+1)c}{4l}$, kus n = 1, 2, 3..., ja c – elektromagnetlaine levikukiirus.

4.94 $Q = 120 \ln\frac{D}{r} \approx 470\ \Omega$

4.95 $L = 736 \cdot 10^{-7} H$, $C = 24 \cdot 10^{-11} F$, $\rho = 552\ \Omega$

4.96 $\rho = 138\ \Omega$

4.97 $\rho = 60 \ln\frac{R}{r} = 97\ \Omega$

4.98 $v = 1{,}4 \cdot 10^8 m/s$

4.99 $\mathcal{E} = 1{,}78$

4.100 $T_n = \frac{2l\sqrt{\varepsilon}}{nc}$, kus n = 1, 2, 3..., ja c – valguse levikukiirus vaakumis

4.101 $\mathcal{E} = \frac{c^2}{4\Delta x^2 \nu^2} = 2{,}2$

4.102 $\frac{U_m}{U_x} = 3{,}86$; $\frac{I_m}{I_x} = 1{,}04$

4.103 $I_x = 1{,}73\ A$, $U_x = 500\ V$

4.104 $\nu_{min} = 3\ kHz$

4.105 $\rho = \frac{\ln\frac{R}{r}}{2\pi\varepsilon_0\sqrt{\varepsilon}C} = 69\ \Omega$

4.106 $Z_s = \left|\rho ctg\frac{2\pi l}{\lambda}\right|$, kus $\rho = \sqrt{\frac{\mu_0}{\varepsilon_0}}\frac{ln\frac{d}{r}}{\pi} = 298\ \Omega$,

$Z_{s1} = 172\ \Omega$, takistusel on induktiivne iseloom;

$Z_{s2} = \infty$, vooluresonantsiga analoogiline olukord, mil liini alguses on pinge pais ja voolu sõlm;

$Z_{s3} = 516\ \Omega$, takistusel on mahtuvuslik iseloom;

$Z_{s4} = 0$, pingeresonantsiga analoogiline olukord, mil liini alguses on pinge sõlm ja voolu pais.

4.107 Liin kujutab enesest induktiivkoormust induktiivsusega $L = 23 \cdot 10^{-8} H$

4.108 $Z_s = \left|\rho tg\frac{2\pi x}{\lambda}\right| = \left|298 tg\frac{2\pi x}{6}\right|$, kus ρ on liini lainetakistus:

1) kui $x < \frac{\lambda}{4} =$ 1,5 m, on sisendtakistusel induktiivne iseloom;

2) kui $x = \frac{\lambda}{4} =$ 1,5 m, on liinis vooluresonantsiga analoogiline olukord, mil liini alguses on voolu sõlm ja pinge pais;

3) kui $\frac{\lambda}{4} < x < \frac{\lambda}{2}$, on sisendtakistusel mahtuvuslik iseloom;

4)) kui $x = \frac{\lambda}{2} =$ 3,0 m, on liinis pingeresonantsiga analoogiline olukord, mil liini alguses on voolu pais ja pinge sõlm.

4.109 Liin kujutab enesest mahtuvuslikku koormust mahtuvusega $C = 1\ pF$.

4.110 $L = 3{,}3\ \mu H$

4.111 $Z_s = 0$, liin kujutab enesest generaatori jaoks järjestikuse resonantskontuuriga analoogilist koormust.

4.112 $Z_s = 1240\ \Omega$

4.113 $a)\ Z_s = \frac{2\rho^2}{R_1 l} = 392\ k\Omega$, b) $Z_s = \frac{R_1 l}{2} = 0{,}5\ \Omega$

4.114 $Z_{s1} = \frac{\rho^2}{r} = 2000\ \Omega$, $Z_{s2} = r = 80\ \Omega$

4.115 $Z_s = \rho = 400\ \Omega$

4.116 Vasakul

4.117

4.118

4.119

4.120 Poyntingi vektori vastav komponent on suunatud juhtme telje poole.

4.121

4.122

4.123 $\Phi_W = 0$

4.124

4.125 $W = 2 \cdot 10^{-9} J$

4.126 $W = \frac{1}{2}\sqrt{\frac{\varepsilon_0}{\mu_0}} E_0^2 S\tau = 8{,}0 \cdot 10^{-11} J$