

Chemistry Data Booklet

Standard Grade and Intermediate 2

For use in National Qualification Courses
leading to the 2007 examinations and beyond.

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ELECTRON ARRANGEMENTS OF MAIN GROUP ELEMENTS

Key

Atomic number
Name of element
Symbol
Electron arrangement

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
1 Hydrogen H 1							2 Helium He 2
3 Lithium Li 2, 1	4 Beryllium Be 2, 2	5 Boron B 2, 3	6 Carbon C 2, 4	7 Nitrogen N 2, 5	8 Oxygen O 2, 6	9 Fluorine F 2, 7	10 Neon Ne 2, 8
11 Sodium Na 2, 8, 1	12 Magnesium Mg 2, 8, 2	13 Aluminium Al 2, 8, 3	14 Silicon Si 2, 8, 4	15 Phosphorus P 2, 8, 5	16 Sulphur S 2, 8, 6	17 Chlorine Cl 2, 8, 7	18 Argon Ar 2, 8, 8
19 Potassium K 2, 8, 8, 1	20 Calcium Ca 2, 8, 8, 2	31 Gallium Ga 2, 8, 18, 3	32 Germanium Ge 2, 8, 18, 4	33 Arsenic As 2, 8, 18, 5	34 Selenium Se 2, 8, 18, 6	35 Bromine Br 2, 8, 18, 7	36 Krypton Kr 2, 8, 18, 8
37 Rubidium Rb 2, 8, 18, 8, 1	38 Strontium Sr 2, 8, 18, 8, 2	49 Indium In 2, 8, 18, 18, 3	50 Tin Sn 2, 8, 18, 18, 4	51 Antimony Sb 2, 8, 18, 18, 5	52 Tellurium Te 2, 8, 18, 18, 6	53 Iodine I 2, 8, 18, 18, 7	54 Xenon Xe 2, 8, 18, 18, 8
55 Caesium Cs 2, 8, 18, 18, 8, 1	56 Barium Ba 2, 8, 18, 18, 8, 2	81 Thallium Tl 2, 8, 18, 32, 18, 3	82 Lead Pb 2, 8, 18, 32, 18, 4	83 Bismuth Bi 2, 8, 18, 32, 18, 5	84 Polonium Po 2, 8, 18, 32, 18, 6	85 Astatine At 2, 8, 18, 32, 18, 7	86 Radon Rn 2, 8, 18, 32, 18, 8
87 Francium Fr 2, 8, 18, 32, 18, 8, 1	88 Radium Ra 2, 8, 18, 32, 18, 8, 2						

←

The elements on this side of the dark line are metals.

→

The elements on this side of the dark line are non-metals.

MELTING AND BOILING POINTS OF SELECTED ELEMENTS

Group	1	2	3	4	5	6	7	8	9	10
	1									2
	Hydrogen									Helium
	-259									-272
	<i>-253</i>									<i>-269</i>
	3	4								
	Lithium	Beryllium							Fluorine	Neon
	181	1278							-220	-249
	<i>1347</i>	<i>2970*</i>							<i>-188</i>	<i>-246</i>
	11	12								
	Sodium	Magnesium							Chlorine	Argon
	98	649							-101	-189
	<i>883</i>	<i>1090</i>							<i>-35</i>	<i>-186</i>
	19	20								
	Potassium	Calcium							Oxygen	
	63	842							-218	
	<i>759</i>	<i>1484</i>							<i>-183</i>	
	37	38								
	Rubidium	Strontium							Sulphur	
	39	769							113	
	<i>688</i>	<i>1384</i>							<i>445</i>	
	55	56								
	Caesium	Barium							Phosphorus	
	28	725							44	
	<i>671</i>	<i>1640</i>							<i>280</i>	
	5	6								
	Boron	Carbon							Nitrogen	
	2300	†3642							-210	
	<i>4000</i>								<i>-196</i>	
	13	14								
	Aluminium	Silicon							Phosphorus	
	660	1410							44	
	<i>2467</i>	<i>2355</i>							<i>280</i>	
	31	32								
	Gallium	Germanium							Selenium	
	30	937							217	
	<i>2403</i>	<i>2830</i>							<i>685</i>	
	49	50								
	Indium	Tin							Antimony	
	157	232							631	
	<i>2080</i>	<i>2602</i>							<i>1750</i>	
	81	82								
	Thallium	Lead							Tellurium	
	304	328							452	
	<i>1457</i>	<i>1749</i>							<i>988</i>	
	83	84								
	Bismuth	Polonium							Iodine	
	271	254							114	
	<i>1560</i>	<i>962</i>							<i>184</i>	
	85	86								
	Astatine	Radon							Mercury	
	302	-71							-39	
	<i>302</i>	<i>-62</i>							<i>357</i>	
	29	30								
	Copper	Zinc							Cadmium	
	1083	420							321	
	<i>2567</i>	<i>907</i>							<i>765</i>	
	27	28								
	Cobalt	Nickel							Gold	
	1495	1453							1064	
	<i>2927</i>	<i>2913</i>							<i>2856</i>	
	45	46								
	Rhodium	Palladium							Platinum	
	1966	1552							1772	
	<i>3695</i>	<i>2963</i>							<i>3827</i>	
	44	45								
	Ruthenium	Rhodium							Iridium	
	2310	1966							2410	
	<i>3900</i>	<i>3695</i>							<i>4130</i>	
	76	77								
	Osmium	Osmium							Platinum	
	3033	3033							1772	
	<i>5012</i>	<i>5012</i>							<i>3827</i>	
	75	76								
	Rhenium	Rhenium							Gold	
	3180	3180							1064	
	<i>5627</i>	<i>5627</i>							<i>2856</i>	
	24	25								
	Chromium	Manganese							Silver	
	1857	1244							962	
	<i>2672</i>	<i>1962</i>							<i>2212</i>	
	42	43								
	Molybdenum	Technetium							Mercury	
	2623	2157							-39	
	<i>4639</i>	<i>4265</i>							<i>357</i>	
	41	42								
	Niobium	Molybdenum							Mercury	
	2477	2623							-39	
	<i>4742</i>	<i>4639</i>							<i>357</i>	
	73	74								
	Tantalum	Tungsten							Mercury	
	2996	3410							-39	
	<i>5425</i>	<i>5660</i>							<i>357</i>	
	22	23								
	Titanium	Vanadium							Mercury	
	1660	1890							-39	
	<i>3287</i>	<i>3380</i>							<i>357</i>	
	21	22								
	Scandium	Titanium							Mercury	
	1541	1660							-39	
	<i>2831</i>	<i>3287</i>							<i>357</i>	
	39	40								
	Yttrium	Zirconium							Mercury	
	1522	1852							-39	
	<i>3338</i>	<i>4377</i>							<i>357</i>	
	57	58								
	Lanthanum	Hafnium							Mercury	
	921	2227							-39	
	<i>3457</i>	<i>4602</i>							<i>357</i>	

Key
Atomic number
Name of element
Melting point/°C
Boiling point/°C

* at 28 atmospheres
† sublimates

NAMES, SYMBOLS AND RELATIVE ATOMIC MASSES OF SELECTED ELEMENTS

(Relative atomic masses have been rounded to the nearest 0.5)

Relative atomic masses are also known as the average atomic masses.

Element	Symbol	Relative atomic mass
aluminium	Al	27
argon	Ar	40
bromine	Br	80
calcium	Ca	40
carbon	C	12
chlorine	Cl	35.5
copper	Cu	63.5
fluorine	F	19
gold	Au	197
helium	He	4
hydrogen	H	1
iodine	I	127
iron	Fe	56
lead	Pb	207
lithium	Li	7

Element	Symbol	Relative atomic mass
magnesium	Mg	24.5
mercury	Hg	200.5
neon	Ne	20
nickel	Ni	58.5
nitrogen	N	14
oxygen	O	16
phosphorus	P	31
platinum	Pt	195
potassium	K	39
silicon	Si	28
silver	Ag	108
sodium	Na	23
sulphur	S	32
tin	Sn	118.5
zinc	Zn	65.5

FLAME COLOURS

Element	Ion	Flame colour
barium	Ba ²⁺	green
calcium	Ca ²⁺	orange-red
copper	Cu ²⁺	blue-green
lithium	Li ⁺	red

Element	Ion	Flame colour
potassium	K ⁺	lilac
sodium	Na ⁺	yellow
strontium	Sr ²⁺	red

FORMULAE OF SELECTED IONS CONTAINING MORE THAN ONE KIND OF ATOM

one positive		one negative		two negative		three negative	
Ion	Formula	Ion	Formula	Ion	Formula	Ion	Formula
ammonium	NH ₄ ⁺	ethanoate	CH ₃ COO ⁻	carbonate	CO ₃ ²⁻	phosphate	PO ₄ ³⁻
		hydrogencarbonate	HCO ₃ ⁻	chromate	CrO ₄ ²⁻		
		hydrogensulphate	HSO ₄ ⁻	dichromate	Cr ₂ O ₇ ²⁻		
		hydrogensulphite	HSO ₃ ⁻	sulphate	SO ₄ ²⁻		
		hydroxide	OH ⁻	sulphite	SO ₃ ²⁻		
		nitrate	NO ₃ ⁻				
		permanganate	MnO ₄ ⁻				

SOLUBILITIES OF SELECTED COMPOUNDS IN WATER

The table shows how some compounds behave in water

- vs means very soluble (a solubility greater than 10 g/l)
- s means soluble (a solubility of between 1 and 10 g/l)
- i means insoluble (a solubility of less than 1 g/l)
- no data

	bromide	carbonate	chloride	iodide	nitrate	phosphate	sulphate	oxide	hydroxide
aluminium	vs	i	vs	vs	vs	i	vs	i	i
ammonium	vs	vs	vs	vs	vs	vs	vs	—	—
barium	vs	i	vs	vs	vs	i	i	vs	vs
calcium	vs	i	vs	vs	vs	i	s	s	s
copper(II)	vs	i	vs	—	vs	i	vs	i	i
iron(II)	vs	i	vs	vs	vs	i	vs	i	i
iron(III)	vs	—	vs	—	vs	i	vs	i	i
lead(II)	s	i	s	i	vs	i	i	i	i
lithium	vs	vs	vs	vs	vs	i	vs	vs	vs
magnesium	vs	i	vs	vs	vs	i	vs	i	i
nickel	vs	i	vs	vs	vs	i	vs	i	i
potassium	vs	vs	vs	vs	vs	vs	vs	vs	vs
silver	i	i	i	i	vs	i	s	i	—
sodium	vs	vs	vs	vs	vs	vs	vs	vs	vs
tin(II)	vs	i	vs	s	—	i	vs	i	i
zinc	vs	i	vs	vs	vs	i	vs	i	i

Note Some of the compounds in the table hydrolyse significantly in water.

MELTING AND BOILING POINTS OF SELECTED INORGANIC COMPOUNDS

COVALENT		
Name of compound	mp/°C	bp/°C
ammonia	-78	-33
carbon dioxide	-57	-78
carbon monoxide	-199	-192
nitrogen dioxide	-11	21
silicon dioxide	1700	2230
sulphur dioxide	-73	-10
water	0	100

IONIC		
Name of compound	mp/°C	bp/°C
barium chloride	963	1560
calcium oxide	2614	2850
lithium bromide	547	1265
magnesium chloride	712	1418
potassium iodide	686	1330
sodium chloride	801	1413

Under normal conditions, carbon dioxide does not melt but sublimes instead. The melting point and boiling point were measured under different conditions.

MELTING AND BOILING POINTS OF SELECTED ORGANIC COMPOUNDS

Name of compound	mp/°C	bp/°C
methane	-182.5	-164
ethane	-183	-89
propane	-190	-42
butane	-138	-1
pentane	-130	36
hexane	-95	69
heptane	-91	98
octane	-57	126
cyclobutane	-50	12
cyclopentane	-94	49
cyclohexane	7	81

<i>For use by Standard Grade candidates</i>		
Name of compound	mp/°C	bp/°C
ethene	-169	-104
propene	-185	-47
butene †	-185	-6
pentene †	-138	30
hexene †	-140	63

<i>For use by Intermediate 2 candidates</i>		
Name of compound	mp/°C	bp/°C
ethene	-169	-104
propene	-185	-47
but-1-ene	-185	-6
pent-1-ene	-138	30
hex-1-ene	-140	63
methanol	-94	65
ethanol	-117	79
propan-1-ol	-127	97
propan-2-ol	-90	82
butan-1-ol	-90	117
butan-2-ol	-100	100
methanoic acid	8	101
ethanoic acid	17	118
propanoic acid	-21	141
butanoic acid	-4	164

† These compounds have two or more isomers. Other isomers have slightly different melting points and boiling points.

ELECTROCHEMICAL SERIES (REDUCTION REACTIONS)

Metal	Reaction
lithium	$\text{Li}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Li}(\text{s})$
potassium	$\text{K}^+(\text{aq}) + \text{e}^- \longrightarrow \text{K}(\text{s})$
calcium	$\text{Ca}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Ca}(\text{s})$
sodium	$\text{Na}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Na}(\text{s})$
magnesium	$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Mg}(\text{s})$
aluminium	$\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \longrightarrow \text{Al}(\text{s})$
zinc	$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Zn}(\text{s})$
iron	$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Fe}(\text{s})$
nickel	$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Ni}(\text{s})$
tin	$\text{Sn}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Sn}(\text{s})$
lead	$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Pb}(\text{s})$
	$\text{Fe}^{3+}(\text{aq}) + 3\text{e}^- \longrightarrow \text{Fe}(\text{s})$
hydrogen	$2\text{H}^+(\text{aq}) + 2\text{e}^- \longrightarrow \text{H}_2(\text{g})$
	$\text{SO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \longrightarrow \text{SO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell)$
copper	$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Cu}(\text{s})$
	$2\text{H}_2\text{O}(\ell) + \text{O}_2(\text{g}) + 4\text{e}^- \longrightarrow 4\text{OH}^-(\text{aq})$
	$\text{I}_2(\text{s}) + 2\text{e}^- \longrightarrow 2\text{I}^-(\text{aq})$
	$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \longrightarrow \text{Fe}^{2+}(\text{aq})$
silver	$\text{Ag}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Ag}(\text{s})$
mercury	$\text{Hg}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Hg}(\ell)$
	$\text{Br}_2(\ell) + 2\text{e}^- \longrightarrow 2\text{Br}^-(\text{aq})$
	$\text{Cl}_2(\text{g}) + 2\text{e}^- \longrightarrow 2\text{Cl}^-(\text{aq})$
gold	$\text{Au}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Au}(\text{s})$

PERIODIC TABLE OF THE ELEMENTS SHOWING SYMBOL AND DATE OF DISCOVERY

Group 1 Group 2 Group 3 Group 4 Group 5 Group 6 Group 7 Group 0

Key		Atomic number	Name of element	Symbol	Date of discovery																																																																																																																																																																																																																																																																																																																		
1	Hydrogen	H	1766	2	Helium	He	1862	3	Lithium	Li	1817	4	Beryllium	Be	1798	5	Boron	B	1808	6	Carbon	C	Prehistoric	7	Nitrogen	N	1772	8	Oxygen	O	1774	9	Fluorine	F	1771	10	Neon	Ne	1898																																																																																																																																																																																																																																																																																
11	Sodium	Na	1807	12	Magnesium	Mg	1775	13	Aluminium	Al	1827	14	Silicon	Si	1823	15	Phosphorus	P	1669	16	Sulphur	S	Prehistoric	17	Chlorine	Cl	1774	18	Argon	Ar	1894	19	Potassium	K	1807	20	Calcium	Ca	1808	21	Scandium	Sc	1879	22	Titanium	Ti	1791	23	Vanadium	V	1830	24	Chromium	Cr	1797	25	Manganese	Mn	1774	26	Iron	Fe	Prehistoric	27	Cobalt	Co	1735	28	Nickel	Ni	1751	29	Copper	Cu	Prehistoric	30	Zinc	Zn	16th century	31	Gallium	Ga	1875	32	Germanium	Ge	1866	33	Arsenic	As	~1250	34	Selenium	Se	1817	35	Bromine	Br	1826	36	Krypton	Kr	1898	37	Rubidium	Rb	1861	38	Strontium	Sr	1790	39	Yttrium	Y	1794	40	Zirconium	Zr	1789	41	Niobium	Nb	1801	42	Molybdenum	Mo	1778	43	Technetium	Tc	1937	44	Ruthenium	Ru	1844	45	Rhodium	Rh	1803	46	Palladium	Pd	1803	47	Silver	Ag	Prehistoric	48	Cadmium	Cd	1817	49	Indium	In	1863	50	Tin	Sn	Prehistoric	51	Antimony	Sb	~1450	52	Tellurium	Te	1782	53	Iodine	I	1811	54	Xenon	Xe	1898	55	Caesium	Cs	1860	56	Barium	Ba	1808	57	Lanthanum	La	1839	58-71	Cerium	Ce	1803	59	Praseodymium	Pr	1885	60	Neodymium	Nd	1885	61	Promethium	Pm	1947	62	Samarium	Sm	1879	63	Europium	Eu	1896	64	Gadolinium	Gd	1880	65	Terbium	Tb	1843	66	Dysprosium	Dy	1886	67	Holmium	Ho	1879	68	Erbium	Er	1843	69	Thulium	Tm	1879	70	Ytterbium	Yb	1907	71	Lutetium	Lu	1907	87	Francium	Fr*	1939	88	Radium	Ra	1898	89	Actinium	Ac	1899	90-103	Thorium	Th	1828	91	Protactinium	Pa	1917	92	Uranium	U	1789	93	Neptunium	Np*	1940	94	Plutonium	Pu*	1940	95	Americium	Am*	1944	96	Curium	Cm*	1944	97	Berkelium	Bk*	1949	98	Californium	Cf*	1952	99	Einsteinium	Es*	1953	100	Fermium	Fm*	1955	101	Mendelevium	Md*	1957	102	Nobelium	No*	1961	103	Lawrencium	Lr*	1969

TRANSITION METALS

← The elements on this side of the dark line are metals. The elements on this side of the dark line are non-metals. →

58	Cerium	Ce	1803	59	Praseodymium	Pr	1885	60	Neodymium	Nd	1885	61	Promethium	Pm	1947	62	Samarium	Sm	1879	63	Europium	Eu	1896	64	Gadolinium	Gd	1880	65	Terbium	Tb	1843	66	Dysprosium	Dy	1886	67	Holmium	Ho	1879	68	Erbium	Er	1843	69	Thulium	Tm	1879	70	Ytterbium	Yb	1907	71	Lutetium	Lu	1907
90	Thorium	Th	1828	91	Protactinium	Pa	1917	92	Uranium	U	1789	93	Neptunium	Np*	1940	94	Plutonium	Pu*	1940	95	Americium	Am*	1944	96	Curium	Cm*	1944	97	Berkelium	Bk*	1949	98	Californium	Cf*	1952	99	Einsteinium	Es*	1953	100	Fermium	Fm*	1955	101	Mendelevium	Md*	1957	102	Nobelium	No*	1961	103	Lawrencium	Lr*	1969

* = element which is not found in nature either as the element or in a compound, but has been made by scientists

