



GCE AS

B410U10-1A



S19-B410U10-1A



CHEMISTRY – AS component 1

MONDAY, 20 MAY 2019 – MORNING

Data Booklet

Avogadro constant
molar gas constant
molar gas volume

$$\begin{aligned}N_A &= 6.02 \times 10^{23} \text{ mol}^{-1} \\ R &= 8.31 \text{ J mol}^{-1} \text{ K}^{-1} \\ V_m &= 22.4 \text{ dm}^3 \text{ at } 273 \text{ K and } 1 \text{ atm} \\ V_m &= 24.5 \text{ dm}^3 \text{ at } 298 \text{ K and } 1 \text{ atm}\end{aligned}$$

Planck constant
speed of light
density of water
specific heat capacity of water
fundamental electronic charge

$$\begin{aligned}h &= 6.63 \times 10^{-34} \text{ Js} \\ c &= 3.00 \times 10^8 \text{ ms}^{-1} \\ d &= 1.00 \text{ g cm}^{-3} \\ c &= 4.18 \text{ J g}^{-1} \text{ K}^{-1} \\ e &= 1.60 \times 10^{-19} \text{ C}\end{aligned}$$

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

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

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

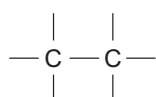
Multiple	Prefix	Symbol
10^3	kilo	k
10^6	mega	M
10^9	giga	G

Infrared absorption values

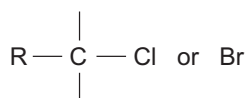
Bond	Wavenumber / cm^{-1}
C — Br	500 to 600
C — Cl	650 to 800
C — O	1000 to 1300
C = C	1620 to 1670
C = O	1650 to 1750
C $\equiv$ N	2100 to 2250
C — H	2800 to 3100
O — H (carboxylic acid)	2500 to 3200 (very broad)
O — H (alcohol / phenol)	3200 to 3550 (broad)
N — H	3300 to 3500

¹³C NMR chemical shifts relative to TMS = 0

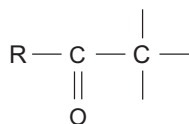
Type of carbon	Chemical shift, δ (ppm)
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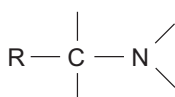
5 to 40



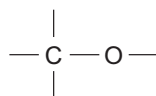
10 to 70



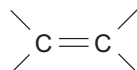
20 to 50



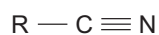
25 to 60



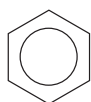
50 to 90



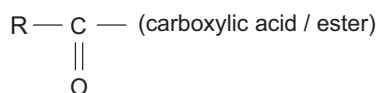
90 to 150



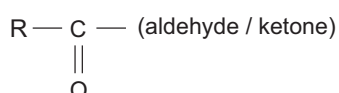
110 to 125



110 to 160



160 to 185



190 to 220

^1H NMR chemical shifts relative to TMS = 0

Type of proton	Chemical shift, δ (ppm)
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$-\text{CH}_3$	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 *
$-\text{C}=\text{CH}-\text{CO}$	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

Period **1** **2** **3** **4** **5** **6** **7** **0**

Group

s block		p block																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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1.01 H Hydrogen 1	6.94 Li Lithium 3	23.0 Na Sodium 11	39.1 K Potassium 19	85.5 Rb Rubidium 37	133 Cs Caesium 55	(223) Fr Francium 87	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	131 Xe Xenon 54	(222) Rn Radon 86	127 I Iodine 53	(210) At Astatine 85	(210) Po Polonium 84	207 Pb Lead 82	204 Tl Thallium 81	201 Hg Mercury 80	197 Au Gold 79	195 Pt Platinum 78	192 Ir Iridium 77	190 Os Osmium 76	186 Re Rhenium 75	184 W Tungsten 74	181 Ta Tantalum 73	179 Hf Hafnium 72	139 La Lanthanum 57	(227) Ac Actinium 89	(226) Ra Radium 88	(223) Fr Francium 87																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													