

OCR

Oxford Cambridge and RSA

**AS Level Chemistry A (H032)
A Level Chemistry A (H432)****Data Sheet****INSTRUCTIONS**

- Do **not** send this Data Sheet for marking. Keep it in the centre or recycle it.

INFORMATION

- This document has **4** pages.

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

General Information

Molar gas volume = $24.0 \text{ dm}^3 \text{ mol}^{-1}$ at room temperature and pressure, RTP

Avogadro constant, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

Specific heat capacity of water, $c = 4.18 \text{ J g}^{-1} \text{ K}^{-1}$

Ionic product of water, $K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ at 298 K

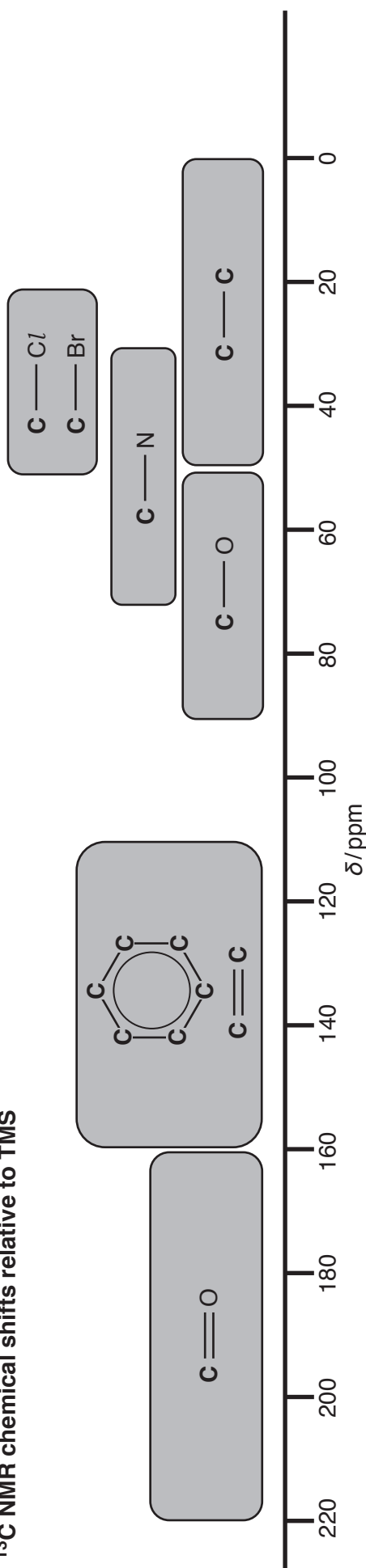
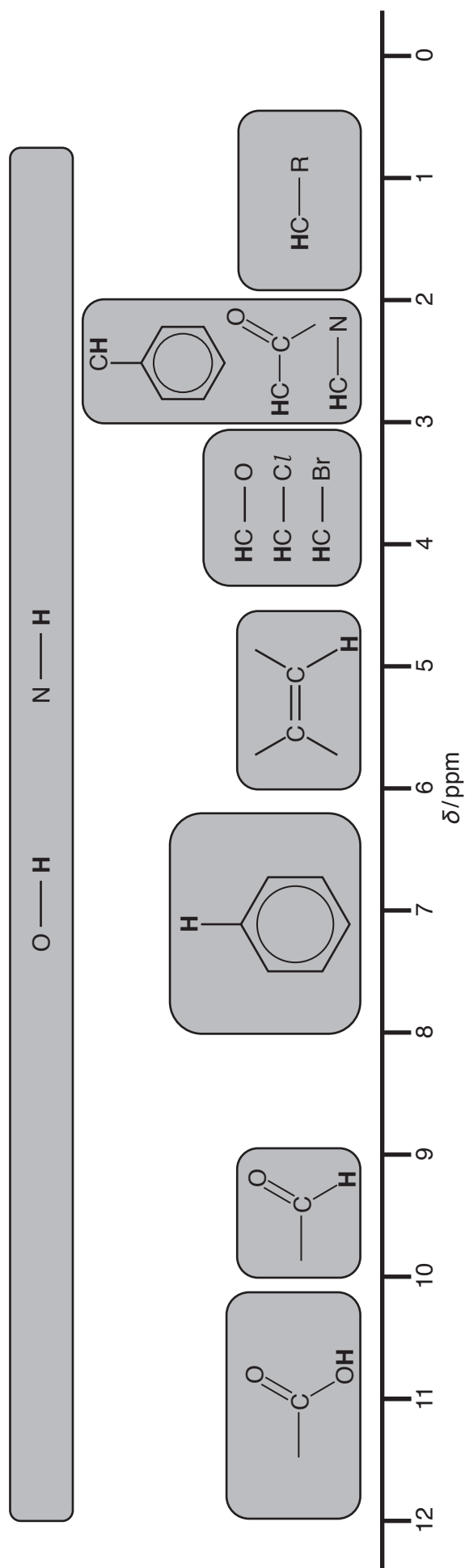
1 tonne = 10^6 g

Arrhenius equation: $k = Ae^{-E_a/RT}$ or $\ln k = -E_a/RT + \ln A$

Gas constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

Characteristic infrared absorptions in organic molecules

Bond	Location	Wavenumber/ cm^{-1}
C–C	Alkanes, alkyl chains	750–1100
C–X	Haloalkanes (X = Cl, Br, I)	500–800
C–F	Fluoroalkanes	1000–1350
C–O	Alcohols, esters, carboxylic acids	1000–1300
C=C	Alkenes	1620–1680
C=O	Aldehydes, ketones, carboxylic acids, esters, amides, acyl chlorides and acid anhydrides	1630–1820
aromatic C=C	Arenes	Several peaks in range 1450–1650 (variable)
C≡N	Nitriles	2220–2260
C–H	Alkyl groups, alkenes, arenes	2850–3100
O–H	Carboxylic acids	2500–3300 (broad)
N–H	Amines, amides	3300–3500
O–H	Alcohols, phenols	3200–3600

^{13}C NMR chemical shifts relative to TMS **^1H NMR chemical shifts relative to TMS**

Chemical shifts are variable and can vary depending on the solvent, concentration and substituents. As a result, shifts may be outside the ranges indicated above.

OH and **NH** chemical shifts are very variable and are often broad. Signals are not usually seen as split peaks. Note that **CH** bonded to 'shifting groups' on either side, e.g. $\text{O}-\text{CH}_2-\text{C}=\text{O}$, may be shifted more than indicated above.

The Periodic Table of the Elements

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
1 H hydrogen 1.0	2 He helium 4.0	3 Li lithium 6.9	4 Be beryllium 9.0	5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9	19 K potassium 39.1	20 Ca calcium 40.1
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4
55 Cs caesium 132.9	56 Ba barium 137.3	57-71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium
119 K potassium 39.1	120 Ca calcium 40.1	121 Sc scandium 45.0	122 Ti titanium 47.9	123 V vanadium 50.9	124 Cr chromium 52.0	125 Mn manganese 54.9	126 Fe iron 55.8	127 Co cobalt 58.9	128 Ni nickel 58.7
137 Rb rubidium 85.5	138 Sr strontium 87.6	139 Y yttrium 88.9	140 Zr zirconium 91.2	141 Nb niobium 92.9	142 Mo molybdenum 95.9	143 Tc technetium	144 Ru ruthenium 101.1	145 Rh rhodium 102.9	146 Pd palladium 106.4
151 K potassium 39.1	152 Ca calcium 40.1	153 Sc scandium 45.0	154 Ti titanium 47.9	155 V vanadium 50.9	156 Cr chromium 52.0	157 Mn manganese 54.9	158 Fe iron 55.8	159 Co cobalt 58.9	160 Ni nickel 58.7
167 Rb rubidium 85.5	168 Sr strontium 87.6	169 Y yttrium 88.9	170 Zr zirconium 91.2	171 Nb niobium 92.9	172 Mo molybdenum 95.9	173 Tc technetium	174 Ru ruthenium 101.1	175 Rh rhodium 102.9	176 Pd palladium 106.4
183 K potassium 39.1	184 Ca calcium 40.1	185 Sc scandium 45.0	186 Ti titanium 47.9	187 V vanadium 50.9	188 Cr chromium 52.0	189 Mn manganese 54.9	190 Fe iron 55.8	191 Co cobalt 58.9	192 Ni nickel 58.7
199 K potassium 39.1	200 Ca calcium 40.1	201 Sc scandium 45.0	202 Ti titanium 47.9	203 V vanadium 50.9	204 Cr chromium 52.0	205 Mn manganese 54.9	206 Fe iron 55.8	207 Co cobalt 58.9	208 Ni nickel 58.7
215 K potassium 39.1	216 Ca calcium 40.1	217 Sc scandium 45.0	218 Ti titanium 47.9	219 V vanadium 50.9	220 Cr chromium 52.0	221 Mn manganese 54.9	222 Fe iron 55.8	223 Co cobalt 58.9	224 Ni nickel 58.7
231 K potassium 39.1	232 Ca calcium 40.1	233 Sc scandium 45.0	234 Ti titanium 47.9	235 V vanadium 50.9	236 Cr chromium 52.0	237 Mn manganese 54.9	238 Fe iron 55.8	239 Co cobalt 58.9	240 Ni nickel 58.7
247 K potassium 39.1	248 Ca calcium 40.1	249 Sc scandium 45.0	250 Ti titanium 47.9	251 V vanadium 50.9	252 Cr chromium 52.0	253 Mn manganese 54.9	254 Fe iron 55.8	255 Co cobalt 58.9	256 Ni nickel 58.7
263 K potassium 39.1	264 Ca calcium 40.1	265 Sc scandium 45.0	266 Ti titanium 47.9	267 V vanadium 50.9	268 Cr chromium 52.0	269 Mn manganese 54.9	270 Fe iron 55.8	271 Co cobalt 58.9	272 Ni nickel 58.7
279 K potassium 39.1	280 Ca calcium 40.1	281 Sc scandium 45.0	282 Ti titanium 47.9	283 V vanadium 50.9	284 Cr chromium 52.0	285 Mn manganese 54.9	286 Fe iron 55.8	287 Co cobalt 58.9	288 Ni nickel 58.7
295 K potassium 39.1	296 Ca calcium 40.1	297 Sc scandium 45.0	298 Ti titanium 47.9	299 V vanadium 50.9	300 Cr chromium 52.0	301 Mn manganese 54.9	302 Fe iron 55.8	303 Co cobalt 58.9	304 Ni nickel 58.7
311 K potassium 39.1	312 Ca calcium 40.1	313 Sc scandium 45.0	314 Ti titanium 47.9	315 V vanadium 50.9	316 Cr chromium 52.0	317 Mn manganese 54.9	318 Fe iron 55.8	319 Co cobalt 58.9	320 Ni nickel 58.7
327 K potassium 39.1	328 Ca calcium 40.1	329 Sc scandium 45.0	330 Ti titanium 47.9	331 V vanadium 50.9	332 Cr chromium 52.0	333 Mn manganese 54.9	334 Fe iron 55.8	335 Co cobalt 58.9	336 Ni nickel 58.7
343 K potassium 39.1	344 Ca calcium 40.1	345 Sc scandium 45.0	346 Ti titanium 47.9	347 V vanadium 50.9	348 Cr chromium 52.0	349 Mn manganese 54.9	350 Fe iron 55.8	351 Co cobalt 58.9	352 Ni nickel 58.7
359 K potassium 39.1	360 Ca calcium 40.1	361 Sc scandium 45.0	362 Ti titanium 47.9	363 V vanadium 50.9	364 Cr chromium 52.0	365 Mn manganese 54.9	366 Fe iron 55.8	367 Co cobalt 58.9	368 Ni nickel 58.7
375 K potassium 39.1	376 Ca calcium 40.1	377 Sc scandium 45.0	378 Ti titanium 47.9	379 V vanadium 50.9	380 Cr chromium 52.0	381 Mn manganese 54.9	382 Fe iron 55.8	383 Co cobalt 58.9	384 Ni nickel 58.7
391 K potassium 39.1	392 Ca calcium 40.1	393 Sc scandium 45.0	394 Ti titanium 47.9	395 V vanadium 50.9	396 Cr chromium 52.0	397 Mn manganese 54.9	398 Fe iron 55.8	399 Co cobalt 58.9	400 Ni nickel 58.7
407 K potassium 39.1	408 Ca calcium 40.1	409 Sc scandium 45.0	410 Ti titanium 47.9	411 V vanadium 50.9	412 Cr chromium 52.0	413 Mn manganese 54.9	414 Fe iron 55.8	415 Co cobalt 58.9	416 Ni nickel 58.7
423 K potassium 39.1	424 Ca calcium 40.1	425 Sc scandium 45.0	426 Ti titanium 47.9	427 V vanadium 50.9	428 Cr chromium 52.0	429 Mn manganese 54.9	430 Fe iron 55.8	431 Co cobalt 58.9	432 Ni nickel 58.7
439 K potassium 39.1	440 Ca calcium 40.1	441 Sc scandium 45.0	442 Ti titanium 47.9	443 V vanadium 50.9	444 Cr chromium 52.0	445 Mn manganese 54.9	446 Fe iron 55.8	447 Co cobalt 58.9	448 Ni nickel 58.7
455 K potassium 39.1	456 Ca calcium 40.1	457 Sc scandium 45.0	458 Ti titanium 47.9	459 V vanadium 50.9	460 Cr chromium 52.0	461 Mn manganese 54.9	462 Fe iron 55.8	463 Co cobalt 58.9	464 Ni nickel 58.7
471 K potassium 39.1	472 Ca calcium 40.1	473 Sc scandium 45.0	474 Ti titanium 47.9	475 V vanadium 50.9	476 Cr chromium 52.0	477 Mn manganese 54.9	478 Fe iron 55.8	479 Co cobalt 58.9	480 Ni nickel 58.7
487 K potassium 39.1	488 Ca calcium 40.1	489 Sc scandium 45.0	490 Ti titanium 47.9	491 V vanadium 50.9	492 Cr chromium 52.0	493 Mn manganese 54.9	494 Fe iron 55.8	495 Co cobalt 58.9	496 Ni nickel 58.7
503 K potassium 39.1	504 Ca calcium 40.1	505 Sc scandium 45.0	506 Ti titanium 47.9	507 V vanadium 50.9	508 Cr chromium 52.0	509 Mn manganese 54.9	510 Fe iron 55.8	511 Co cobalt 58.9	512 Ni nickel 58.7
519 K potassium 39.1	520 Ca calcium 40.1	521 Sc scandium 45.0	522 Ti titanium 47.9	523 V vanadium 50.9	524 Cr chromium 52.0	525 Mn manganese 54.9	526 Fe iron 55.8	527 Co cobalt 58.9	528 Ni nickel 58.7
535 K potassium 39.1	536 Ca calcium 40.1	537 Sc scandium 45.0	538 Ti titanium 47.9	539 V vanadium 50.9	540 Cr chromium 52.0	541 Mn manganese 54.9	542 Fe iron 55.8	543 Co cobalt 58.9	544 Ni nickel 58.7
551 K potassium 39.1	552 Ca calcium 40.1	553 Sc scandium 45.0	554 Ti titanium 47.9	555 V vanadium 50.9	556 Cr chromium 52.0	557 Mn manganese 54.9	558 Fe iron 55.8	559 Co cobalt 58.9	560 Ni nickel 58.7
567 K potassium 39.1	568 Ca calcium 40.1	569 Sc scandium 45.0	570 Ti titanium 47.9	571 V vanadium 50.9	572 Cr chromium 52.0	573 Mn manganese 54.9	574 Fe iron 55.8	575 Co cobalt 58.9	576 Ni nickel 58.7
583 K potassium 39.1	584 Ca calcium 40.1	585 Sc scandium 45.0	586 Ti titanium 47.9	587 V vanadium 50.9	588 Cr chromium 52.0	589 Mn manganese 54.9	590 Fe iron 55.8	591 Co cobalt 58.9	592 Ni nickel 58.7
599 K potassium 39.1	600 Ca calcium 40.1	601 Sc scandium 45.0	602 Ti titanium 47.9	603 V vanadium 50.9	604 Cr chromium 52.0	605 Mn manganese 54.9	606 Fe iron 55.8	607 Co cobalt 58.9	608 Ni nickel 58.7
615 K potassium 39.1	616 Ca calcium 40.1	617 Sc scandium 45.0	618 Ti titanium 47.9	619 V vanadium 50.9	620 Cr chromium 52.0	621 Mn manganese 54.9	622 Fe iron 55.8	623 Co cobalt 58.9	624 Ni nickel 58.7
631 K potassium 39.1	632 Ca calcium 40.1	633 Sc scandium 45.0	634 Ti titanium 47.9	635 V vanadium 50.9	636 Cr chromium 52.0	637 Mn manganese 54.9	638 Fe iron 55.8	639 Co cobalt 58.9	640 Ni nickel 58.7
647 K potassium 39.1	648 Ca calcium 40.1	649 Sc scandium 45.0	650 Ti titanium 47.9	651 V vanadium 50.9	652 Cr chromium 52.0	653 Mn manganese 54.9	654 Fe iron 55.8	655 Co cobalt 58.9	656 Ni nickel 58.7
663 K potassium 39.1	664 Ca calcium 40.1	665 Sc scandium 45.0	666 Ti titanium 47.9	667 V vanadium 50.9	668 Cr chromium 52.0	669 Mn manganese 54.9	670 Fe iron 55.8	671 Co cobalt 58.9	672 Ni nickel 58.7
679 K potassium 39.1	680 Ca calcium 40.1	681 Sc scandium 45.0	682 Ti titanium 47.9	683 V vanadium 50.9	684 Cr chromium 52.0	685 Mn manganese 54.9	686 Fe iron 55.8	687 Co cobalt 58.9	688 Ni nickel 58.7
695 K potassium 39.1	696 Ca calcium 40.1	697 Sc scandium 45.0	698 Ti titanium 47.9	699 V vanadium 50.9	700 Cr chromium 52.0	701 Mn manganese 54.9	702 Fe iron 55.8	703 Co cobalt 58.9	704 Ni nickel 58.7
711 K potassium 39.1	712 Ca calcium 40.1	713 Sc scandium 45.0	714 Ti titanium 47.9	715 V vanadium 50.9	716 Cr chromium 52.0	717 Mn manganese 54.9	718 Fe iron 55.8	719 Co cobalt 58.9	720 Ni nickel 58.7
727 K potassium 39.1	728 Ca calcium 40.1	729 Sc scandium 45.0	730 Ti titanium 47.9	731 V vanadium 50.9	732 Cr chromium 52.0	733 Mn manganese 54.9	734 Fe iron 55.8	735 Co cobalt 58.9	736 Ni nickel 58.7
743 K potassium 39.1	744 Ca calcium 40.1	745 Sc scandium 45.0	746 Ti titanium 47.9	747 V vanadium 50.9	7				