Thermal Properties of the Elements

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Alkaline earth metals	Transition metals
Alkali metals	Lanthanides
Nonmetals	Actinides
Halogens	Other metals
Semimetallics	Solid elements
Inert gases	Liquid elements
	Gaseous elements
	Radioactive

Atomic Number	Name	Atomic Mass
Specific Heat	**Element** values generally valid for standard conditions at RT	Melting Point
Thermal Conductivity		Heat of Fusion
Expansion Coefficient		Boiling Point
Electron Configuration	Density	Ionization Energy

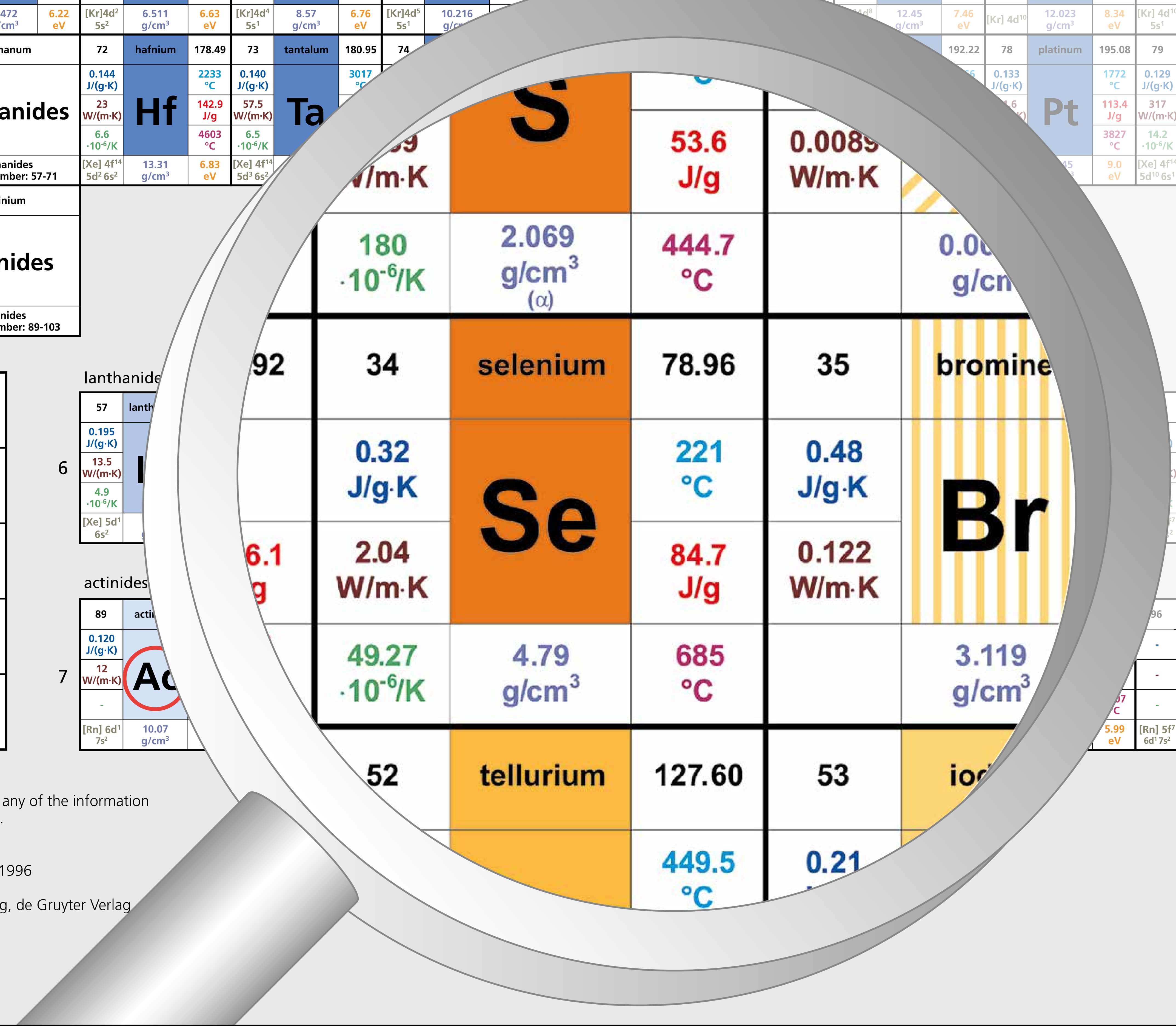
Period	Group	Atomic Number	Name	Element	Atomic Mass	Specific Heat J/(g·K)	Thermal Conductivity W/(m·K)	Expansion Coefficient ·10⁻⁶/K	Electron Configuration	Density g/cm³	Melting Point °C	Heat of Fusion J/g	Boiling Point °C	Ionization Energy eV
1	Group 1	1	hydrogen	H	1.01	14.304	0.18	-	$1s^{1}$	0.0000899	-259.1	116.1	-253	13.60
1	Group 18	2	helium	He	4.00	5.193	0.15	-	$1s^{2}$	0.0001785	-272.2	5.3	-268.9	24.59
2	Group 1	3	lithium	Li	6.94	3.582	84.70	56	$[He]2s^{1}$	0.534	180.5	432.3	1342	5.39
2	Group 2	4	beryllium	Be	9.01	1.825	201	12.3	$[He]2s^{2}$	1.848	1278	1387.0	2477	9.32
2	Group 13	5	boron	B	10.81	1.026	27	8.3	$[He]2s^{2}2p^{1}$	2.34	2075	2090.5	3927	8.30
2	Group 14	6	carbon	C	12.01	G: 0.709 J/(g·K) D: 0.427 J/(g·K)	G: 119-165 W/(m·K) D: 900-4300 W/(m·K)	-	$[He]2s^{2}2p^{2}$	G: 2.25 g/cm³ D: 3.51 g/cm³	3550	-	4800	11.26 eV
2	Group 15	7	nitrogen	N	14.01	1.040	0.026	-	$[He]2s^{2}2p^{3}$	0.0012506	-210.0	51.5	-195.8	14.53
2	Group 16	8	oxygen	O	16.00	0.918	0.026	-	$[He]2s^{2}2p^{4}$	0.00143	-218.8	13.9	-183	13.62
2	Group 17	9	fluorine	F	19.00	0.824	0.028	-	$[He]2s^{2}2p^{5}$	0.001696	-219.6	13.4	-188.1	17.42
2	Group 18	10	neon	Ne	20.18	1.030	0.049	-	$[He]2s^{2}2p^{6}$	0.000899	-248.6	16.4	-246.1	21.56
3	Group 1	11	sodium	Na	22.99	1.228	1.41	71	$[Ne]3s^{1}$	0.968	97.7	113.1	883	5.14
3	Group 2	12	magnesium	Mg	24.31	1.023	156	26	$[Ne]3s^{2}$	1.738	650	368.4	1107	7.65
3	Group 13	13	aluminium	Al	26.98	0.897	237	23.86	$[Ne]3s^{2}3p^{1}$	2.700	660.3	397.0	2467	5.99
3	Group 14	14	silicon	Si	28.09	0.705	148	2.53	$[Ne]3s^{2}3p^{2}$	2.330	1410	1799.8	2355	8.15
3	Group 15	15	phosphorus	P	30.97	0.769	0.235	372	$[Ne]3s^{2}3p^{3}$	2.67 (black)	44.2 °C (white)	21.3	[illegible]	[illegible]
3	Group 16	16	sulfur	S	32.07	0.710	[illegible]	180	$[Ne]3s^{2}3p^{4}$	2.069	[illegible]	53.6	444.7	10.36
3	Group 17	17	chlorine	Cl	35.45	[illegible]	0.0089	-	$[Ne]3s^{2}3p^{5}$	0.0032	-101.5	90.3	-34	[illegible]
3	Group 18	18	argon	Ar	39.95	0.520	0.018	-	$[Ne]3s^{2}3p^{6}$	0.00178	-189.3	29.7	-185.8	15.76
4	Group 1	19	potassium	K	39.10	0.757	102.4	84	$[Ar]4s^{1}$	0.856	63.4	59.6	759	4.34
4	Group 2	20	calcium	Ca	40.08	0.647	201	25.2	$[Ar]4s^{2}$	1.55	842	213.0	1484	6.11
4	Group 3	21	scandium	Sc	44.96	0.568	15.8	-	$[Ar]3d^{1}4s^{2}$	2.985	1541	313.7	2830	6.56
4	Group 4	22	titanium	Ti	47.87	0.523	21.9	8.35	$[Ar]3d^{2}4s^{2}$	4.507	1668	322.8	3287	6.83
4	Group 5	23	vanadium	V	50.94	0.489	30.7	8.3	$[Ar]3d^{3}4s^{2}$	6.11	1902	422.0	3409	6.75
4	Group 6	24	chromium	Cr	52.00	0.449	93.7	6.6	$[Ar]3d^{5}4s^{1}$	7.14	1857	325.0	2672	6.77
4	Group 7	25	manganese	Mn	54.94	0.479	7.82	23	$[Ar]3d^{5}4s^{2}$	7.47	1244	235.0	1962	7.43
4	Group 8	26	iron	Fe	55.85	0.449	76.6	11.5	$[Ar]3d^{6}4s^{2}$	7.874	1535	247.3	2750	7.90
4	Group 9	27	cobalt	Co	58.93	0.421	100	12.6	$[Ar]3d^{7}4s^{2}$	8.9	1495	272.4	2927	7.88
4	Group 10	28	nickel	Ni	58.69	0.444	90.7	13	$[Ar]3d^{8}4s^{2}$	8.908	1455	290.4	2730	7.64
4	Group 11	29	copper	Cu	63.55	0.385	404	16.8	$[Ar]3d^{10}4s^{1}$	8.89	1084.6	203.4	2567	7.73
4	Group 12	30	zinc	Zn	65.41	0.388	120	83.3	$[Ar]3d^{10}4s^{2}$	7.14	419.5	107.5	907	9.39
4	Group 13	31	gallium	Ga	69.72	0.371	40.6	5.2	$[Ar]3d^{10}4s^{2}4p^{1}$	5.904	29.8	80.0	2204	6.00
4	Group 14	32	germanium	Ge	72.61	0.320	59.9	5.2	$[Ar]3d^{10}4s^{2}4p^{2}$	5.323	938.3	508.7	2830	7.90
4	Group 15	33	arsenic	As	[illegible]	0.329	50	6.0	$[Ar]3d^{10}4s^{2}4p^{3}$	5.72	[illegible]	[illegible]	[illegible]	[illegible]
4	Group 16	34	selenium	Se	78.96	0.321	2.04	49.27	$[Ar]3d^{10}4s^{2}4p^{4}$	4.79	221	84.7	685	9.75
4	Group 17	35	bromine	Br	[illegible]	0.226	0.122	-	$[Ar]3d^{10}4s^{2}4p^{5}$	3.119	[illegible]	[illegible]	[illegible]	11.81
4	Group 18	36	krypton	Kr	83.80	0.248	0.00949	-	$[Ar]3d^{10}4s^{2}4p^{6}$	0.003749	-157.4	19.5	-153	14.00
5	Group 1	37	rubidium	Rb	85.47	0.363	58.2	270	$[Kr]5s^{1}$	1.532	39.3	25.6	688	4.18
5	Group 2	38	strontium	Sr	87.62	0.301	35.3	-	$[Kr]5s^{2}$	2.63	777	94.7	1382	5.69
5	Group 3	39	yttrium	Y	88.91	0.298	17.2	28.3	$[Kr]4d^{1}5s^{2}$	4.472	1526	128.2	3336	6.22
5	Group 4	40	zirconium	Zr	91.22	0.278	22.7	5.8	$[Kr]4d^{2}5s^{2}$	6.511	1857	219.0	4409	6.63
5	Group 5	41	niobium	Nb	92.91	0.265	53.7	7.31	$[Kr]4d^{4}5s^{1}$	8.57	2477	328.3	4744	6.76
5	Group 6	42	molybdenum	Mo	95.94	0.251	138.5	5.1	$[Kr]4d^{5}5s^{1}$	10.216	2623	390.7	4639	[illegible]
5	Group 7	43	technetium	Tc	98.91	0.25	50.6	[illegible]	[illegible]	[illegible]	2157	240.7	[illegible]	[illegible]
5	Group 8	44	ruthenium	Ru	101.07	0.238	117	[illegible]	[illegible]	[illegible]	2334	237.5	4150	[illegible]
5	Group 9	45	rhodium	Rh	102.91	0.243	87.2	8.5	[illegible]	12.45	1964	208.9	3695	7.46
5	Group 10	46	palladium	Pd	106.42	0.244	71.8	11.9	$[Kr]4d^{10}$	12.023	1554.8 (oxygen free)	157.3	3125	8.34
5	Group 11	47	silver	Ag	107.87	0.235	429	18.9	$[Kr]4d^{10}5s^{1}$	10.49	961.8	104.6	2212	7.58
5	Group 12	48	cadmium	Cd	112.41	0.232	96.8	29.4	$[Kr]4d^{10}5s^{2}$	8.65	321.1	55.2	767	8.99
5	Group 13	49	indium	In	114.82	0.233	81.6	30	$[Kr]4d^{10}5s^{2}5p^{1}$	7.31	156.6	28.6	2072	5.79
5	Group 14	50	tin	Sn	118.71	0.228	66.3	27	$[Kr]4d^{10}5s^{2}5p^{2}$	7.31	231.9	60.1	2602	7.34
5	Group 15	51	antimony	Sb	[illegible]	0.207	24.3	[illegible]	[illegible]	6.697	[illegible]	[illegible]	1587	8.64
5	Group 16	52	tellurium	Te	127.60	0.202	2.35	16.8	$[Kr]4d^{10}5s^{2}5p^{4}$	6.24	449.5	137.1	990	9.01
5	Group 17	53	iodine	I	126.90	[illegible]	0.449	-	$[Kr]4d^{10}5s^{2}5p^{5}$	4.94	113.7	122.3	184	10.45
5	Group 18	54	xenon	Xe	131.29	0.158	0.00569	-	$[Kr]4d^{10}5s^{2}5p^{6}$	0.0059	-111.7	17.5	-108	12.13
6	Group 1	55	cesium	Cs	132.91	0.242	36	291	$[Xe]6s^{1}$	1.879	28.5	15.8	671	3.89
6	Group 2	56	barium	Ba	137.33	0.204	18.4	19	$[Xe]6s^{2}$	3.62	727	56.4	1640	5.21
6	Group 3	57-71	lanthanum	lanthanides (lanthanides atomic number: 57-71)										
6	Group 4	72	hafnium	Hf	178.49	0.144	23	6.6	$[Xe]4f^{14}5d^{2}6s^{2}$	13.31	2233	142.9	4603	6.83
6	Group 5	73	tantalum	Ta	180.95	0.140	57.5	6.5	$[Xe]4f^{14}5d^{3}6s^{2}$	[illegible]	3017	[illegible]	[illegible]	[illegible]
6	Group 9	77	[illegible]	[illegible]	192.22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	Group 10	78	platinum	Pt	195.08	0.133	[illegible]	[illegible]	[illegible]	[illegible]	1772	113.4	3827	9.0
6	Group 11	79	gold	Au	196.97	0.129	317	14.2	$[Xe]4f^{14}5d^{10}6s^{1}$	19.32	1064.2	63.7	2856	9.23
6	Group 12	80	mercury	Hg	200.59	0.140	8.34	182	$[Xe]4f^{14}5d^{10}6s^{2}$	13.546	-38.8	11.4	357	10.44
6	Group 13	81	thallium	Tl	204.38	0.129	46.1	29.4	$[Xe]4f^{14}5d^{10}6s^{2}6p^{1}$	11.85	304	20.3	1473	6.11
6	Group 14	82	lead	Pb	207.2	0.129	35.3	29.4	$[Xe]4f^{14}5d^{10}6s^{2}6p^{2}$	11.34	327.5	23.0	1750	7.42
6	Group 15	83	bismuth	Bi	208.98	0.122	7.87	13.5	$[Xe]4f^{14}5d^{10}6s^{2}6p^{3}$	9.78	271.4	53.1	1564	7.29
6	Group 16	84	polonium	Po	209.98	-	20	-	$[Xe]4f^{14}5d^{10}6s^{2}6p^{4}$	9.196	254	286.2	962	8.42
6	Group 17	85	astatine	At	209.99	0.48	1.7	-	$[Xe]4f^{14}5d^{10}6s^{2}6p^{5}$	-	302	542.9	337	-
6	Group 18	86	radon	Rn	222	0.094	0.00364	-	$[Xe]4f^{14}5d^{10}6s^{2}6p^{6}$	0.00973	-71	13.0	-61.8	10.75
7	Group 1	87	francium	Fr	223.02	0.24	15	291	$[Rn]7s^{1}$	1.870	27	16.4	677	-
7	Group 2	88	radium	Ra	226.03	0.094	18.6	-	$[Rn]7s^{2}$	5.5	700	37.0	1737	5.28
7	Group 3	89-103	actinium	actinides (actinides atomic number: 89-103)										

lanthanides

Period	Atomic Number	Name	Element	Atomic Mass	Specific Heat J/(g·K)	Thermal Conductivity W/(m·K)	Expansion Coefficient ·10⁻⁶/K	Electron Configuration	Density g/cm³	Melting Point °C	Heat of Fusion J/g	Boiling Point °C	Ionization Energy eV
6	57	lanthanum	La	[illegible]	0.195	13.5	4.9	$[Xe]5d^{1}6s^{2}$	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	64	gadolinium	Gd	157.25	[illegible]	[illegible]	[illegible]	[illegible]	7.901	1312	63.9	3250	6.15
6	65	terbium	Tb	158.93	0.182	11.1	-	$[Xe]4f^{9}6s^{2}$	8.219	1356	67.9	3230	5.86
6	66	dysprosium	Dy	162.50	0.173	10.7	8.6	$[Xe]4f^{10}6s^{2}$	8.551	1407	68.1	2567	5.94
6	67	holmium	Ho	164.93	0.165	16.2	-	$[Xe]4f^{11}6s^{2}$	8.8	1474	74.0	2695	6.02
6	68	erbium	Er	167.26	0.168	14.3	9.2	$[Xe]4f^{12}6s^{2}$	9.066	1522	119.0	2510	6.11
6	69	thulium	Tm	168.93	0.160	16.8	-	$[Xe]4f^{13}6s^{2}$	9.321	1545	99.7	1947	6.18
6	70	ytterbium	Yb	173.04	0.155	34.9	25	$[Xe]4f^{14}6s^{2}$	6.965	824	44.3	1194	6.25
6	71	lutetium	Lu	174.97	0.154	16.4	-	$[Xe]4f^{14}5d^{1}6s^{2}$	9.841	1663	106.3	3395	5.43

actinides

Period	Atomic Number	Name	Element	Atomic Mass	Specific Heat J/(g·K)	Thermal Conductivity W/(m·K)	Expansion Coefficient ·10⁻⁶/K	Electron Configuration	Density g/cm³	Melting Point °C	Heat of Fusion J/g	Boiling Point °C	Ionization Energy eV
7	89	actinium	Ac	[illegible]	0.120	12	-	$[Rn]6d^{1}7s^{2}$	10.07	[illegible]	[illegible]	[illegible]	[illegible]
7	96	curium	Cm	247.07	-	-	-	$[Rn]5f^{7}6d^{1}7s^{2}$	13.51	1340	-	3110	6.02
7	97	berkelium	Bk	247	-	-	-	$[Rn]5f^{9}7s^{2}$	14.78	986	-	-	6.23
7	98	californium	Cf	251	-	-	-	$[Rn]5f^{10}7s^{2}$	15.1	950	-	-	6.30
7	99	einsteinium	Es	252	-	-	-	$[Rn]5f^{11}7s^{2}$	13.50	860	-	-	6.42
7	100	fermium	Fm	257.10	-	-	-	$[Rn]5f^{12}7s^{2}$	-	1527	-	-	6.50
7	101	mendelevium	Md	258	-	-	-	$[Rn]5f^{13}7s^{2}$	-	-	-	-	6.58
7	102	nobelium	No	259	-	-	-	$[Rn]5f^{14}7s^{2}$	-	827	-	-	6.65
7	103	lawrencium	Lr	260.11	-	-	-	$[Rn]5f^{14}6d^{1}7s^{2}$	-	1627	-	-	-



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Bibliography:
Handbook of Chemistry and Physics, 76th Edition, 1995-1996
D'ANS LAX
Lehrbuch der Anorganischen Chemie, Holleman & Wiberg, de Gruyter Verlag
Others

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