



GCE AS

B410U20-1A



S25-B410U20-1A



TUESDAY, 20 MAY 2025 – MORNING

CHEMISTRY – AS component 2
Data Booklet

Avogadro constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
molar gas constant	$R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
molar gas volume at 273 K and 1 atm	$V_m = 22.4 \text{ dm}^3 \text{ mol}^{-1}$
molar gas volume at 298 K and 1 atm	$V_m = 24.5 \text{ dm}^3 \text{ mol}^{-1}$
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$
speed of light	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
density of water	$d = 1.00 \text{ g cm}^{-3}$
specific heat capacity of water	$c = 4.18 \text{ J g}^{-1} \text{ K}^{-1}$
ionic product of water at 298 K	$K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$
fundamental electronic charge	$e = 1.60 \times 10^{-19} \text{ C}$

temperature (K) = temperature (°C) + 273

$1 \text{ dm}^3 = 1000 \text{ cm}^3$
 $1 \text{ m}^3 = 1000 \text{ dm}^3$
1 tonne = 1000 kg
 $1 \text{ atm} = 1.01 \times 10^5 \text{ Pa}$

Multiple	Prefix	Symbol
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m

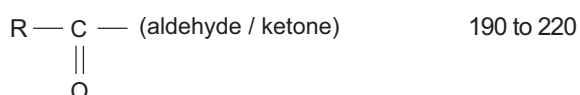
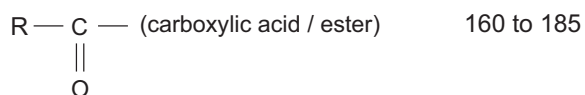
Multiple	Prefix	Symbol
10^3	kilo	k
10^6	mega	M
10^9	giga	G

Infrared absorption values

Bond	Wavenumber / cm^{-1}
C — Br	500 to 600
C — Cl	650 to 800
C — O	1000 to 1300
C = C	1620 to 1670
C = O	1650 to 1750
C $\equiv$ N	2100 to 2250
C — H	2800 to 3100
O — H (carboxylic acid)	2500 to 3200 (very broad)
O — H (alcohol / phenol)	3200 to 3550 (broad)
N — H	3300 to 3500

¹³C NMR chemical shifts relative to TMS = 0

Type of carbon	Chemical shift, δ (ppm)
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^1H NMR chemical shifts relative to TMS = 0

Type of proton	Chemical shift, δ (ppm)
$-\text{CH}_3$	0.1 to 2.0
$\text{R}-\text{CH}_3$	0.9
$\text{R}-\text{CH}_2-\text{R}$	1.3
$\text{CH}_3-\text{C}\equiv\text{N}$	2.0
$\text{CH}_3-\text{C}(=\text{O})$	2.0 to 2.5
$-\text{CH}_2-\text{C}(=\text{O})$	2.0 to 3.0
 - CH_3	2.2 to 2.3
$\text{HC}-\text{Cl}$ or $\text{HC}-\text{Br}$	3.1 to 4.3
$\text{HC}-\text{O}$	3.3 to 4.3
$\text{R}-\text{OH}$	4.5 *
$-\text{C}=\text{CH}$	4.5 to 6.3
$-\text{C}=\text{CH}-\text{CO}$	5.8 to 6.5
 - $\text{CH}=\text{C}$	6.5 to 7.5
 - H	6.5 to 8.0
 - OH	7.0 *
$\text{R}-\text{C}(=\text{O})\text{H}$	9.8 *
$\text{R}-\text{C}(=\text{O})\text{OH}$	11.0 *

*variable figure dependent on concentration and solvent

Group

Period	s block										p block									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.01 H Hydrogen 1												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	4.00 He Helium 2	
2	6.94 Li Lithium 3	9.01 Be Beryllium 4											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	40.0 Ar Argon 18		
3	23.0 Na Sodium 11	24.3 Mg Magnesium 12											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		
4	39.1 K Potassium 19	40.1 Ca Calcium 20											112 Cd Cadmium 48	115 In Indium 49	122 Sn Tin 50	127 I Iodine 53	131 Xe Xenon 54			
5	85.5 Rb Rubidium 37	87.6 Sr Strontium 38											197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	(210) Po Polonium 84	(222) Rn Radon 86	
6	133 Cs Caesium 55	137 Ba Barium 56											192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	(210) Po Polonium 84	(222) Rn Radon 86
7	(223) Fr Francium 87	(226) Ra Radium 88											192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	(210) Po Polonium 84	(222) Rn Radon 86

▶ Lanthanoid elements	140	Ce	Cerium	58
	141	Pr	Praseodymium	59
	144	Nd	Neodymium	60
	(147)	Pm	Promethium	61
	150	Sm	Samarium	62
	(153)	Eu	Europium	63
	157	Gd	Gadolinium	64
	159	Tb	Terbium	65
	163	Dy	Dysprosium	66
	165	Ho	Holmium	67
	167	Er	Erbium	68
	169	Tm	Thulium	69
	173	Yb	Ytterbium	70
	175	Lu	Lutetium	71
▶▶ Actinoid elements	232	Th	Thorium	90
	(231)	Pa	Protactinium	91
	238	U	Uranium	92
	(237)	Np	Neptunium	93
	(242)	Pu	Plutonium	94
	(243)	Am	Americium	95
	(247)	Cm	Curium	96
	(245)	Bk	Berkelium	97
	(251)	Cf	Californium	98
	(254)	Es	Einsteinium	99
	(253)	Fm	Fermium	100
	(256)	Md	Mendelevium	101
	(254)	No	Nobelium	102
	(257)	Lr	Lawrencium	103