



GCE A LEVEL

A410U10-1A



S25-A410U10-1A



TUESDAY, 10 JUNE 2025 – MORNING

CHEMISTRY – A level component 1

Data Booklet

Avogadro constant
molar gas constant
molar gas volume at 273 K and 1 atm
molar gas volume at 298 K and 1 atm
Planck constant
speed of light
density of water
specific heat capacity of water
ionic product of water at 298 K
fundamental electronic charge

$$\begin{aligned}N_A &= 6.02 \times 10^{23} \text{ mol}^{-1} \\R &= 8.31 \text{ J mol}^{-1} \text{ K}^{-1} \\V_m &= 22.4 \text{ dm}^3 \text{ mol}^{-1} \\V_m &= 24.5 \text{ dm}^3 \text{ mol}^{-1} \\h &= 6.63 \times 10^{-34} \text{ J s} \\c &= 3.00 \times 10^8 \text{ m s}^{-1} \\d &= 1.00 \text{ g cm}^{-3} \\c &= 4.18 \text{ J g}^{-1} \text{ K}^{-1} \\K_w &= 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6} \\e &= 1.60 \times 10^{-19} \text{ C}\end{aligned}$$

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

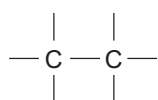
Multiple	Prefix	Symbol
10^3	kilo	k
10^6	mega	M
10^9	giga	G

Infrared absorption values

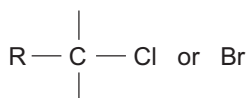
Bond	Wavenumber / cm^{-1}
C — Br	500 to 600
C — Cl	650 to 800
C — O	1000 to 1300
C = C	1620 to 1670
C = O	1650 to 1750
C $\equiv$ N	2100 to 2250
C — H	2800 to 3100
O — H (carboxylic acid)	2500 to 3200 (very broad)
O — H (alcohol / phenol)	3200 to 3550 (broad)
N — H	3300 to 3500

 ^{13}C NMR chemical shifts relative to TMS = 0

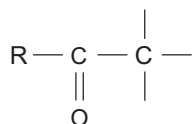
Type of carbon	Chemical shift, δ (ppm)
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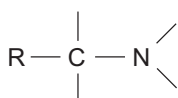
5 to 40



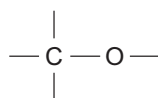
10 to 70



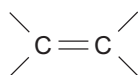
20 to 50



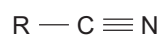
25 to 60



50 to 90



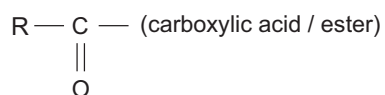
90 to 150



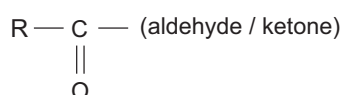
110 to 125



110 to 160



160 to 185



190 to 220

^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

THE PERIODIC TABLE

2
1

Period s block

Group

3 4 5 6 7 0

[illegible]

► Lanthanoid elements

►► Actinoid elements

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