

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary GCE (H033)**

**Advanced GCE (H433)**

**Data Sheet for Chemistry B**

**MODIFIED ENLARGED**

**The information in this sheet is for the use of candidates following the Advanced Subsidiary GCE in Chemistry B (H033) course and Advanced GCE in Chemistry B (H433) course.**

**The data in this sheet will be printed for distribution with the examination papers.**

**Copies of this sheet may be used for teaching.**

DC (ST/ST) 131593/1  
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## GENERAL INFORMATION

Molar gas volume =  $24.0 \text{ dm}^3 \text{ mol}^{-1}$  at RTP

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

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

Planck constant,  $h = 6.63 \times 10^{-34} \text{ J Hz}^{-1}$

Speed of light in a vacuum,  $c = 3.00 \times 10^8 \text{ m s}^{-1}$

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

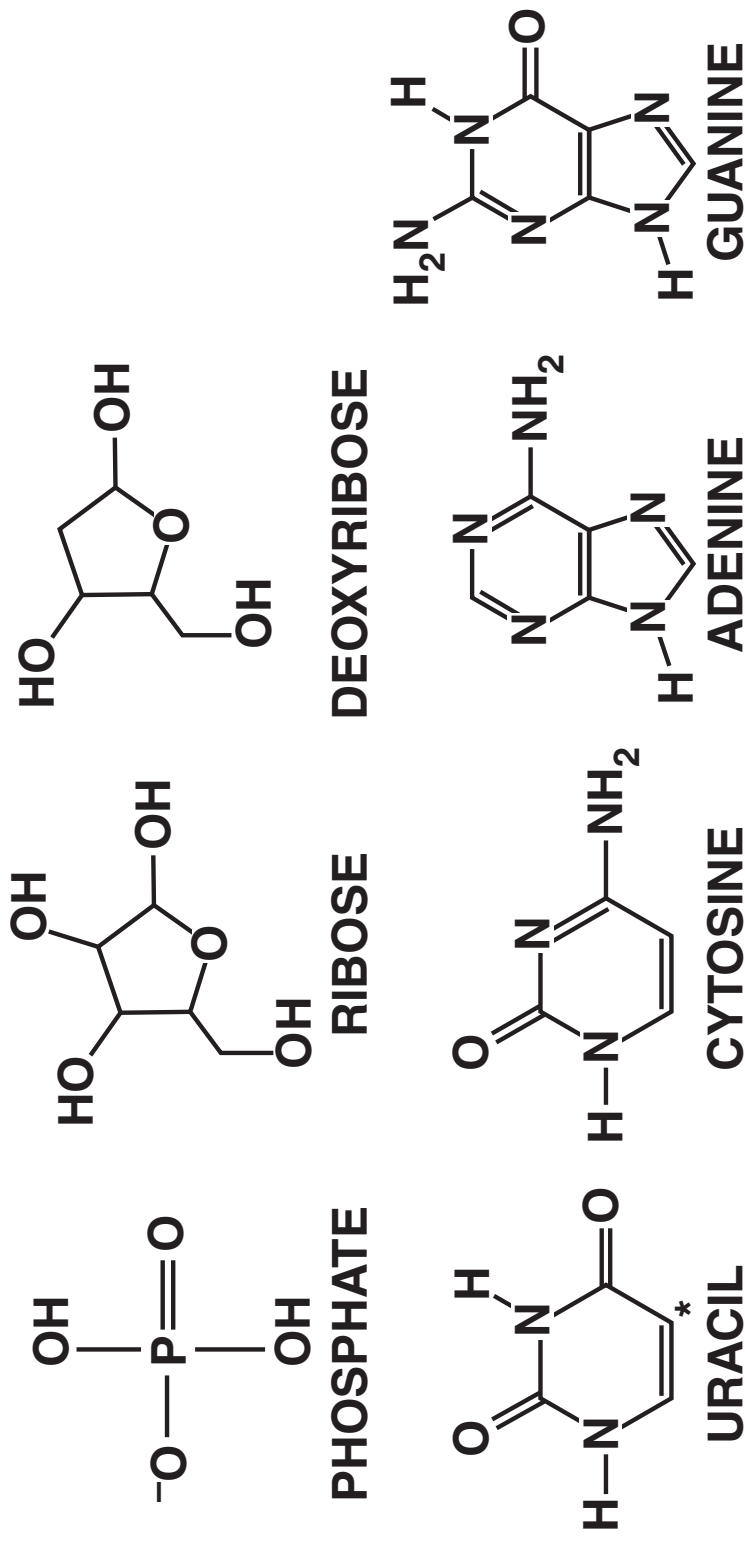
## TRIPLET BASE CODES (CODONS) FOR SOME AMINO ACIDS USED IN mRNA

Glycine	GGU
Alanine	GCC
Leucine	CUG
Serine	UCG
Aspartic acid	GAU
Glutamine	CAA
Valine	GUC

## CHARACTERISTIC INFRARED ABSORPTIONS IN ORGANIC MOLECULES

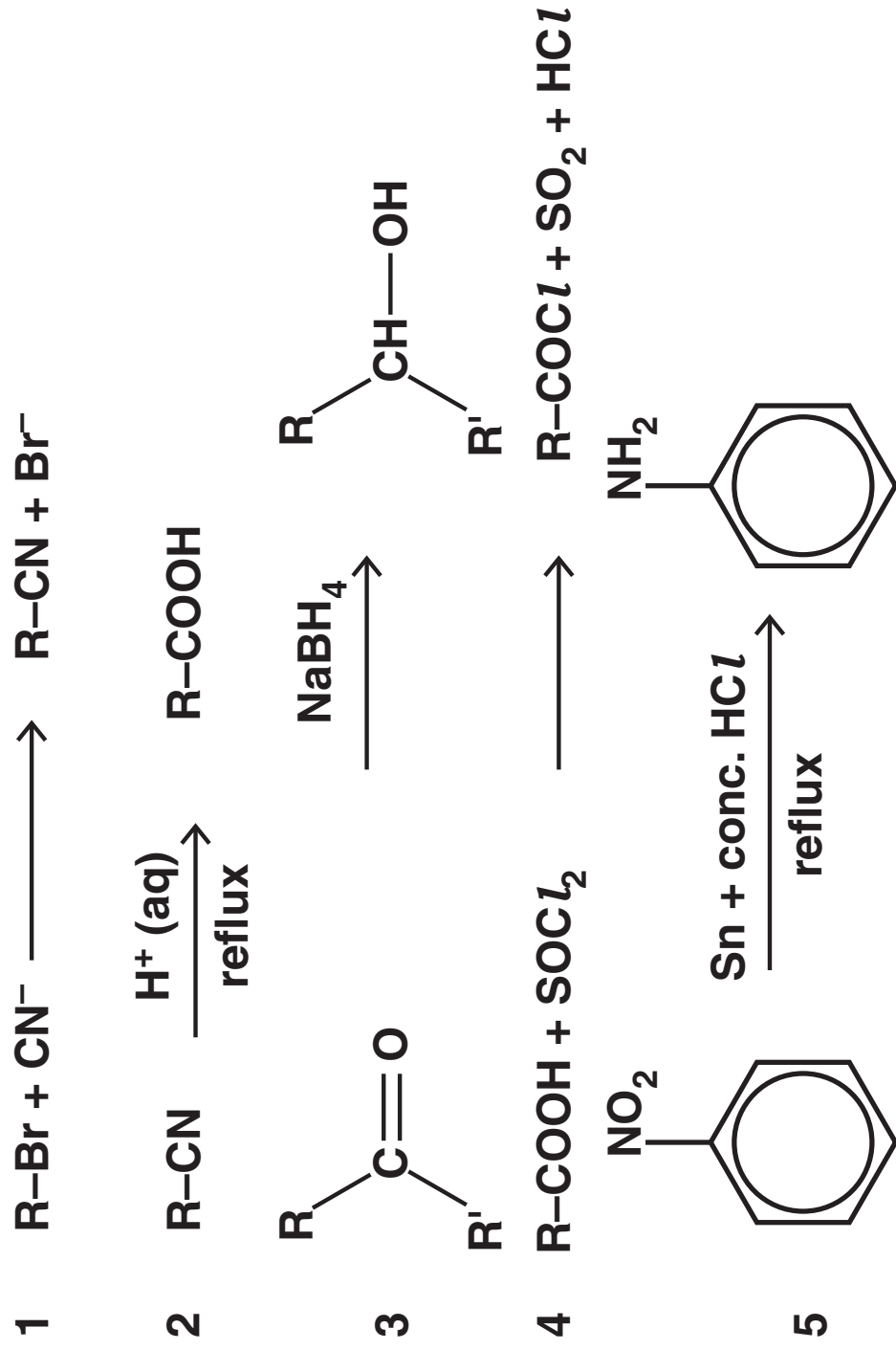
BOND	LOCATION	WAVENUMBER/cm <sup>-1</sup>
C–H	Alkenes Alkenes, arenes	2850–2950 3000–3100
C–C	Alkanes	750–1100
C=C	Alkenes	1620–1680
aromatic C=C	Arenes	Several peaks in range 1450–1650 (variable)
C=O	Aldehydes Ketones Carboxylic acids Esters Amides Acyl chlorides and acid anhydrides	1720–1740 1705–1725 1700–1725 1735–1750 1630–1700 1750–1820
C–O	Alcohols, ethers, esters and carboxylic acids	1000–1300
C≡N	Nitriles	2220–2260
C–X	Fluoroalkanes Chloroalkanes Bromoalkanes	1000–1350 600–800 500–600
O–H	Alcohols, phenols Carboxylic acids	3200–3600 (broad) 2500–3300 (broad)
N–H	Primary amines Amides	3300–3500 ca. 3500

## MONOMERS OF DNA AND RNA

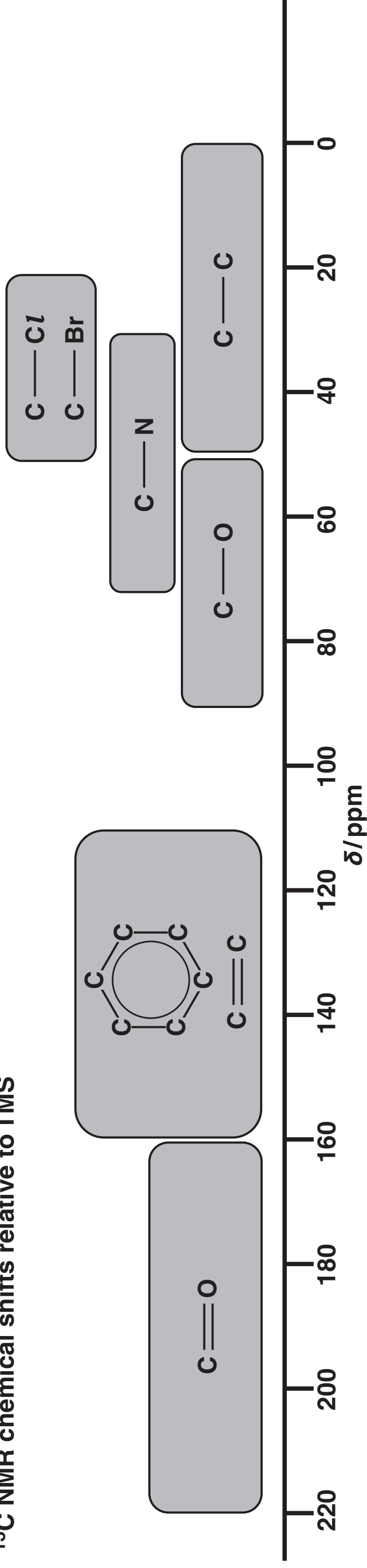


(thymine has a CH<sub>3</sub> at position \*)

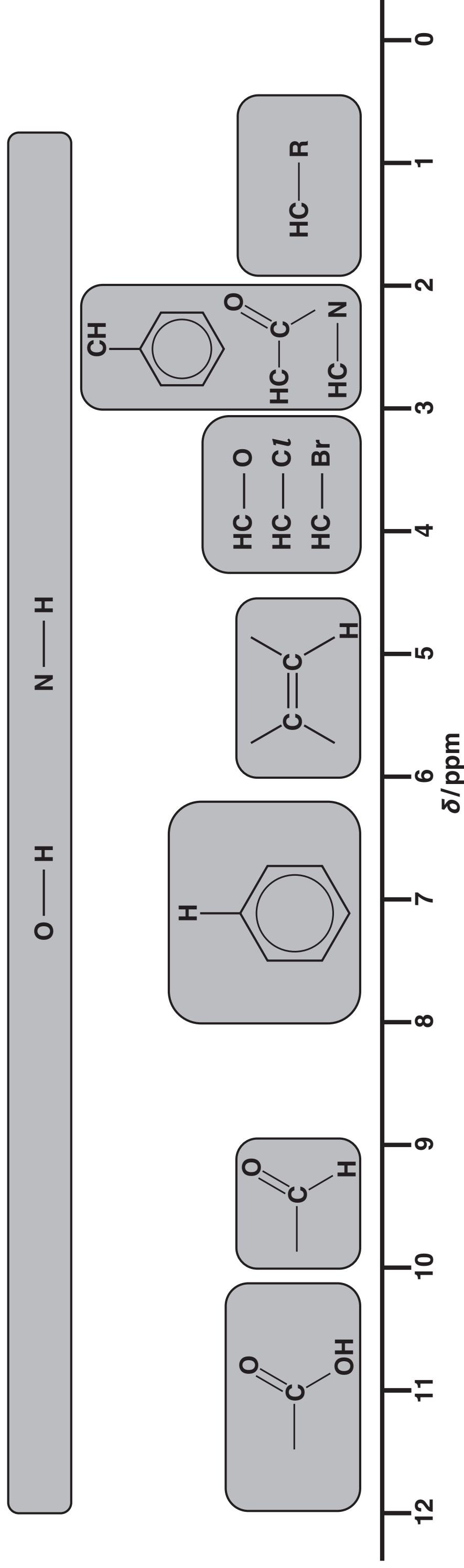
## SOME USEFUL ORGANIC REACTIONS



### <sup>13</sup>C NMR chemical shifts relative to TMS



### <sup>1</sup>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. O—CH<sub>2</sub>—C=O, may be shifted more than indicated above.

# The Periodic Table of the Elements

(1)

(2)

(3)

(4)

(5)

(6)

(7)

(0)

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Key atomic number Symbol name relative atomic mass			1 H hydrogen 1.0			3 Li lithium 6.9			11 Na sodium 23.0			19 K potassium 39.1			37 Rb rubidium 85.5			55 Cs caesium 132.9			87 Fr francium			20 Ca calcium 40.1			38 Sr strontium 87.6			56 Ba barium 137.3			88 Ra radium			21 Sc scandium 45.0			39 Y yttrium 88.9			57–71 lanthanoids			89–103 actinoids			22 Ti titanium 47.9			40 Zr zirconium 91.2			72 Hf hafnium 178.5			104 Rf rutherfordium			23 V vanadium 50.9			41 Nb niobium 92.9			73 Ta tantalum 180.9			105 Db dubnium			24 Cr chromium 52.0			42 Mo molybdenum 95.9			74 W tungsten 183.8			106 Sg seaborgium			25 Mn manganese 54.9			43 Tc technetium			75 Re rhenium 186.2			107 Bh bohrium			26 Fe iron 55.8			44 Ru ruthenium 101.1			76 Os osmium 190.2			108 Hs hassium			27 Co cobalt 58.9			45 Rh rhodium 102.9			77 Ir iridium 192.2			109 Mt meitnerium			28 Ni nickel 58.7			46 Pd palladium 106.4			78 Pt platinum 195.1			110 Ds darmstadtium			29 Cu copper 63.5			47 Ag silver 107.9			79 Au gold 197.0			111 Rg roentgenium			30 Zn zinc 65.4			48 Cd cadmium 112.4			80 Hg mercury 200.6			112 Cn copernicium			31 Ga gallium 69.7			49 In indium 114.8			81 Tl thallium 204.4			114 Fl flerovium			32 Ge germanium 72.6			50 Sn tin 118.7			82 Pb lead 207.2			116 Lv livermorium			33 As arsenic 74.9			51 Sb antimony 121.8			83 Bi bismuth 209.0			34 Se selenium 79.0			52 Te tellurium 127.6			84 Po polonium			35 Br bromine 79.9			53 I iodine 126.9			85 At astatine			36 Kr krypton 83.8			54 Xe xenon 131.3			37 Rb rubidium 85.5			55 Cs caesium 132.9			86 Rn radon			38 Sr strontium 87.6			56 Ba barium 137.3			88 Ra radium			39 Y yttrium 88.9			57–71 lanthanoids			89–103 actinoids			40 Zr zirconium 91.2			72 Hf hafnium 178.5			104 Rf rutherfordium			41 Nb niobium 92.9			73 Ta tantalum 180.9			105 Db dubnium			42 Mo molybdenum 95.9			74 W tungsten 183.8			106 Sg seaborgium			43 Tc technetium			75 Re rhenium 186.2			107 Bh bohrium			44 Ru ruthenium 101.1			76 Os osmium 190.2			108 Hs hassium			45 Rh rhodium 102.9			77 Ir iridium 192.2			109 Mt meitnerium			46 Pd palladium 106.4			78 Pt platinum 195.1			110 Ds darmstadtium			47 Ag silver 107.9			79 Au gold 197.0			111 Rg roentgenium			48 Cd cadmium 112.4			80 Hg mercury 200.6			112 Cn copernicium			49 In indium 114.8			81 Tl thallium 204.4			114 Fl flerovium			50 Sn tin 118.7			82 Pb lead 207.2			116 Lv livermorium			51 Sb antimony 121.8			83 Bi bismuth 209.0			52 Te tellurium 127.6			84 Po polonium			53 I iodine 126.9			85 At astatine			54 Xe xenon 131.3			55 Cs caesium 132.9			86 Rn radon			56 Ba barium 137.3			88 Ra radium			57–71 lanthanoids			89–103 actinoids			57 La lanthanum 138.9			89 Ac actinium 227.0			58 Ce cerium 140.1			90 Th thorium 232.0			91 Pa protactinium 231.0			92 U uranium 238.0			93 Np neptunium 237.0			94 Pu plutonium 244.0			95 Am americium 243.0			96 Cm curium 247.0			97 Bk berkelium 247.0			98 Cf californium 251.0			99 Es einsteinium 252.0			100 Fm fermium 257.0			101 Md mendelevium 258.1			102 No nobelium 259.1			103 Lr lawrencium 262.1			104 Rf rutherfordium 261.1			105 Db dubnium 262.1			106 Sg seaborgium 266.1			107 Bh bohrium 264.1			108 Hs hassium 277.1			109 Mt meitnerium 268.1			110 Ds darmstadtium 271.1			111 Rg roentgenium 272.1			112 Cn copernicium 285.1			113 Nh nihonium 286.1			114 Fl flerovium 289.1			115 Mc moscovium 288.1			116 Lv livermorium 293.0			117 Ts tennessine 294.0			118 Og oganesson 294.0			119 Uut unbinilium 293.0			120 Uub unbinilium 293.0			121 Uuh unbinilium 293.0			122 Uuq unbinilium 293.0			123 Uubh unbinilium 293.0			124 Uuql unbinilium 293.0			125 Uubh unbinilium 293.0			126 Uuql unbinilium 293.0			127 Uubh unbinilium 293.0			128 Uuql unbinilium 293.0			129 Uubh unbinilium 293.0			130 Uuql unbinilium 293.0			131 Uubh unbinilium 293.0			132 Uuql unbinilium 293.0			133 Uubh unbinilium 293.0			134 Uuql unbinilium 293.0			135 Uubh unbinilium 293.0			136 Uuql unbinilium 293.0			137 Uubh unbinilium 293.0			138 Uuql unbinilium 293.0			139 Uubh 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