

## GCE Chemistry Data Sheet


**Table 1**  
Infrared absorption data

Bond	Wavenumber /cm <sup>-1</sup>
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 2**  
<sup>1</sup>H n.m.r. chemical shift data

Type of proton	δ/ppm
ROH	0.5–5.0
RCH <sub>3</sub>	0.7–1.2
RNH <sub>2</sub>	1.0–4.5
R <sub>2</sub> CH <sub>2</sub>	1.2–1.4
R <sub>3</sub> 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 <sub>2</sub> 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 3**  
<sup>13</sup>C 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
$\begin{array}{c}   \\ \text{R}-\text{C}-\text{C}- \\    \quad   \\ \text{O} \quad   \end{array}$	20–50
$\begin{array}{c}   \\ \text{R}-\text{C}-\text{N} \\   \quad \diagdown \end{array}$	25–60
$\begin{array}{c}   \\ -\text{C}-\text{O}- \\   \end{array}$ alcohols, ethers or esters	50–90
$\begin{array}{c} \diagdown \quad / \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \end{array}$	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	
																				(18)
																				4.0 <b>He</b> helium 2
																				20.2 <b>Ne</b> neon 10
																				39.9 <b>Ar</b> argon 18
																				83.8 <b>Kr</b> krypton 36
																				131.3 <b>Xe</b> xenon 54
																				[222] <b>Rn</b> radon 86
																				[222] <b>Fr</b> francium 87
																				[226] <b>Ra</b> radium 88
																				[227] <b>Ac</b> † actinium 89
																				[267] <b>Rf</b> rutherfordium 104
																				[268] <b>Db</b> dubnium 105
																				[271] <b>Sg</b> seaborgium 106
																				[272] <b>Bh</b> bohrium 107
																				[270] <b>Hs</b> hassium 108
																				[276] <b>Mt</b> meitnerium 109
																				[281] <b>Ds</b> darmstadtium 110
																				[280] <b>Rg</b> roentgenium 111
Elements with atomic numbers 112-116 have been reported but not fully authenticated																				

**Key**

relative atomic mass
<b>symbol</b>
name
atomic (proton) number

1.0 <b>H</b> hydrogen 1
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\* 58 – 71 Lanthanides

† 90 – 103 Actinides

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