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# AS Level Chemistry A (H032) A Level Chemistry A (H432)

## Data Sheet



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### INFORMATION

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## General Information

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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

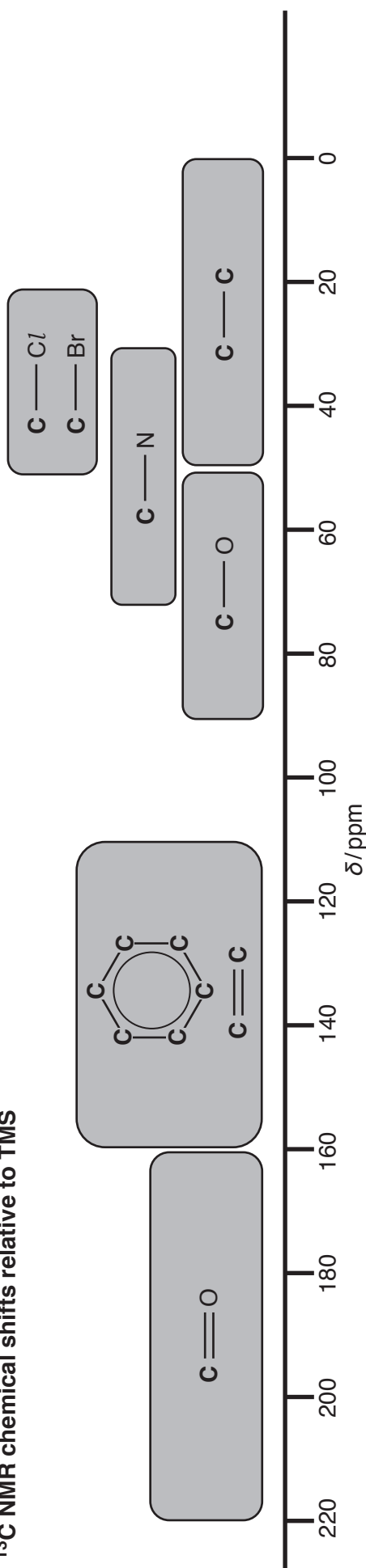
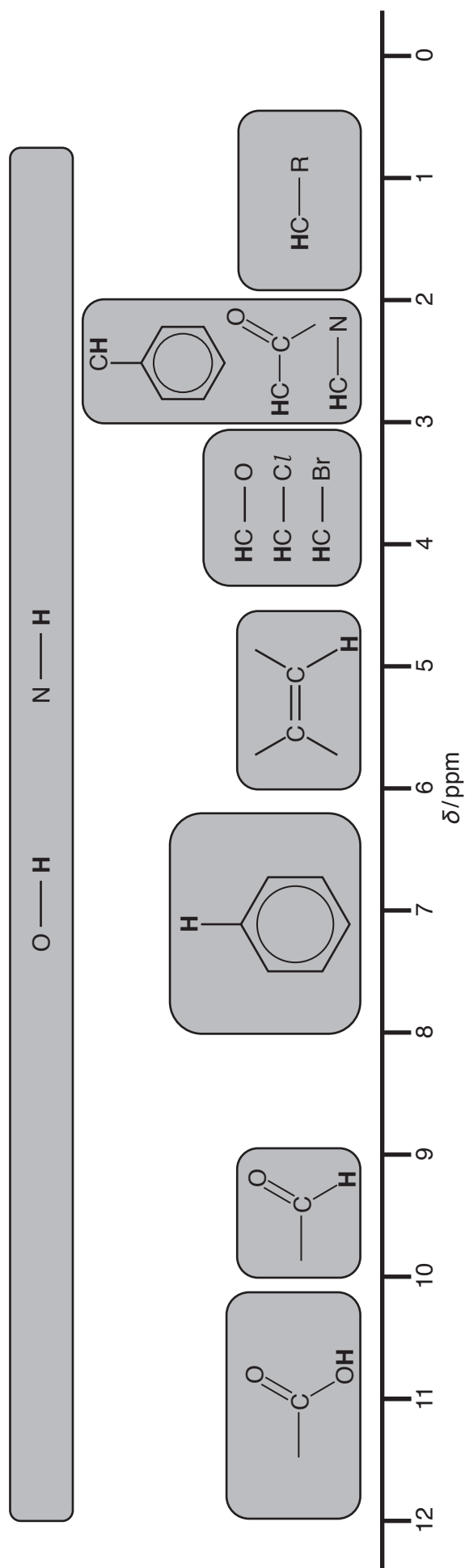
1 tonne =  $10^6 \text{ g}$

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/ $\text{cm}^{-1}$
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

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