

GCE Chemistry Data Sheet

Table 1

Infrared absorption data

Bond	Wavenumber /cm ⁻¹
N—H (amines)	3300–3500
O—H (alcohols)	3230–3550
C—H	2850–3300
O—H (acids)	2500–3000
C≡N	2220–2260
C=O	1680–1750
C=C	1620–1680
C—O	1000–1300
C—C	750–1100

Table 2¹H n.m.r. chemical shift data

Type of proton	δ/ppm
ROH	0.5–5.0
RCH ₃	0.7–1.2
RNH ₂	1.0–4.5
R ₂ CH ₂	1.2–1.4
R ₃ CH	1.4–1.6
$\begin{array}{c} \\ \text{R}-\text{C}-\text{C}- \\ \quad \\ \text{O} \quad \text{H} \end{array}$	2.1–2.6
$\begin{array}{c} \text{R}-\text{O}-\text{C}- \\ \\ \text{H} \end{array}$	3.1–3.9
RCH ₂ Cl or Br	3.1–4.2
$\begin{array}{c} \\ \text{R}-\text{C}-\text{O}-\text{C}- \\ \quad \\ \text{O} \quad \text{H} \end{array}$	3.7–4.1
$\begin{array}{c} \text{R} \quad \text{H} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \end{array}$	4.5–6.0
$\begin{array}{c} \text{O} \\ \\ \text{R}-\text{C} \\ \\ \text{H} \end{array}$	9.0–10.0
$\begin{array}{c} \text{O} \\ \\ \text{R}-\text{C} \\ \\ \text{O}-\text{H} \end{array}$	10.0–12.0

Table 3¹³C n.m.r. chemical shift data

Type of carbon	δ/ppm
$\begin{array}{c} \quad \\ -\text{C}-\text{C}- \\ \quad \end{array}$	5–40
$\begin{array}{c} \\ \text{R}-\text{C}-\text{Cl or Br} \\ \end{array}$	10–70
$\begin{array}{c} \quad \\ \text{R}-\text{C}-\text{C}- \\ \quad \\ \text{O} \end{array}$	20–50
$\begin{array}{c} \\ \text{R}-\text{C}-\text{N} \diagup \diagdown \end{array}$	25–60
$\begin{array}{c} \\ -\text{C}-\text{O}- \end{array}$ alcohols, ethers or esters	50–90
$\begin{array}{c} \diagdown \quad \diagup \\ \text{C}=\text{C} \\ / \quad \diagdown \end{array}$	90–150
R—C≡N	110–125
	110–160
$\begin{array}{c} \text{O} \\ \\ \text{R}-\text{C}- \end{array}$ esters or acids	160–185
$\begin{array}{c} \text{O} \\ \\ \text{R}-\text{C}- \end{array}$ aldehydes or ketones	190–220



The Periodic Table of the Elements

1		2										3		4		5		6		7		0	
(1)		(2)		Key								(13)		(14)		(15)		(16)		(17)		(18)	
6.9 Li lithium 3		9.0 Be beryllium 4		relative atomic mass symbol name atomic (proton) number								10.8 B boron 5		12.0 C carbon 6		14.0 N nitrogen 7		16.0 O oxygen 8		19.0 F fluorine 9		20.2 He helium 2	
23.0 Na sodium 11		24.3 Mg magnesium 12		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)	
39.1 K potassium 19		40.1 Ca calcium 20		45.0 Sc scandium 21		47.9 Ti titanium 22		50.9 V vanadium 23		52.0 Cr chromium 24		54.9 Mn manganese 25		55.8 Fe iron 26		58.9 Co cobalt 27		58.7 Ni nickel 28		63.5 Cu copper 29		65.4 Zn zinc 30	
85.5 Rb rubidium 37		87.6 Sr strontium 38		88.9 Y yttrium 39		91.2 Zr zirconium 40		92.9 Nb niobium 41		96.0 Mo molybdenum 42		[98] Tc technetium 43		101.1 Ru ruthenium 44		102.9 Rh rhodium 45		106.4 Pd palladium 46		107.9 Ag silver 47		112.4 Cd cadmium 48	
132.9 Cs caesium 55		137.3 Ba barium 56		138.9 La * lanthanum 57		178.5 Hf hafnium 72		180.9 Ta tantalum 73		183.8 W tungsten 74		186.2 Re rhenium 75		190.2 Os osmium 76		192.2 Ir iridium 77		195.1 Pt platinum 78		197.0 Au gold 79		200.6 Hg mercury 80	
204.4 Tl thallium 81		207.2 Pb lead 82		209.0 Bi bismuth 83		[209] Po polonium 84		[210] At astatine 85		[222] Rn radon 86		Elements with atomic numbers 112-116 have been reported but not fully authenticated											
[223] Fr francium 87		[226] Ra radium 88		[227] Ac † actinium 89		[267] Rf rutherfordium 104		[268] Db dubnium 105		[271] Sg seaborgium 106		[272] Bh bohrium 107		[270] Hs hassium 108		[276] Mt meitnerium 109		[281] Ds darmstadtium 110		[280] Rg roentgenium 111			

* **58 – 71** Lanthanides

† 90 – 103 Actinides

140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	[145] Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.3 Gd gadolinium 64	158.9 Tb terbium 65	162.5 Dy dysprosium 66	164.9 Ho holmium 67	167.3 Er erbium 68	168.9 Tm thulium 69	173.1 Yb ytterbium 70	175.0 Lu lutetium 71
232.0 Th thorium 90	231.0 Pa protactinium 91	238.0 U uranium 92	[237] Np neptunium 93	[244] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[247] Bk berkelium 97	[251] Cf californium 98	[252] Es einsteinium 99	[257] Fm fermium 100	[258] Md mendelevium 101	[259] No nobelium 102	[262] Lr lawrencium 103