Rješenja problema i zadataka za treći razred

Modul 1

Problemi:

6. c) **8.** a) **11.** d) **23.** b) **28.** d) **36.** c) **37.** b) **38.** a) **41.** a)

42. a) **46.** *a)* $tg\varphi < 0 \Rightarrow R_L < R_C$; *b)* $tg\varphi = 0 \Rightarrow R_L = R_C$; *c)* $tg\varphi > 0 \Rightarrow R_L > R_C$ **51.** c)

57. $E_k = 3E_{ep}$ **64.** $T_1 = 2T_0,\ T_2 = T_0/2$ **65.** $T_{a)} = T_{b)} = T_{c)}$ **70.** d) **71.** $y = 2cm\sin(\pi s^{-1} + \pi)$

72. $x_0 = 10cm,\ T = 8s,\ f = 0{,}125Hz$

75. *i*) a), c), d), f); *ii*) $x = 0,\ v = v_0,\ a = 0,\ F = 0,\ E_k = E_{k0},\ E_{ep} = 0$

Zadaci:

77. c) **78.** $v = 240m/s$ **79.** a) $\Phi = 5 \cdot 10^{-4} Wb$; b) $U_i = 10mV$ **80.** $\Delta t = 3{,}43\mu s$

81. $U_i = 0{,}1V$ **82.** $U_i = 1{,}88mV$ **83.** $U_i = 4{,}71V$ **84.** $I_i = 0{,}365A$ **85.** $U_i = 40{,}69mV$

86. $U_L = 0{,}5V$ **87.** $L = 3{,}89mH$ **88.** $\mathscr{E}_L = 125V$ **89.** $L = 3H$

90. $\mathscr{E}_{i1} = -0{,}6V,\ \mathscr{E}_{i2} = 0{,}6V;\ I_{i1} = -6A I_{i2} = 6A$ **91.** $\Delta I/\Delta t = 50A/s$ **92.** 100 puta u $1s,\ t = 5ms$

93. $U = 220V,\ U_0 = 311V,\ I = 0{,}1136\text{A},\ I_0 = 0{,}16A$

94. $f = 50Hz,\ I_0 = 2{,}8A,\ I = 1{,}98A,\ U_0 = 280V,\ U = 198V$ **95.** $u = 314V\sin(628t + \pi/4)$

96. $\varphi = \pi/3,\ U_0 = 11{,}5V$ **97.** $t = 12{,}2ms$ **98.** $U_2 = 13{,}2kV$ **99.** e) **100.** $I_2 = 50A$

101. $N_2 = 12$ **102.** *i*) $N_2/N_1 = 50$, *ii*) $U_2' = 4{,}8V$ **103.** b) **104.** e) **105.** b)

106. $R = 3{,}626\Omega$ **107.** $I = 5{,}02A,\ f = 50Hz,\ U_L = 157{,}63V$ **108.** $C = 7{,}2\mu F$

109. $R_L/R_C = 1{,}97 \cdot 10^{-2}$ **110.** $Z = 111{,}8\Omega,\ I = 1{,}968A$ **111.** $\cos\varphi = 0{,}894,\ P_a = 387W$

112. $C = 28{,}2\mu F$ **113.** $\varphi = 0{,}6435$ ($\varphi = 36°52'$) **114.** $I = 2{,}04A$ **115.** $C = 1{,}58\mu F$

116. $C = 5{,}07\mu F$ **117.** b) **118.** $f = 10Hz,\ N = 300$ **119.** $k = 54{,}78N/m$

120. $\Delta l = 6{,}2cm$ **121.** $m_2/m_1 = 5/4$ **122.** $T = 1{,}4s,\ f = 0{,}714Hz,\ \omega = 4{,}486rad/s$

123. $T = 0{,}628s$ **124.** b) **125.** $y_0 = 19{,}6cm,\ T = 0{,}888s,\ f = 1{,}126Hz$

126. $l = 21{,}2cm$ **127.** $T = 0{,}565s$ **128.** $T = 0{,}628s$ **129.** b) **130.** $E_{ep0} = E_{k0} \equiv E = 0{,}5J$

131. e) **132.** $k = 400N/m$ **133.** $E_{ep} = 22{,}6mJ$ **134.** c) **135.** $y = 5cm\sin\pi/2 \cdot s^{-1}t$

136. *tablica i graf* **137.** $y = 5cm\sin 4\pi s^{-1}t$ **138.** c) **139.** $y_0 = 0{,}75cm,\ T = 0{,}2s,\ f = 5Hz$

140. $y = 2cm\cos 10\pi s^{-1}t$ **141.** *i*) $y_{0A} = 2{,}5m,\ T_A = 4s,\ f_A = 0{,}25Hz,\ y_A = 2{,}5m\sin\pi/2 \cdot s^{-1}t$

ii) $y_{0B} = 3{,}5m,\ T_B = 2s,\ f_B = 0{,}5Hz,\ y_B = 3{,}5m\cos\pi s^{-1}t$

142. $f = 0{,}5Hz,\ y(2{,}75s) = 7mm$ **143.** $y(T/6) = 4{,}33cm$ **144.** $t = 0{,}25s$

145. $t = 0{,}04s,\ y = 2{,}4cm$ **146.** $y = 2{,}165cm$ **147.** $t = 0{,}062s$ **148.** $t = 0{,}1047s$

149. $v = 1{,}73m/s$ **150.** $v = 2\pi m/s\ \cos(\pi/2 \cdot s^{-1}t \pm \pi),\ a = -\pi^2 m/s^2 \sin(\pi/2 \cdot s^{-1}t \pm \pi)$

151. $y = 17{,}32cm,\ y' = 10cm$ **152.** a) $k = 39{,}24N/m$; b) $v_0 = 0{,}7m/s,\ E_{k0} = 4{,}9 \cdot 10^{-2}J$

Modul 2

Problemi:

5. b) **9.** b) **10.** e) **11.** $(g_Z > g_M) \Rightarrow f_Z > f_M$ **12.** $T_p < T_e \Rightarrow$ brže "ide" na polu

13. Za jednostavno njihalo: $T_M = T_Z$, T elastične opruge s utegom ne ovisi o g **15.** $l_2 = 4l_1$

31. $T_2 = T_1\sqrt{2}$ **35.** a) **58.** slobodan **63.** $v_B > v_A$ **71.** i **72.** načelo superpozicije

Zadaci:

78. $t = 0{,}45s$ **79.** c) **80.** b) **81.** $T_M = 4{,}94s$ **82.** $T_M = 4{,}9s$

83. $y = 17{,}7cm,\ v = -0{,}224m/s,\ a = -0{,}1037m/s^2$ **84.** a) $T_1 = T = 1s$; b) $a = 7{,}36m/s^2$ (gore)

85. $g = 9{,}655m/s^2$ **86.** $l = 12cm$ **87.** $f = 1{,}115Hz$ **88.** $T = 1{,}7s$ **89.** $k_2 = 2{,}5N/m$

90. $T = 2{,}96\mu s,\ f = 0{,}34MHz$ **91.** $L = 2{,}5\mu H$ **92.** e) **93.** b) **94.** $C = 3{,}5pF$

95. a) $I_0 = 0{,}64A,\ Q_0 = 1{,}2mC,\ E_{e0} = 7{,}2mJ$; b) $i(t) = -0{,}32A,\ q(t) = 1{,}039mC$ **96.** $T = 25{,}12ns$

97. $C = 22{,}5nF$ **98.** $f = 0{,}796MHz$ **99.** $v = 20m/s$ **100.** $v_1 = 1{,}25v_2$ **101.** $t = 1{,}749s$

102. $F = 187{,}5N$ **103.** $f = 3{,}5Hz$ **104.** $m_2 = 50{,}97kg$ **105.** $E = 9{,}85 \cdot 10^{10}N/m^2$

106. $\Delta v = 0{,}4m/s$ **107.** $f = 5Hz$

108. $y_0 = 0{,}06m,\ \lambda = 8cm,\ f = 3{,}75kHz,\ y = 0{,}06m\sin 2\pi\,(7500\pi s^{-1}t - x/0{,}08m)$

109. a) $y_0 = 5cm$; b) $\lambda = 0{,}4m$; c) $v = 12m/s$; d) $f = 30Hz$; e) $v_0 = 9{,}42m/s$; f) $\varphi_0 = \pi/4$,
g) $y = 5cm\sin 2\pi\,(30s^{-1}t - 2{,}5m^{-1}x + 1/8)$ **110.** $y = -0{,}924m$

111. $y = 0{,}2m\sin 2\pi\,(t/2s - x/400m)$

112. a) $y_0 = 3mm$; b) $f = 60Hz$; c) $T = 16{,}7ms$; d) $\lambda = 2cm$; e) $v = 1{,}2m/s$

113. $\lambda = 4cm,\ y_0 = 2cm,\ y = 2cm\sin 2\pi\,(t/0{,}3s + x/4cm \pm 1/2)$ (val se širi u smjeru negativne x-osi)

114. $\lambda = 0{,}6m,\ y_0 = 2m,\ y = 2m\sin 2\pi\,(t/0{,}03s - x/0{,}6m)$

115. $T = 0{,}1s,\ f = 10Hz,\ y = 2m\sin 2\pi\,(t/0{,}1s - x/30m)$

116. $T = 2s,\ f = 0{,}5Hz,\ y = 2m\sin 2\pi\,(t/2s - x/400m + 1/4)$ **117.** $y = 1{,}41cm$

118. i 119. *uraditi tablicu elongacije i nacrtati graf* **120.** $y = 0$

121. $y(x,t) = 2cm\ \sin(2\pi s^{-1}t + \pi/2)$ - nacrtati graf

122. a) $y_0 = 2cm$; b) $\lambda = 3cm$; c) $f = 1kHz$; d) $v = 30m/s$

123. a) $x_1 = 4m$; b) $x_2 = 2m$; c) $x_3 = 6m$

124. a) $y_0 = 0{,}05m$; b) $\omega = 2\pi\ rad/s,\ f = 1Hz,\ T = 1s$; c) $v = 2m/s$ (udesno); d) $\Delta\varphi = 3\pi/2$

125. d) **126.** $\Delta\varphi = 1{,}33\pi$ (240°) **127.** $d = 120m$ **128.** b)

129. $\lambda \equiv d = 25m,\ f = 0{,}25Hz,\ v = 6{,}25m/s$ **130.** $v_{mol} = 0{,}94m/s,\ v_v = 6{,}25m/s$

131. $v_v = 6{,}63v_{mol}$ **132.** $\lambda_v = 3{,}4m,\ \beta = 50°$ **133.** $\beta = 70°30'$ **134.** $\beta = 51°2',\ \alpha_{max} = 12°54'$

135. a) $(k = 2)$ **136.** $\Delta s = 6\lambda$ (registriraćemo maksimalnu jakost zvuka)

137. Ispunjen je uvjet za destruktivnu interferenciju: $\Delta s = (2k - 1)\lambda/2,\ k = 3 \Rightarrow$ magarac neće čuti zvuk.

138. $\lambda = 2m$ **139.** c) **140.** $\lambda = 0{,}6m,\ v = 6m/s$ **141.** $f_{min} = v/0{,}5m$ **142.** $f_1 = 2{,}5Hz$

Modul 3

Problemi:

7. $v_{H_2} > v_{CO_2},\ v_{H_2} = 4{,}69 v_{CO_2}$ **26.** a) **27.** $f_{min} = v/2l$ **29.** $f_2 = 2f_1$ **34.** $f_{1o} = 2f_{1z}$

40. a) u točki A; b) u točki C **55.** slušatelj radija čije je uho uz zvučnik radija, ($c >> v_{zrak}$)

67. $\alpha + \beta = 90°,\ \alpha = \beta \Rightarrow \alpha = 45°$

72. Neće vidjeti strelicu u potpunosti već samo njezin vrh (nacrtaj). **73.** $x' = -x$

75. Konkavno zrcalo služi kao povećalo jer može dati uvećanu (virtualnu) sliku.

Zadaci:

80. $\lambda_{min} = 1{,}7cm,\ \lambda_{max} = 17m$ **81.** $\lambda \in (72cm - 2{,}27m)$ **82.** $t = 1{,}336s$ **83.** $F = 80N$

84. $v_2/v_1 = 2{,}45$ **85.** $E = 1{,}68 \cdot 10^{11} Pa$ **86.** $v_1 = 490m/s,\ v_2 = 0$ **87.** $d = 1721{,}2m$

88. $\Delta v = 6m/s$ **89.** $\delta v\ (\%) = 4{,}9\ \%$ **90.** $v = 1924{,}1m/s$ **91.** $\lambda = 1{,}22m$ **92.** a)

93. $I = 0{,}54 W/m^2$ **94.** $y_0 = 107{,}5nm$ **95.** $\Delta I/I_1\ (\%) = 99{,}9\%$ **96.** $E = 2\mu J$ **97.** $L = 17dB$

98. $I_1 = 10^{-11} W/m^2,\ I_2 = 10^{-6} W/m^2,\ I_3 = 1W/m^2$ **99.** $L = 77dB$ **100.** $L = 40dB$

101. $I_2 = 100 I_1$ **102.** $l_2/l_1 = 0{,}5$ **103.** $f_1 = 156{,}5Hz,\ f_2 = 313Hz,\ f_3 = 469{,}5Hz$

104. $\lambda_{max} = 0{,}5m$ **105.** $f_1' = 400Hz$ **106.** $f_1 = 2{,}5Hz$ **107.** $E = 1{,}584 \cdot 10^{10} Pa$

108. *i*) $\lambda_1 = 8m,\ f_1 = 625Hz$ *ii*) $\lambda_2 = 2{,}667m,\ f_2 = 1875Hz$ **109.** $l_{niže} = 7{,}5m$

110. $f_3 = 18{,}56Hz$, *i*) $s_{1č} = l/3 = 0{,}267m,\ s_{2č} = 2l/3 = 0{,}533m,\ s_{3č} = l = 0{,}8m,$

ii) $s_{1tr} = l/6 = 0{,}133m,\ s_{2tr} = l/2 = 0{,}4m,\ s_{3tr} = 5l/3 = 0{,}667m$ **111.** $l = 18{,}6cm$

112. c) **113.** $l \equiv h = 16{,}6cm$ **114.** a)

115. $\lambda_1 = 1{,}52m,\ f_1 = 223{,}68Hz,\ \lambda_2 = 0{,}76m,\ f_2 = 447{,}36Hz$ **116.** c)

117. $f_{min,o} = 144{,}58Hz,\ f_{min,z} = 72{,}29Hz$ **118.** $f' = 1133{,}3Hz$

119. $f' = 630Hz,\ f'' = 570{,}27Hz$ **120.** $v_z = 1039{,}5km/h$ **121.** $v_b = 4{,}95m/s$

122. $\Delta f = 571{,}4Hz$ **123.** $f'' = 42{,}8Hz$ **124.** $v_k = 3{,}317m/s,\ (v_{k\,rel.} = 1{,}68m/s)$

125. $v_o = 0{,}185c$ **126.** $\lambda = 0{,}57m$ (*radioval*) **127.** $\lambda = 0{,}674m$ **128.** $\varepsilon_r = 81$

129. a) $\lambda = 30m,\ T = 10^{-7}s$; b) $E = 5V/m$ **130.** $\lambda = 29{,}8m$ **131.** $f = 1{,}25 \cdot 10^8 Hz$

132. $\lambda_0 = 3 \cdot 10^{-6} m,\ v = 3{,}83 \cdot 10^7 m/s$ **133.** $I_0 = 0{,}64A,\ Q_0 = 1{,}2mC,\ E_{ep0} = 7{,}2mJ$

134. $\gamma = 20°$ **135.** $x = 0{,}86m$ **136.** $x = 60cm,\ x' = 30cm$ **137.** $t = 0{,}714s$

138. $R = 0{,}8m$

139. $x' = -15cm,\ y' = 6cm$ (slika je virtualna ($x' < 0$), uspravna ($y' > 0$) i uvećana ($y' > y$)).

140. $x = 60cm,\ x' = 30cm$ **141.** $y = 1cm$ **142.** *i*) $x = 0{,}75m$, *ii*) $x = 1{,}25m$ **143.** $f = 40cm$

144. $R \approx 1{,}03cm$ **145.** $x' = 11{,}11cm$ ($x' < 0$), $m = 0{,}56$ **146.** $x = 50cm$ **147.** $x = 5m$

Modul 4

Problemi:

6. a) **8.** Koristiti transformaciju $sin\alpha \approx tg\alpha$ (za male kutove) $\Rightarrow n_2 tg\alpha = n_1 tg\beta \Rightarrow h' = h n_2 / n_1$

23. $f_1 = 20cm,\ f_1 = -50cm$

25. Uranjanjem u vodu jakost leće se smanjuje tj. povećava se žarišna daljina.

45. $m_{1,1} = 50,\ m_{1,2} = 100,\ m_{1,3} = 150,\ m_{2,1} = 100,\ m_{2,2} = 200,\ m_{2,3} = 300,\ m_{3,1} = 200,\ m_{3,2} = 400,\ m_{3,3} = 600,$

48. $k = 5 \Rightarrow$ a) **49.** $n_2 < n_1,\ \delta s = 2\lambda$ (konstruktivna interferencija)

Zadaci:

68. $n = 1{,}333$ **69.** $v = 2 \cdot 10^8 m/s$ **70.** $v = 2{,}25 \cdot 10^8 m/s$ **71.** $d_v/d_u = 1{,}1$

72. $\lambda = 333,3nm$ **73.** $\alpha = 41°40'$ **74.** $\beta = 6°38',\ \beta' = 9°56',\ \beta'' = 16°22'$

75. $\Delta\beta \equiv \beta_{lj} - \beta_c = 2°38'$ **76.** $\beta = 50°9'$ **77.** $n_t = 1{,}47,\ v_t = 0{,}68c$ **78.** $l = 0{,}858m$

79. $l = 2{,}95m$ **80.** $n_s = 1{,}5$ **81.** b) **82.** $\alpha_{gr} = 48°33',\ v = 0{,}75c$ **83.** $n_1 = 1{,}62$

84. $\alpha_{gr} = 61°2'$ **85.** $n_s = 1{,}52$ **86.** $n = 1{,}37$ **87.** e) **88.** $d = 10mm$ **89.** $\delta = 4{,}42cm$

90. $n_{min} = 1{,}414$ **91.** $\delta = 16°14'$ **92.** $\varepsilon = 43°$ **93.** $\varepsilon = 38°58'$ **94.** $\Delta\beta \equiv \beta_{lj} - \beta_c = 4°10'$

95. $R = 14cm$ **96.** $R = 15{,}39cm$ **97.** a) $x' = -4m$; b) $x' = 3m$

98. $x' = 60cm$ (slika je realna) **99.** $x' = -20cm,\ y' = 2{,}5cm$ **100.** $x_1 = 30cm,\ x_2 = 10cm$

101. $f = 26{,}67cm$ **102.** d) **103.** $d = 40cm$ **104.** $x = 75cm$

105. $x_1 = 49{,}25cm,\ x_2 = 16{,}75cm$ **106.** $x = 2m$ **107.** $m = 6$

108. $x' = 28{,}57cm$ ($x' < 0 \Rightarrow$ slika je virtualna) **109.** $x' = 6cm$ (slika je virtualna i uspravna), $m = 0{,}4$

110. $x' = 15cm$ ($x' < 0 \Rightarrow$ slika je virtualna i uspravna), $m = 0{,}25,\ y' = 1cm,\ j = -5m^{-1}$

111. $x = 10cm$ **112.** $f = 12cm$ ($f < 0$) **113.** $x' = 12{,}5cm,\ y' = 1cm$ **114.** a) **115.** a)

116. $j = -1{,}25D$ **117.** b) **118.** $j = 2{,}67D$ **119.** b) **120.** $s_{1c}/s_{1lj} = \lambda_c/\lambda_{lj}$

121. $\lambda = 580nm$ **122.** $\Delta s_3 = 4{,}558cm$ **123.** $a = 1{,}6m$ **124.** $\lambda = 667nm$

125. $s_2 = 4{,}48cm,\ \Delta s = 2{,}24cm$ **126.** $r_2 = 1503\lambda$ **127.** b) **128.** $d = 0{,}58mm$

129. $\lambda' = 576{,}87nm$ **130.** $\lambda = 624nm,\ f = 4{,}8 \cdot 10^{14}Hz$ **131.** $\lambda = 698nm$ **132.** $\alpha_4 = 2°45'$

133. $\lambda = 600nm$ **134.** $\Delta\alpha = \alpha_{3c} - \alpha_{3lj} = 18°12'$ **135.** $\lambda = 500nm$ **136.** $\alpha_3 = 48°35'$

137. $\alpha_1 = 22°19',\ \alpha_2 = 42°24',\ \alpha_3$ ne postoji **138.** $f = 5{,}69 \cdot 10^{14}Hz$ **139.** $\alpha = 10°14'$

140. $k_{max} = 4,\ \alpha_4 = 70°27'$ **141.** $k_{max} = 7,\ \alpha_7 = 64°54'$ **142.** $n_2 = 1{,}58$ **143.** $\gamma = 36°57'$

144. $n_t = 1{,}33$ **145.** a) $\alpha = 56°19'$; b) $\alpha' = 44°49'$

Modul 5

Problemi:

6. Pogrešno je, pri tako velikim brzinama, koristiti relacije klasične fizike. **7.** $v_x = c$

8. Prema relativističkoj relaciji slaganja $\Rightarrow$: Ako je jedna ili obje brzine jednaka $\boldsymbol{c}$ njihov zbroj ne može dati rezultat $v > \boldsymbol{c}$.

12. c) **13.** c) **36.** a) **42.** najveći je u slučaju c) a najmanji u slučaju a) **57.** a)

58. c) **61.** $W_1/W_2 = 4$ **62.** b)

Zadaci:

63. $x' = 2{,}3km,\ t' = 3{,}08 \cdot 10^{-5}s$ **64.** $v_x = 0{,}97c$ **65.** $v_x = -c$ **66.** $v_x = 0{,}727c$

67. $v_{x1} = v_{x2} = c$ **68.** $v_x = 0{,}143c$ **69.** c) **70.** $v = 0{,}943c$ **71.** $\delta l \equiv \Delta l/l_0 = 20\%$

72. $v = 0{,}6c$ **73.** $\ell = 0{,}436m$ **74.** $P = 72cm^2$ **75.** $l_0 = 15,27m,\ \alpha' = 19°6'$ **76.** c)

77. a) $s_0 = 9{,}36 \cdot 10^{15}m$; b) $s = 6{,}62 \cdot 10^{16}m$ **78.** $\Delta t = 7{,}07s$ **79.** $\Delta t = 4god$ **80.** $v = \sqrt{3}\,c/2$

81. $E_0 = 8{,}19 \cdot 10^{-14}J,\ p = 5{,}63 \cdot 10^{-22}kgm/s$ **82.** $v = 0{,}967c$ **83.** $v = 0{,}995c$

84. $\Delta t/\Delta t_0 = 20$ **85.** $\Delta t_0 = \Delta t/8$ **86.** $E/E_0 = 2$ **87.** $v = 0{,}998c$ **88.** $v = 2\sqrt{2}\,c/3$

89. $E_k = 5{,}46 \cdot 10^{-14}J$ **90.** $v = 0{,}95c$ **91.** $p = 4{,}728 \cdot 10^{-22}kgm/s$ **92.** $v_e = 0{,}878c$

93. $p = 9 \cdot 10^{-19}kgm/s$ **94.** $U = 215kV$ **95.** $\omega = 40rad/s$ **96.** c) **97.** $N = 15{,}92okr.$

98. $\alpha = 0{,}157rad/s^2,\ N = 5$ **99.** $\alpha = 21{,}6rad/s^2$ **100.** $\alpha = 2{,}4\pi rad/s^2,\ a = 7{,}54m/s^2$

101. $\varphi = 3\ (rad),\ \omega = 0{,}7rad/s$ **102.** $\omega = 1rad/s$

103. $M_{a)} = 0,\ M_{b)} = 0{,}707Nm,\ M_{c)} = 0$ **104.** $F_{min} = 14{,}14N$ **105.** $l_1 = 9cm,\ l_2 = 5cm$

106. $F = 654N$ **107.** $x = 2{,}045m$ (od težeg dječaka) **108.** $l_1 = 1m,\ l_2 = 2m$

109. Hoće, $M_v(600Nm) > M_g\,(490{,}5Nm)$ **110.** $F_N = 1510{,}7N$ **111.** $x = 3m$

112. $M = 43{,}96N$ **113.** $M_{tr} = 1Nm$ **114.** $I = 0{,}64kgm^2$ **115.** $m = 340{,}4kg,\ N \approx 15$

116. $I = 9{,}52kgm^2$ **117.** a) **118.** $M = 0{,}04Nm$ **119.** $\varphi = 4930\ (rad)$

120. $L = 21{,}195kgm^2/s$ **121.** $v_{CMpl.} = 3{,}2m/s,\ \omega_{pl.} = 10{,}67rad/s$ **122.** $f_2 = 0{,}88okr./s$

123. $\omega = 46rad/s$ **124.** $E_{krot.} = 4{,}92kJ$ **125.** $E_k = 2352J$ **126.** $E_{krot.} = 197{,}2kJ$

127. $a_k > a_o$ **128.** $W = 23{,}15J,\ v = 1{,}183m/s$ **129.** $\Delta E_{krot.} = 163{,}225J$ **130.** $v = 5{,}6m/s$

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