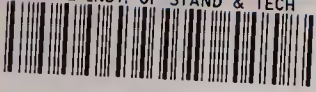


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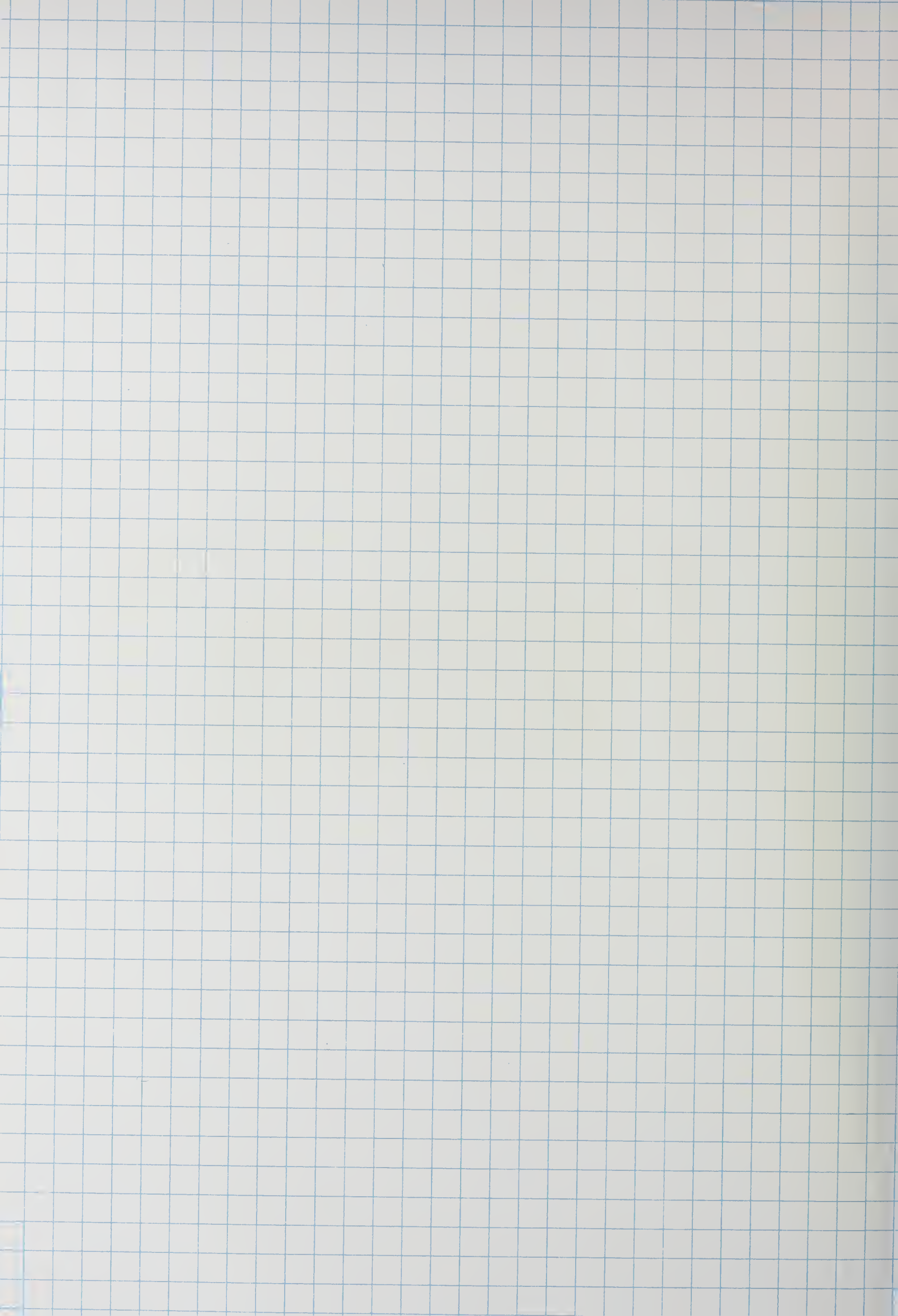
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Periodic table Atomic proerties of the
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PERIODIC TABLE Atomic Properties of the Elements

National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

Physics Laboratory
Standard Reference Data Program
physics.nist.gov
www.nist.gov/srd

Frequently used fundamental physical constants

For the most accurate values of these and other constants, visit physics.nist.gov/constants

1 second = 9 192 631 770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of ¹³³Cs

speed of light in vacuum c 299 792 458 m s⁻¹ (exact)

Planck constant h 6.626 1 × 10⁻³⁴ J s (exact) ($h = h/2\pi$)

elementary charge e 1.602 2 × 10⁻¹⁹ C

electron mass m_e 9.109 4 × 10⁻³¹ kg

proton mass m_p 1.672 6 × 10⁻²⁷ kg

fine-structure constant α 1/137.036

Rydberg constant R_∞ 10 973 732 m⁻¹

Boltzmann constant k 1.380 7 × 10⁻²³ J K⁻¹

Solids
 Liquids
 Gases
 Artificially Prepared

1 H Hydrogen 1.00794 1s	2 He Helium 4.00260 1s ²																																																																																																																		
3 Li Lithium 6.941 1s ² 2s	4 Be Beryllium 9.01218 1s ² 2s ²	5 B Boron 10.811 1s ² 2s ² 2p	6 C Carbon 12.0107 1s ² 2s ² 2p ²	7 N Nitrogen 14.00674 1s ² 2s ² 2p ³	8 O Oxygen 15.9994 1s ² 2s ² 2p ⁴	9 F Fluorine 18.99840 1s ² 2s ² 2p ⁵	10 Ne Neon 20.1797 1s ² 2s ² 2p ⁶	11 Na Sodium 22.98977 [Ne]3s	12 Mg Magnesium 24.3050 [Ne]3s ²	13 Al Aluminum 26.98154 [Ne]3s ² 3p	14 Si Silicon 28.0855 [Ne]3s ² 3p ²	15 P Phosphorus 30.97376 [Ne]3s ² 3p ³	16 S Sulfur 32.066 [Ne]3s ² 3p ⁴	17 Cl Chlorine 35.4527 [Ne]3s ² 3p ⁵	18 Ar Argon 39.948 [Ne]3s ² 3p ⁶	19 K Potassium 39.0983 [Ar]4s	20 Ca Calcium 40.078 [Ar]4s ²	21 Sc Scandium 44.95591 [Ar]3d ¹ 4s ²	22 Ti Titanium 47.867 [Ar]3d ² 4s ²	23 V Vanadium 50.9415 [Ar]3d ³ 4s ²	24 Cr Chromium 51.9961 [Ar]3d ⁵ 4s	25 Mn Manganese 54.93805 [Ar]3d ⁵ 4s ²	26 Fe Iron 55.845 [Ar]3d ⁶ 4s ²	27 Co Cobalt 58.93320 [Ar]3d ⁷ 4s ²	28 Ni Nickel 58.6934 [Ar]3d ⁸ 4s ²	29 Cu Copper 63.546 [Ar]3d ¹⁰ 4s	30 Zn Zinc 65.39 [Ar]3d ¹⁰ 4s ²	31 Ga Gallium 69.723 [Ar]3d ¹⁰ 4s ² 4p	32 Ge Germanium 72.61 [Ar]3d ¹⁰ 4s ² 4p ²	33 As Arsenic 74.92160 [Ar]3d ¹⁰ 4s ² 4p ³	34 Se Selenium 78.96 [Ar]3d ¹⁰ 4s ² 4p ⁴	35 Br Bromine 79.904 [Ar]3d ¹⁰ 4s ² 4p ⁵	36 Kr Krypton 83.80 [Ar]3d ¹⁰ 4s ² 4p ⁶	37 Rb Rubidium 85.4678 [Kr]5s	38 Sr Strontium 87.62 [Kr]4d ⁵ 5s ²	39 Y Yttrium 88.90585 [Kr]4d ⁵ 5s ²	40 Zr Zirconium 91.224 [Kr]4d ² 5s ²	41 Nb Niobium 92.90638 [Kr]4d ⁴ 5s	42 Mo Molybdenum 95.94 [Kr]4d ⁵ 5s	43 Tc Technetium (98) [Kr]4d ⁵ 5s ²	44 Ru Ruthenium 101.07 [Kr]4d ⁷ 5s	45 Rh Rhodium 102.90550 [Kr]4d ⁸ 5s	46 Pd Palladium 106.42 [Kr]4d ¹⁰	47 Ag Silver 107.8682 [Kr]4d ¹⁰ 5s	48 Cd Cadmium 112.411 [Kr]4d ¹⁰ 5s ²	49 In Indium 114.818 [Kr]4d ¹⁰ 5s ² 5p	50 Sn Tin 118.710 [Kr]4d ¹⁰ 5s ² 5p ²	51 Sb Antimony 121.760 [Kr]4d ¹⁰ 5s ² 5p ³	52 Te Tellurium 127.60 [Kr]4d ¹⁰ 5s ² 5p ⁴	53 I Iodine 126.90447 [Kr]4d ¹⁰ 5s ² 5p ⁵	54 Xe Xenon 131.29 [Kr]4d ¹⁰ 5s ² 5p ⁶	55 Cs Cesium 132.90545 [Xe]6s	56 Ba Barium 137.327 [Xe]6s ²	57 La Lanthanum 138.9055 [Xe]5d ¹ 6s ²	58 Ce Cerium 140.116 [Xe]4f ¹ 5d ¹ 6s ²	59 Pr Praseodymium 140.90765 [Xe]4f ³ 6s ²	60 Nd Neodymium 144.24 [Xe]4f ⁴ 6s ²	61 Pm Promethium (145) [Xe]4f ⁵ 6s ²	62 Sm Samarium 150.36 [Xe]4f ⁶ 6s ²	63 Eu Europium 151.964 [Xe]4f ⁷ 6s ²	64 Gd Gadolinium 157.25 [Xe]4f ⁷ 5d ¹ 6s ²	65 Tb Terbium 158.92534 [Xe]4f ⁹ 6s ²	66 Dy Dysprosium 162.50 [Xe]4f ¹⁰ 6s ²	67 Ho Holmium 164.93032 [Xe]4f ¹¹ 6s ²	68 Er Erbium 167.26 [Xe]4f ¹² 6s ²	69 Tm Thulium 168.93421 [Xe]4f ¹³ 6s ²	70 Yb Ytterbium 173.04 [Xe]4f ¹⁴ 6s ²	71 Lu Lutetium 174.967 [Xe]4f ¹⁴ 5d ¹ 6s ²	72 Hf Hafnium 178.49 [Xe]4f ¹⁴ 5d ² 6s ²	73 Ta Tantalum 180.9479 [Xe]4f ¹⁴ 5d ³ 6s ²	74 W Tungsten 183.84 [Xe]4f ¹⁴ 5d ⁴ 6s ²	75 Re Rhenium 186.207 [Xe]4f ¹⁴ 5d ⁵ 6s ²	76 Os Osmium 190.23 [Xe]4f ¹⁴ 5d ⁶ 6s ²	77 Ir Iridium 192.217 [Xe]4f ¹⁴ 5d ⁷ 6s ²	78 Pt Platinum 195.078 [Xe]4f ¹⁴ 5d ⁹ 6s	79 Au Gold 196.96655 [Xe]4f ¹⁴ 5d ¹⁰ 6s	80 Hg Mercury 200.59 [Xe]4f ¹⁴ 5d ¹⁰ 6s ²	81 Tl Thallium 204.3833 [Hg]6p	82 Pb Lead 207.2 [Hg]6p ²	83 Bi Bismuth 208.98038 [Hg]6p ³	84 Po Polonium (209) [Hg]6p ⁴	85 At Astatine (210) [Hg]6p ⁵	86 Rn Radon (222) [Hg]6p ⁶	87 Fr Francium (223) [Rn]7s	88 Ra Radium (226) [Rn]7s ²	89 Ac Actinium (227) [Rn]6d ¹ 7s ²	90 Th Thorium 232.0381 [Rn]6d ² 7s ²	91 Pa Protactinium 231.03588 [Rn]5f ² 6d ¹ 7s ²	92 U Uranium 238.0289 [Rn]5f ³ 6d ¹ 7s ²	93 Np Neptunium (237) [Rn]5f ⁴ 6d ¹ 7s ²	94 Pu Plutonium (244) [Rn]5f ⁶ 7s ²	95 Am Americium (243) [Rn]5f ⁷ 7s ²	96 Cm Curium (247) [Rn]5f ⁷ 6d ¹ 7s ²	97 Bk Berkelium (247) [Rn]5f ⁹ 7s ²	98 Cf Californium (251) [Rn]5f ¹⁰ 7s ²	99 Es Einsteinium (252) [Rn]5f ¹¹ 7s ²	100 Fm Fermium (257) [Rn]5f ¹² 7s ²	101 Md Mendelevium (258) [Rn]5f ¹³ 7s ²	102 No Nobelium (259) [Rn]5f ¹⁴ 7s ²	103 Lr Lawrencium (262) [Rn]5f ¹⁴ 7s ² 7p ¹	104 Rf Rutherfordium (261) [Rn]5f ¹⁴ 6d ¹ 7s ² 7p ¹	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Uun Ununnilium (271)	111 Uuu Ununnilium (272)	112 Uub Ununbium (277)	113 Uuq Ununquadium (289)	114 Uuq Ununquadium (289)	115 Uuh Ununhexium (289)	116 Uuh Ununhexium (289)	117 Uue Ununseptium (293)	118 Uuo Ununoctium (293)

Atomic Number

Ground-state Level

Symbol

Name

Atomic Weight†

Ground-state Configuration

Ionization Energy (eV)

58 Ce
Cerium
140.116
[Xe]4f¹5d¹6s²
5.5387

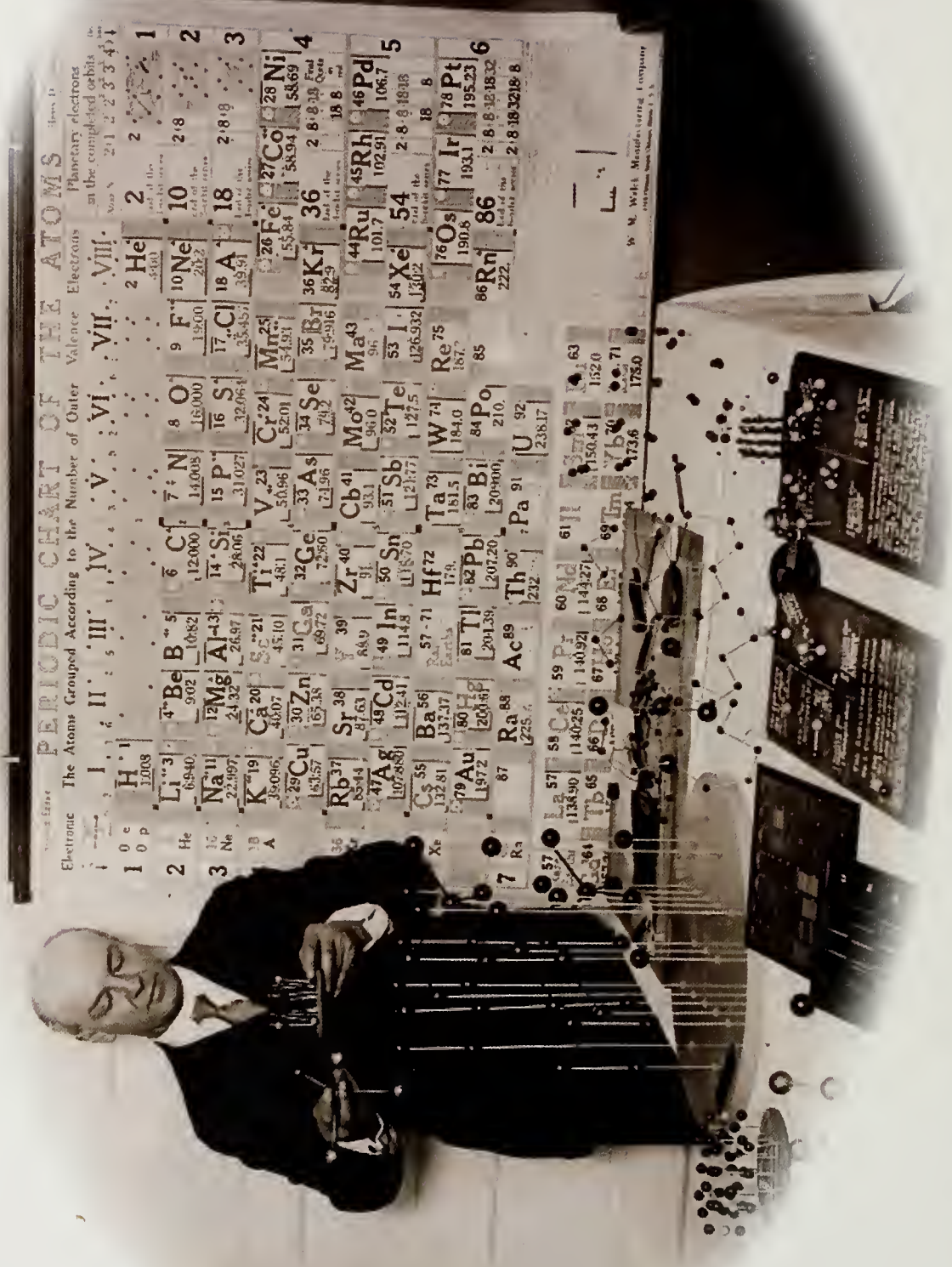
†Based upon ¹²C. () indicates the mass number of the most stable isotope.

For a description of the data, visit physics.nist.gov/data

NIST SP 966 (March 2001)



National Bureau of Standards / National Institute of Standards and Technology
First Century of Service to the Nation, 1901 – 2001



The Hubbard Chart of the Atoms, ca. 1924
 Henry D. Hubbard, the designer of the "Chart of the Atoms," was the first secretary of the National Bureau of Standards and served continuously in that capacity from 1901 until his retirement in 1938. Secretary Hubbard made a contribution to instruction in physics that is still in use today, his modernization of Mendeleev's periodic table. First constructed in the 1920's, it has been frequently revised and reprinted.

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