

# Rješenja problema i zadatka za četvrti razred

## Modul 1

### Problemi:

7. a) ( $\lambda_{max} = C/T$ )    8. plava ( $\lambda_{max} = C/T$ )    10. b) ( $P = \sigma AT^4$ )    12.  $R_1/R_2 = (T_2/T_1)^2$     13. d)  
19. d)    25. a)    32. d)    33. b)    34. a)    46. za gama zračenje    52. d)    53. b)  
55. a)    66. d)

### Zadaci:

67. b) ( $\lambda_{max} = 483nm$ )    68.  $\lambda_{max} = 9,345\mu m$     69.  $\lambda_{max} = 10,6\mu m, I = 315W/m^2$   
70.  $\lambda_{max} = 2,99\mu m$     71.  $E = 34J$     72. a)  $P = 3,86 \cdot 10^{26}W$ ; b)  $t = 5507^\circ C$ ; c)  $\lambda_{max} = 501,2nm$   
73.  $t = 760,6^\circ C$     74.  $t = 816,9^\circ C$     75. b)    76.  $A = 9,12cm^2$   
77.  $\Delta T = -513K$  (sniženje temper.)    78. c)    79.  $T_1 = 2414K, T_2 = 4828K$     80.  $P = 459W$   
81.  $P = 7278W$     82.  $E = 2,34 \cdot 10^{28}J$     83.  $E = 1445,6J$     84.  $I = 7,28 \cdot 10^7W/m^2$   
85.  $t = 633^\circ C$     86. b)    87.  $\lambda = 552,2nm$     88.  $E_1/E_2 = 7 \cdot 10^4$     89.  $N = 1,006 \cdot 10^{31}$   
90. c)    91. neće ( $E_f = 1,55eV < W_i$ )    92.  $f = 4,98 \cdot 10^{14}Hz$     93.  $\lambda_{max} = 248,5nm$   
94.  $\lambda_g = 463nm$     95.  $v_{max} \approx 5,8 \cdot 10^5m/s$     96.  $E_k = 0,235eV$     97.  $W_i = 3,825eV$     98. e)  
99.  $E_{kmax} = 0,547eV, v_{max} = 4,38 \cdot 10^5m/s$     100. a)    101. d)    102.  $\lambda = 203,7nm$   
103.  $\lambda_g = 212nm$     104.  $f = 13,2 \cdot 10^{14}Hz$     105.  $U_z = 0,9V$     106.  $h = 6,64 \cdot 10^{-34}Js, W_i = 1,9eV$   
107.  $\lambda_{min} = 35,5pm$     108. a)  $v = 2,295 \cdot 10^8m/s$ ; b)  $\lambda_{min} = 8,28pm$   
109. Ne možemo ( $\lambda < \lambda_{min} = 3,26pm$ )    110.  $\lambda_{min} = 12,4pm$     111.  $\lambda = 66,9pm$   
112.  $d = 140pm$     113.  $d = 2,025 \cdot 10^{-10}m$     114.  $\alpha_1 = 22^\circ 38'$     115.  $\alpha_1 = 14^\circ 25', \alpha_2 = 29^\circ 53'$   
116.  $E_{max} = 3,27eV, E_{min} = 1,635eV, p \in (8,7 \cdot 10^{-28} - 1,74 \cdot 10^{-27})kgm/s$     117.  $m = 4,42 \cdot 10^{-36}kg$   
118. a)  $E_1 = 3,58 \cdot 10^{-19}J, p_1 = 1,194 \cdot 10^{-27}kgm/s$ ; b)  $E_2 = 1,99 \cdot 10^{-15}J, p_2 = 6,626 \cdot 10^{-24}kgm/s$   
119. a) ne vrijede; b)  $p = 1,325 \cdot 10^{-27}kgm/s, E = 2,48eV$ ; c)  $E_k = E$ ; d)  $E^2 - (pc)^2 = 0$   
120.  $E_f = 1,96eV, p = 1,047 \cdot 10^{-27}kgm/s, m = 3,49 \cdot 10^{-36}kg$     121.  $v = 2,476 \cdot 10^4m/s$   
122.  $\lambda = 3,64 \cdot 10^{-7}m$     123.  $\lambda = 8,28 \cdot 10^{-35}m$     124. a)  $\lambda = 1,37 \cdot 10^{-10}m$ ; b)  $\lambda = 8,73 \cdot 10^{-13}m$   
125.  $\lambda = 2,58 \cdot 10^{-11}m$     126.  $\lambda \approx 1,23nm$     127.  $U = 150,34V$     128.  $\lambda = 54,9pm$   
129.  $U = 602,36V$     130. a)  $\Delta v \geq 57,9m/s$ ; b)  $\Delta v \geq 5,27 \cdot 10^{-23}m/s$     131.  $\Delta x \geq 7,72 \cdot 10^{-10}m$   
132.  $\Delta x \geq 2,1 \cdot 10^{-8}m$     133.  $\Delta v \geq 0,116m/s$     134.  $\Delta x \geq 3,5 \cdot 10^{-11}m$   
135. a)  $\Delta x \geq 4,567 \cdot 10^{-12}m$ ; b)  $\Delta x \geq 1,16 \cdot 10^{-8}m$ ; c)  $\Delta x \geq 2,11 \cdot 10^{-33}m$     136.  $\Delta v \geq 1,158 \cdot 10^6m/s$   
137.  $\Delta x \geq 5,79 \cdot 10^{-10}m$     138.  $\lambda/\Delta x = 0,0628$     139.  $E_k = 1,39 \cdot 10^{-21}J$   
140.  $\Delta v/v$  (%)  $\geq 5 \cdot 10^{-3}$  (%)    141.  $\Delta x \geq 3,33 \cdot 10^{-13}m$     142.  $\Delta E_{min} \geq 6,59 \cdot 10^{-8}eV$   
143.  $\Delta t \geq 8,24 \cdot 10^{-27}s, s \approx c\Delta t = 2,47 \cdot 10^{-18}m$

## Modul 2

### Problemi:

20.  $r_4 = 16r_1$       24.  $E_k = -E$ ,  $E_{ep} = 2E$       33. d)  
39. a)  $hf_{4,1} = E_4 - E_1$ ; b)  $hf_{4,3} = E_4 - E_3$ ,  $hf_{3,1} = E_3 - E_1$ ; c)  $hf_{4,2} = E_4 - E_2$ ,  $hf_{2,1} = E_2 - E_1$ ;  
d)  $hf_{4,3}$ ,  $hf_{3,2} = E_3 - E_2$ ,  $hf_{2,1}$       40. a)      41.  $\lambda' = \lambda/2$ ,  $\lambda'' = \lambda/3$       42.  $\vec{p}_{at} = -\vec{p}_f$ ,  $E_{kat} = E_f^2/2m_{at}c^2$   
44. c)      45. a)      55. u  $s$ -stanje 2 elektrona, u  $p$ -stanje 6 elektrona, u  $d$ -stanje 10 elektrona  
56. 2 elektrona      57.  $7 \cdot 2 = 14$  elektrona      58. 32 elektrona      59.  $1s^2 2s^2 2p^1$       61. d)  
62.  $1s^2 2s^2 2p^6 3s^2 3p^2$ , silicijev atom, dakle ima 4 valentna elektrona: 2 u  $3s$ -stanju i 2 u  $3p$ -stanju  
63. c)

### Zadaci:

68.  $r_1 = 5,3 \cdot 10^{-11}m$ ,  $r_2 = 2,12 \cdot 10^{-10}m$ ,  $r_3 = 4,77 \cdot 10^{-10}m$ ,  
 $v_1 = 2,18 \cdot 10^6m/s$ ,  $v_2 = 1,09 \cdot 10^6m/s$ ,  $v_3 = 7,27 \cdot 10^5m/s$   
69.  $v_1 = 2,18 \cdot 10^6m/s$ ,  $v_2 = 1,09 \cdot 10^6m/s$ ,  $v_3 = 7,27 \cdot 10^5m/s$       70.  $\lambda = 3,328 \cdot 10^{-10}m$   
71.  $T_1 = 1,523 \cdot 10^{-16}s$ ,  $\omega_1 = 4,12 \cdot 10^{16} rad/s$ ;  $T_2 = 1,218 \cdot 10^{-15}s$ ,  $\omega_2 = 5,16 \cdot 10^{15} rad/s$   
72.  $r_2 = 2,12 \cdot 10^{-10}m$ ,  $v_2 = 1,09 \cdot 10^6m/s$ ,  $L_2 = 2,11 \cdot 10^{-34}kgm^2/s$ ,  
 $E_{k2} = 3,38eV$ ,  $E_{ep2} = -6,76eV$ ,  $E_2 = -3,38eV$       73.  $\lambda_\alpha = 656nm$ ,  $\lambda_\infty = 364,6nm$   
74.  $\lambda_1 = 121,5nm$ ,  $\lambda_2 = 656nm$ ,  $\lambda_3 = 102,5nm$   
75. U Lymanovoj seriji:  $\lambda_1 = hc/(E_2 - E_1)$ ,  $\lambda_2 = hc/(E_3 - E_1)$ ,  $\lambda_3 = hc/(E_4 - E_1)$ ;  
U Balmerovoj seriji:  $\lambda_4 = hc/(E_3 - E_2)$ ,  $\lambda_5 = hc/(E_4 - E_2)$ ; U Paschenovoj seriji:  $\lambda_6 = hc/(E_4 - E_3)$   
76. d)      77.  $E_k = 1,7eV$       78.  $\lambda = 4\mu m$   
79.  $E_n = -1,51eV$  (što odgovara drugom pobuđenom stanju  $n = 3$ )  
80. a)  $\lambda_{max} = 121,5nm$ ,  $\lambda_{min} = 91,16nm$ ; b)  $\lambda_{max} = 656,3nm$ ,  $\lambda_{min} = 364,6nm$       81.  $\lambda_2 = 97,23nm$   
82.  $\lambda = 102,5nm$       83.  $E_{min} = 10,2eV$   
84. a)  $E_{minL} = 10,2eV$ ; b)  $E_{minB} = 2,856eV$ ; c)  $E_{min} = 13,6eV$       85.  $\lambda = 589,8nm$   
86.  $f = 1,18 \cdot 10^{15}Hz$       87.  $E_{aps.min} = 10,2eV$ ,  $\lambda = 121,8nm$ ,  $f = 2,46 \cdot 10^{15}Hz$   
88.  $m = 2$  (pripada Balmerovu nizu)      89.  $n = 4$       90. a)  $n = 4$ ; b)  $n = 3$       91.  $m = 3$ ,  $n = 5$   
92.  $N \approx 3 \cdot 10^{19}$       93.  $E_{ion} = 13,6eV$ ,  $f = 3,284 \cdot 10^{15}Hz$ ,  $\lambda = 91,35nm$   
94. a)  $T = 9,34 \cdot 10^4K$ ; b)  $T' = 2,208 \cdot 10^4K$   
95. a)  $E_1 = -13,6eV$ ,  $E_{k1} = -E_1 = 13,6eV$ ,  $E_{ep1} = 2E_1 = -27,2eV$ ;  
b)  $E_2 = -3,4eV$ ,  $E_{k2} = -E_2 = 3,4eV$ ,  $E_{ep2} = 2E_2 = -6,8eV$   
96. a)  $E_{ion} = 13,6eV$ ,  $T = 1,05 \cdot 10^5K$ ; b)  $E_{ion} = 0,544eV$ ,  $T = 4,2 \cdot 10^3K$       97.  $v = 6,93 \cdot 10^5m/s$   
98.  $E = 1,31MJ$       99.  $v = 2,12 \cdot 10^6m/s$       100.  $E_{fmin} = 10,2eV$ ,  $E_{fmax} = 13,6eV$       101.  $Z = 8$   
102. a)  $E_2 = -3,4eV$ ; b)  $\Delta E_{min} = 6,59 \cdot 10^{-8}eV$       103.  $Z = 30$  (cink)      104.  $E_{fmax} = 22,9keV$   
105.  $U_{min} = 72,628kV$       106.  $\lambda = 633,8nm$  (crvena boja)

## Modul 3

### Problemi:

18. a)  ${}_{19}^{41}K + {}_2^4He \rightarrow {}_{20}^{44}Ca + {}_1^1p$ ; b)  ${}_{25}^{55}Mn + {}_1^1p \rightarrow {}_{26}^{55}Fe + {}_0^1n$ ;  
c)  ${}_1^2H + \gamma \rightarrow {}_1^1H + {}_0^1n$ ; d)  ${}_4^9Be + {}_1^2H \rightarrow {}_5^{10}B + {}_0^1n$
19. a)  ${}_2^4He + {}_6^{12}C \rightarrow {}_7^{15}N + {}_1^1H$ ; b)  ${}_{84}^{210}Po \rightarrow {}_{82}^{206}Pb + {}_2^4He$ ; c)  ${}_1^2H + {}_1^3H \rightarrow {}_2^4He + {}_0^1n$ ;  
d)  ${}_{92}^{235}U \rightarrow {}_{90}^{231}Th + {}_2^4He$ ; e)  ${}_{86}^{222}Rn \rightarrow {}_{84}^{218}Po + {}_2^4He$ ; f)  ${}_{13}^{27}Al + {}_2^4He \rightarrow {}_{15}^{30}P + {}_0^1n$ ;  
g)  ${}_{15}^{31}P + {}_0^1n \rightarrow {}_1^1H + {}_{14}^{31}Si$ ; h)  ${}_{7}^{14}N + {}_2^4\alpha \rightarrow {}_8^{17}O + {}_1^1H$ ; i)  ${}_{5}^{11}B + {}_1^1p \rightarrow {}_6^{11}C + {}_0^1n$       20. d)
21. a)  ${}_1^1H + {}_2^3He \rightarrow {}_2^4He$  (nemoguća); b)  ${}_1^1H + {}_3^7Li \rightarrow {}_2^4He + {}_2^4He$  (moguća);  
c)  ${}_{94}^{238}Pu + {}_0^1n \rightarrow {}_{54}^{141}Xe + {}_{40}^{97}Zr + 2{}_0^1n$  (nemoguća); d)  ${}_{5}^{11}B + {}_1^1H \rightarrow {}_4^8Be + {}_2^4He$  (moguća)
22.  ${}_{13}^{27}Al + {}_0^1n \rightarrow {}_{11}^{23}Na + {}_2^4\alpha + {}_0^1n$       23.  ${}_{92}^{238}U + {}_6^{12}C \rightarrow {}_{98}^{245}Cf + 5{}_0^1n$       28. a)      33. a)      34. b)
52. a)      53. a)  ${}_{81}^{207}Tl$ ; b)  ${}_{82}^{208}Pb$ ; c)  ${}_{88}^{228}Ra$ ; d)  ${}_{92}^{234}U$
56. a)  ${}_{8}^{15}O$ ; b)  ${}_{84}^{214}Po$ ; c)  ${}_{13}^{26}Al$ ; d)  ${}_{27}^{57}Co$ ; e)  ${}_{30}^{65}Zn$ ; f)  ${}_{30}^{64}Zn$       57. c)      62. a)      64. c)
65.  $\Delta N = 7N_0/8$       67. a)      71.  $\delta A \equiv \Delta A/A_0(\%) = 75\%$

### Zadaci:

73. a)  $Z' = 9, N' = 8, ({}_{9}^{17}F)$ ; b)  $Z' = 12, N' = 11, ({}_{12}^{23}Mg)$ ; c)  $Z' = 13, N' = 12, ({}_{13}^{25}Al)$
74.  $N_p = N_{at} \cdot Z = 1,45 \cdot 10^{26}$ ,  $N_n = N_{at} \cdot N = 1,56 \cdot 10^{26}$       75.  $v = 5,3 \cdot 10^7 m/s$ ,  $E_k = 1,28 \cdot 10^{-15} J$
76.  $m_2/m_1 = 1,113$       77.  $d = 1,65 cm$       78.  $r = 8,02 mm$       79.  $B = 2,585 mT$
80.  $m(u) = 0,1492217u$ ,  $m = 2,477 \cdot 10^{-28} kg$       81. (egzotermna reakcija),  $Q = 3,12 MeV$
82.  ${}_2^4He + \gamma \rightarrow {}_1^3H + {}_1^1p$ ,  $E_{\gamma min} = 19,82 MeV$       83.  $\Delta m = 0,002389u$ ,  $E_\nu = 2,225 MeV$
84.  $E_1 = 7,68 MeV$       85. b)      86.  $E_1 = 8,44 MeV$       87.  $E \approx 6,82 \cdot 10^{11} J$
88.  $\Delta m = 0,137036u$ ,  $E_\nu = 127,65 MeV$       89. a)      90.  $E = 4,95 MeV$
91.  $E_{kLi} = 1,017 MeV$ ,  $E_{kHe} = 1,783 MeV$       92.  $Q = 2,12 MeV$       93.  $E = 12,42 MeV$
94.  $\bar{E}_{U-233} = 7,6 MeV$ ,  $\bar{E}_{U-238} = 7,57 MeV \Rightarrow \bar{E}_{U-233} > \bar{E}_{U-238}$       95.  $E_\nu = 10,6 MeV$
96.  $\Delta m = 2,76 \cdot 10^{-31} kg$       97.  $W = 64,75 MeV$       98. a)      99.  $m_{Li} = 9,98 \cdot 10^{-27} kg$
100.  $E = 17,354 MeV$       101.  $E = 1,2 MeV$       102.  $E = 9 \cdot 10^{15} J$       103.  $E = 220,3 MeV$
104. i)  $Q = 4,54 MeV$ ,  $E = 1,456 \cdot 10^{11} J$ , ii)  $Q' = 4,29 MeV$ ,  $E' = 1,378 \cdot 10^{11} J$
105.  $E_1 = 3,584 MeV$       106.  $Q = 17,92 MeV$ ,  $E = 119,9 kWh$
107. a)  $E = 8,2 \cdot 10^{13} J$ ; b)  $E' = 1,93 \cdot 10^{13} J$       108.  $P = 0,91 MW$       109.  $m = 1,013 g$
110.  $P_{isk.} = 28,5 MW$       111.  $\eta = 0,169$  (16,9%)      112. 7  $\alpha$ -raspada i 4  $\beta^-$ -raspada
113. 8  $\alpha$ -raspada i 6  $\beta^-$ -raspada      114.  ${}_{82}^{208}Pb$       115. b)      116. c)      117. a)
118.  $E = 129,12 MeV$       119.  $\lambda = 4,883 \cdot 10^{-18} s^{-1}$       120.  $N = 0,25 N_0$       121.  $T = 2,524 dan$

122.  $\Delta N/N_0(\%) = 35,16\%$       123.  $t = 17,82s$       124.  $t = 2,345h$       125.  $\Delta N = 9,375 \cdot 10^5$
126. Koristeći zakon RA raspada uraditi tablicu i nacrtati odgovarajući graf.
127. c)      128. c)      129.  $T = 1,6$  dana      130.  $t = 2h$       131.  $t = 4T$       132.  $t = 0,836h$
133.  $t = 12$  dana      134.  $\Delta N = 1,08 \cdot 10^{15}$       135.  $\Delta m = 17,5mg$       136.  $m = 0,25g$       137. b)
138.  $m_{0B} = 16kg$       139.  $\Delta m = 0,374mg$       140.  $\Delta m = 7g$       141.  $\mathcal{A} = 1,716 \cdot 10^{10}Bq$  (ili  $0,46Ci$ )
142.  $\mathcal{A} = 3,66 \cdot 10^{10}Bq$       143.  $T = 6,58h$ ,  $\lambda = 2,93 \cdot 10^{-5}s^{-1}$ ,  $N = 1,263 \cdot 10^{11}$       144.  $\mathcal{A}' = \mathcal{A}_0/16$
145.  $\delta\mathcal{A}(\%) = 75\%$       146.  $m = 3,1 \cdot 10^{-10}g$       147.  $V = 5,945dm^3$
148.  $N = N_0/1024$  (Dakle, nakon 80 dana koncentracija radioaktivnog joda-131 u kolutu sira smanjit će se više od 1000 puta pa se može jesti.)

## Modul 4

### Problemi:

18.  $E_{fmin} = 1,0248MeV$       30.  $N(^{12}_6C) = 42$ ,  $N(^{238}_{92}U) = 806$
33. Na rastojanjima navedenim pod: a), b) i c) interakcija je gravitacijska i elektromagnetska a na udaljenosti navedenoj pod d) i jaka nuklearna.
41.  $m \approx hT/2cC$       52. nisu (pogledati kako je nastalo naše Sunce)      53. ne može
68. svijetliće ona koja je spojena u propusnom smjeru
75. emiter spojiti u propusnom a kolektor u nepropusnom smjeru      77. u krugu na slici a)

### Zadaci:

80.  $H = 2mSv$       81.  $H = 7,84Sv$       82.  $H_\alpha = 6mSv$       83.  $Q = 5Sv/Gy$
84. a)  $\Delta N = 8,968 \cdot 10^{11}$ ; b)  $D = 1Gy$ ; c)  $H = 1Sv$       85.  $E_\gamma = 0,511MeV$ ,  $\lambda = 2,43pm$
86.  $E_k = 0,989MeV$       87.  $E_\gamma = 0,751MeV$ ,  $\lambda = 1,654pm$       88.  $f = 1,96 \cdot 10^{20}Hz$ ,
89. a)  $v = 0,9994c$ ; b)  $T = 60\mu s$ ; c)  $s \approx 18km$
90. a) moguća je ( $E_\Sigma > E_n + E_\pi$ ); b) nemoguća je ( $E_\Sigma < E_A + E_\pi$ )      91.  $E_\gamma = 67,5MeV$
92.  $E_\gamma = 67,6MeV$ , smjerovi fotona su suprotni ( $\vec{p}_2 = -\vec{p}_1$ )
93. a)  $E_{0\pi} = 139,8MeV$ ; b)  $v = 0,827c$       94.  $T_0 = 2,54 \cdot 10^{-8}s$       95. b)      96.  $d = 2,47 \cdot 10^{-18}m$
97.  $Q = 4,29MeV$ ,  $E = 1,378 \cdot 10^{11}J$       98.  $E = 7,256MeV$       99.  $E_\gamma = 2,225MeV$
100.  $v = 619km/s$ ,  $r' \approx 3km$

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