

Stjärnor

Föreläsning av Marcell Ziegler

UVS Fysik- och Astronomiläger 2024, Göteborg
2024-11-09

A Periodiska systemet

PERIODIC TABLE OF ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 H Hydrogen 1.008	2 He Helium 4.0026																	
3 Li Lithium 6.94	4 Be Beryllium 9.0122																	
5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180													
11 Na Sodium 22.990	12 Mg Magnesium 24.305																	
13 Al Aluminum 26.982	14 Si Silicon 28.085	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948													
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996													25 Mn Manganese 54.938
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29	55 Cs Caesium 132.91
55 Cs Caesium 132.91	56 Ba Barium 137.33	57–71 Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)	87 Fr Francium (223)
87 Fr Francium (223)	88 Ra Radium (226)	89–103 Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (268)	106 Sg Seaborgium (269)	107 Bh Bohrium (270)	108 Hs Hassium (277)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (290)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)	119 Uue Ununennium (295)
For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.																		
57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.97				
89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (266)				

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
2 He Helium 4.0026	10 Ne Neon 20.180																	
3 Li Lithium 6.94	4 Be Beryllium 9.0122																	
5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180													
11 Na Sodium 22.990	12 Mg Magnesium 24.305																	
13 Al Aluminum 26.982	14 Si Silicon 28.085	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948													
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996													25 Mn Manganese 54.938
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29	55 Cs Caesium 132.91
55 Cs Caesium 132.91	56 Ba Barium 137.33	57–71 Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)	87 Fr Francium (223)
87 Fr Francium (223)	88 Ra Radium (226)	89–103 Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (268)	106 Sg Seaborgium (269)	107 Bh Bohrium (270)	108 Hs Hassium (277)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (290)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)	119 Uue Ununennium (295)
For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.																		
57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.97				
89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (266)				

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Post-transition metals

Metalloids

Reactive nonmetals

Noble gases

Nonmetals

Atomic Symbol
Name
Weight

C Solid

Hg Liquid

H Gas

Rf Unknown

Metals

Alkali metals

Alkaline earth metals

Lanthanoids

Actinoids

Transition metals

Figure 1: Periodiska systemet.

B Formelsamling

B.1 Konstanter

Konstant	Värde
π	3,141 592 653 59
c	299 792 458 m/s