СТАБИЛЬНЫЕ ИЗОТОПЫ ХИМИЧЕСКИХ ЭЛЕМЕНТОВ (для задачи 4.1)

Z - атомный номер (заряд ядра, т.е. число протонов)

A - массовое число (число протонов + число нейтронов)

El - символ химического элемента

Mass - атомная масса (в углеродных единицах, а.е.м.)

Abund - процентное содержание (abundance) в природной смеси изотопов

 Z A El Mass Abund

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 1 1 H 1.007825 99.99

 1 2 H 2.014102 0.015

 2 3 He 3.016029 0.00014

 2 4 He 4.002603 100.00

 3 6 Li 6.015123 7.42

 3 7 Li 7.016005 92.58

 4 9 Be 9.012183 100.00

 5 10 B 10.012938 19.80

 5 11 B 11.009305 80.20

 6 12 C 12.000000 98.90

 6 13 C 13.003355 1.10

 7 14 N 14.003074 99.63

 7 15 N 15.000109 0.37

 8 16 O 15.994915 99.76

 8 17 O 16.999131 0.038

 8 18 O 17.999159 0.20

 9 19 F 18.998403 100.00

 10 20 Ne 19.992439 90.60

 10 21 Ne 20.993845 0.26

 10 22 Ne 21.991384 9.20

 11 23 Na 22.989770 100.00

 12 24 Mg 23.985045 78.90

 12 25 Mg 24.985839 10.00

 12 26 Mg 25.982595 11.10

 13 27 Al 26.981541 100.00

 14 28 Si 27.976928 92.23

 14 29 Si 28.976496 4.67

 14 30 Si 29.973772 3.10

 15 31 P 30.973763 100.00

 16 32 S 31.972072 95.02

 16 33 S 32.971459 0.75

 16 34 S 33.967868 4.21

 16 36 S 35.967079 0.020

 17 35 Cl 34.968853 75.77

 17 37 Cl 36.965903 24.23

 18 36 Ar 35.967546 0.34

 18 38 Ar 37.962732 0.063

 18 40 Ar 39.962383 99.60

 19 39 K 38.963708 93.20

 19 40 K 39.963999 0.012

 19 41 K 40.961825 6.73

 20 40 Ca 39.962591 96.95

 20 42 Ca 41.958622 0.65

 20 43 Ca 42.958770 0.14

 20 44 Ca 43.955485 20.86

 20 46 Ca 45.953689 0.004

 20 48 Ca 47.952532 0.19

 21 45 Sc 44.955914 100.00

 22 46 Ti 45.952633 8.00

 22 47 Ti 46.951765 7.30

 22 48 Ti 47.947947 73.80

 22 49 Ti 48.947871 5.50

 22 50 Ti 49.944786 5.40

 23 50 V 49.947161 0.25

 23 51 V 50.943963 99.75

 24 50 Cr 49.946046 4.35

 24 52 Cr 51.940510 83.79

 24 53 Cr 52.940651 9.50

 24 54 Cr 53.938882 2.36

 25 55 Mn 54.938046 100.00

 26 54 Fe 53.939612 5.80

 26 56 Fe 55.934939 91.72

 26 57 Fe 56.935396 2.20

 26 58 Fe 57.933278 0.28

 27 59 Co 58.933198 100.00

 28 58 Ni 57.935347 68.27

 28 60 Ni 59.930789 26.10

 28 61 Ni 60.931059 1.13

 28 62 Ni 61.928346 3.59

 28 64 Ni 63.927968 0.91

 29 63 Cu 62.929599 69.17

 29 65 Cu 64.927792 30.83

 30 64 Zn 63.929145 48.60

 30 66 Zn 65.926035 27.90

 30 67 Zn 66.927129 4.10

 30 68 Zn 67.924846 18.80

 30 70 Zn 69.925325 0.60

 31 69 Ga 68.925581 60.10

 31 71 Ga 70.924701 39.90

 32 70 Ge 69.924250 20.50

 32 72 Ge 71.922080 27.40

 32 73 Ge 72.923464 7.80

 32 74 Ge 73.921179 36.50

 32 75 Ge 75.921403 7.80

 33 75 As 74.921596 100.00

 34 74 Se 73.922477 0.90

 34 76 Se 75.919207 9.00

 34 77 Se 76.919908 7.60

 34 78 Se 77.917304 23.50

 34 80 Se 79.916521 49.60

 34 82 Se 81.916709 9.40

 35 79 Br 78.918336 50.69

 35 81 Br 80.916290 49.31

 36 78 Kr 77.920397 0.35

 36 80 Kr 79.916375 2.25

 36 82 Kr 81.913483 11.60

 36 83 Kr 82.914134 11.50

 36 84 Kr 83.911506 57.00

 36 86 Kr 85.910614 17.30

 37 85 Rb 84.911800 72.17

 37 87 Rb 86.909184 27.84

 38 84 Sr 83.913428 0.56

 38 86 Sr 85.909273 9.86

 38 87 Sr 86.908902 7.00

 38 88 Sr 87.905625 82.58

 39 89 Y 88.905856 100.00

 40 90 Zr 89.904708 51.45

 40 91 Zr 90.905644 11.27

 40 92 Zr 91.905039 17.17

 40 94 Zr 93.906319 17.33

 40 96 Zr 95.908272 2.78

 41 93 Nb 92.906378 100.00

 42 92 Mo 91.906809 14.84

 42 94 Mo 93.905086 9.25

 42 95 Mo 94.905838 15.92

 42 96 Mo 95.904676 16.68

 42 97 Mo 96.906018 9.55

 42 98 Mo 97.905405 24.13

 42 100 Mo 99.907473 9.63

 44 96 Ru 95.907596 5.52

 44 98 Ru 97.905287 1.88

 44 99 Ru 98.905937 12.70

 44 100 Ru 99.904218 12.60

 44 101 Ru 100.905581 17.00

 44 102 Ru 101.90434 31.60

 44 104 Ru 103.905422 18.70

 45 103 Rh 102.905503 100.00

 46 102 Pd 101.905609 1.02

 46 104 Pd 103.904026 11.14

 46 105 Pd 104.905075 22.33

 46 106 Pd 105.903475 27.33

 46 108 Pd 107.903894 26.46

 46 110 Pd 109.905169 11.72

 47 107 Ag 106.905095 51.84

 47 109 Ag 108.904754 48.16

 48 106 Cd 105.906461 1.25

 48 110 Cd 109.903007 12.49

 48 111 Cd 110.904182 12.80

 48 112 Cd 111.902761 24.13

 48 113 Cd 112.904401 12.22

 48 114 Cd 113.903361 28.73

 48 116 Cd 115.904758 7.49

 49 113 In 112.904056 4.30

 49 115 In 114.903875 95.70

 50 116 Sn 115.901744 14.70

 50 117 Sn 116.902954 7.70

 50 118 Sn 117.901607 24.30

 50 119 Sn 118.903310 8.60

 50 120 Sn 119.902199 32.40

 50 122 Sn 121.903440 4.60

 50 124 Sn 123.905271 5.60

 51 121 Sb 120.903824 57.30

 51 123 Sb 122.904222 42.70

 52 122 Te 121.903055 2.60

 52 123 Te 122.904278 0.91

 52 124 Te 123.902825 4.82

 52 125 Te 124.904435 7.14

 52 126 Te 125.903310 18.95

 52 128 Te 127.904464 31.69

 52 130 Te 129.906229 33.80

 53 127 I 126.904477 100.00

 54 128 Xe 127.903531 1.91

 54 129 Xe 128.904780 26.40

 54 130 Xe 129.903510 4.10

 54 131 Xe 130.905076 21.20

 54 132 Xe 131.904148 26.90

 54 134 Xe 133.905395 10.40

 54 136 Xe 135.907219 8.90

 55 133 Cs 132.905433 100.00

 56 130 Ba 129.906277 0.11

 56 132 Ba 131.905042 0.10

 56 134 Ba 133.904490 2.42

 56 135 Ba 134.905668 6.59

 56 136 Ba 135.904556 7.85

 56 137 Ba 136.905816 11.23

 56 138 Ba 137.905236 71.70

 57 138 La 137.907114 0.09

 57 139 La 138.906355 99.91

 58 136 Ce 135.907140 0.19

 58 138 Ce 137.905996 0.25

 58 140 Ce 139.905442 88.48

 58 142 Ce 141.909249 11.08

 59 141 Pr 140.907657 100.00

 60 142 Nd 141.907731 27.13

 60 143 Nd 142.909823 12.18

 60 144 Nd 143.910096 23.80

 60 145 Nd 144.912582 8.30

 60 146 Nd 145.913126 17.19

 60 148 Nd 147.916901 5.76

 60 150 Nd 149.920900 5.64

 62 144 Sm 143.912009 3.10

 62 147 Sm 146.914907 15.00

 62 148 Sm 147.914832 11.30

 62 149 Sm 148.917193 13.80

 62 150 Sm 149.917285 7.40

 62 152 Sm 151.919741 25.70

 62 154 Sm 153.922218 22.70

 63 151 Eu 150.919860 47.80

 63 153 Eu 152.921243 52.20

 64 152 Gd 151.919803 0.200

 64 154 Gd 153.920876 2.18

 64 155 Gd 154.822629 14.80

 64 156 Gd 155.922130 20.47

 64 157 Gd 156.923967 15.65

 64 158 Gd 157.924111 24.84

 64 160 Gd 159.927061 21.86

 65 159 Tb 158.925350 100.00

 66 156 Dy 155.924287 0.060

 66 158 Dy 157.924412 0.10

 66 160 Dy 159.925203 2.34

 66 161 Dy 160.926939 18.90

 66 162 Dy 161.926805 25.50

 66 163 Dy 162.928737 24.90

 66 164 Dy 163.929183 28.20

 67 165 Ho 164.930332 100.00

 68 162 Er 161.928787 0.14

 68 164 Er 163.929211 1.61

 68 166 Er 165.930305 33.60

 68 167 Er 166.932061 22.95

 68 168 Er 167.932383 26.80

 68 170 Er 169.935476 14.90

 69 169 Tm 168.934225 100.00

 70 168 Yb 167.933908 0.13

 70 170 Yb 169.934774 3.05

 70 171 Yb 170.936338 14.30

 70 172 Yb 171.936393 21.90

 70 173 Yb 172.938222 16.12

 70 174 Yb 173.938873 31.80

 70 176 Yb 175.942576 12.70

 71 175 Lu 174.940785 97.40

 71 176 Lu 175.942694 2.60

 72 174 Hf 173.940065 0.16

 72 176 Hf 175.941420 5.20

 72 177 Hf 176.943233 18.60

 72 178 Hf 177.943710 27.10

 72 179 Hf 178.945827 13.74

 72 180 Hf 179.946561 35.20

 73 180 Ta 179.947489 0.012

 73 181 Ta 180.948014 99.99

 74 180 W 179.946727 0.13

 74 182 W 181.948225 26.30

 74 183 W 182.950245 14.30

 74 184 W 183.950953 30.67

 74 186 W 185.954377 23.60

 75 185 Re 184.952977 37.40

 75 187 Re 186.955765 62.60

 76 184 Os 183.952514 0.02

 76 186 Os 185.953852 1.58

 76 187 Os 186.955762 1.60

 76 188 Os 187.955850 13.30

 76 189 Os 188.958156 16.10

 76 190 Os 189.958455 26.40

 76 192 Os 191.961487 41.00

 77 191 Ir 190.960603 37.30

 77 193 Ir 192.962942 62.70

 78 190 Pt 189.959937 0.010

 78 192 Pt 191.961049 0.79

 78 194 Pt 193.962679 32.90

 78 195 Pt 194.964785 33.80

 78 196 Pt 195.964947 25.30

 78 198 Pt 197.967879 7.20

 79 197 Au 196.966560 100.00

 80 196 Hg 195.965812 0.15

 80 198 Hg 197.966760 10.10

 80 199 Hg 198.968269 17.00

 80 200 Hg 199.968316 23.10

 80 201 Hg 200.970293 13.20

 80 202 Hg 201.970632 29.65

 80 204 Hg 203.973481 6.80

 81 203 Tl 202.972336 29.52

 81 205 Tl 204.974410 70.48

 82 204 Pb 203.973037 1.40

 82 206 Pb 205.974455 24.10

 82 207 Pb 206.975885 22.10

 82 208 Pb 207.976641 52.40

 83 209 Bi 208.980388 100.00

 90 233 Th 232.038054 100.00

 92 234 U 234.040947 0.006

 92 235 U 235.043925 0.72

 92 238 U 238.050786 99.27