

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 2
¹H 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 |
| $\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C} \\ \backslash \\ \text{O}-\text{H} \end{array}$ | 10.0–12.0 |

Table 3
¹³C 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 |
| $\begin{array}{c} \quad / \\ \text{R}-\text{C}-\text{N} \\ \quad \backslash \end{array}$ | 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 |
| $\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C}- \\ \\ \text{O} \end{array}$ esters or acids | 160–185 |
| $\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C}- \\ \\ \text{O} \end{array}$ aldehydes or ketones | 190–220 |



The Periodic Table of the Elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 | | |
|--------------------------------------|--------------------------------------|---|--|--------------------------------------|---|---------------------------------------|---------------------------------------|---|---|--|---|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|------------------------------------|------|---------------------------------|
| | | Key | | | | | | | | | | | | | | | | (18) | |
| (1) | (2) | relative atomic mass symbol name atomic (proton) number | | | | | | | | | | | | | | | | | 4.0 He helium 2 |
| 1.0 H hydrogen 1 | | | | | | | | | | | | (13) | (14) | (15) | (16) | (17) | | | |
| 6.9 Li lithium 3 | 9.0 Be beryllium 4 | | | | | | | | | | | 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 Ne neon 10 | | |
| 23.0 Na sodium 11 | 24.3 Mg magnesium 12 | | | | | | | | | | | 27.0 Al aluminium 13 | 28.1 Si silicon 14 | 31.0 P phosphorus 15 | 32.1 S sulfur 16 | 35.5 Cl chlorine 17 | 39.9 Ar argon 18 | | |
| | | (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 | 69.7 Ga gallium 31 | 72.6 Ge germanium 32 | 74.9 As arsenic 33 | 79.0 Se selenium 34 | 79.9 Br bromine 35 | 83.8 Kr krypton 36 | | |
| 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 | 114.8 In indium 49 | 118.7 Sn tin 50 | 121.8 Sb antimony 51 | 127.6 Te tellurium 52 | 126.9 I iodine 53 | 131.3 Xe xenon 54 | | |
| 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 | | |
| [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 | Elements with atomic numbers 112-116 have been reported but not fully authenticated | | | | | | | | |

* 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 |