

Advanced (Subsidiary) GCE

CHEMISTRY A

Data Sheet

Specimen



The information in this Sheet is for the use of candidates following Chemistry A H034 and H434.

A copy of this sheet will be included as an insert with each unit paper.

Copies of this sheet may be used for teaching.

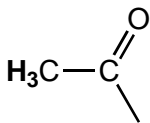
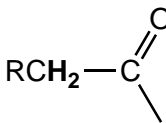
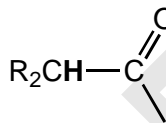
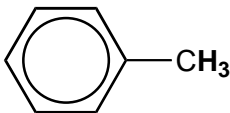
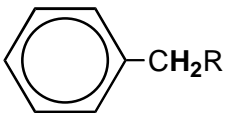
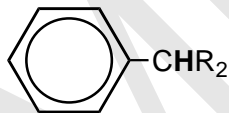

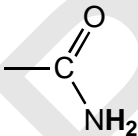
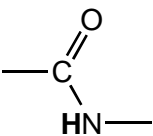
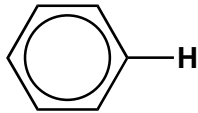
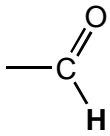
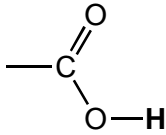
General information

- 1 mol of gas molecules occupies 24.0 dm³ at room temperature and pressure, RTP.
- Avogadro constant, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$.
- Ionic product of water, $K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$.

This document consists of 4 printed pages.

¹H NMR chemical shifts relative to TMS

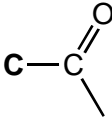
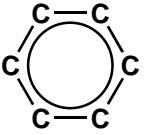
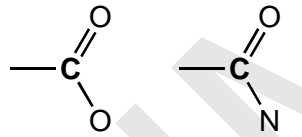
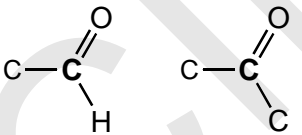
Chemical shifts are typical values and can vary slightly depending on the solvent, concentration and substituents.

type of proton			chemical shift, δ / ppm
R-CH ₃			0.7–1.6
N-H	R-OH		1.0–5.5*
R-CH ₂ -R			1.2–1.4
R ₃ CH			1.6–2.0
			2.0–2.9
			2.3–2.7
N-CH ₃	N-CH ₂ R	N-CHR ₂	2.3–2.9
O-CH ₃	O-CH ₂ R	O-CHR ₂	3.3–4.3
Br or Cl-CH ₃	Br or Cl-CH ₂ R	Br or Cl-CHR ₂	3.0–4.2
			4.5–10.0*
-CH=CH-			4.5–6.0
			5.0–12.0*
			6.5–8.0
			9.0–10
			11.0–12.0*

* OH and NH chemical shifts are very variable (sometimes outside these limits) and are often broad. Signals are not usually seen as split peaks.

¹³C NMR chemical shifts relative to TMS

Chemical shifts are typical values and can vary slightly depending on the solvent, concentration and substituents.

type of carbon	chemical shift, δ / ppm
C–C (alkanes)	10–35
	20–30
C–Cl or C–Br	30–70
C–N (amines)	35–60
C–OH	50–65
C=C (alkenes)	115–140
aromatic 	125–150
carbonyl (ester, carboxylic acid, amide) 	160–185
carbonyl (aldehyde, ketone) 	190–220

Characteristic infrared absorptions in organic molecules

bond	location	wavenumber/cm ⁻¹
C–O	alcohols, esters, carboxylic acids	1000–1300
C=O	aldehydes, ketones, carboxylic acids, esters, amides	1640–1750
C–H	organic compound with a C–H bond	2850–3100
O–H	carboxylic acids	2500–3300 (very broad)
N–H	amines, amides	3200–3500
O–H	alcohols, phenols	3200–3550 (broad)

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[Turn over

The Periodic Table of the Elements

1	2											3	4	5	6	7	0	
		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 1.0 H hydrogen 1 </div>																<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 4.0 He helium 2 </div>
		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> Key relative atomic mass atomic symbol <small>name</small> atomic (proton) number </div>																
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	
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	95.9 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	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated							

140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	144.9 Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.2 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	173.0 Yb ytterbium 70	175.0 Lu lutetium 71
232.0 Th thorium 90	[231] Pa protactinium 91	238.1 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