

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary GCE (H032)**

**Advanced GCE (H432)**

**Data Sheet for Chemistry A**

**MODIFIED ENLARGED**

The information in this sheet is for the use of candidates following the Advanced Subsidiary GCE in Chemistry A (H032) course and Advanced GCE in Chemistry A (H432) course.

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

Copies of this sheet may be used for teaching.

**INSTRUCTIONS TO EXAMS OFFICER/INVIGILATOR**

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CST263



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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 =  $10^6 \text{ g}$

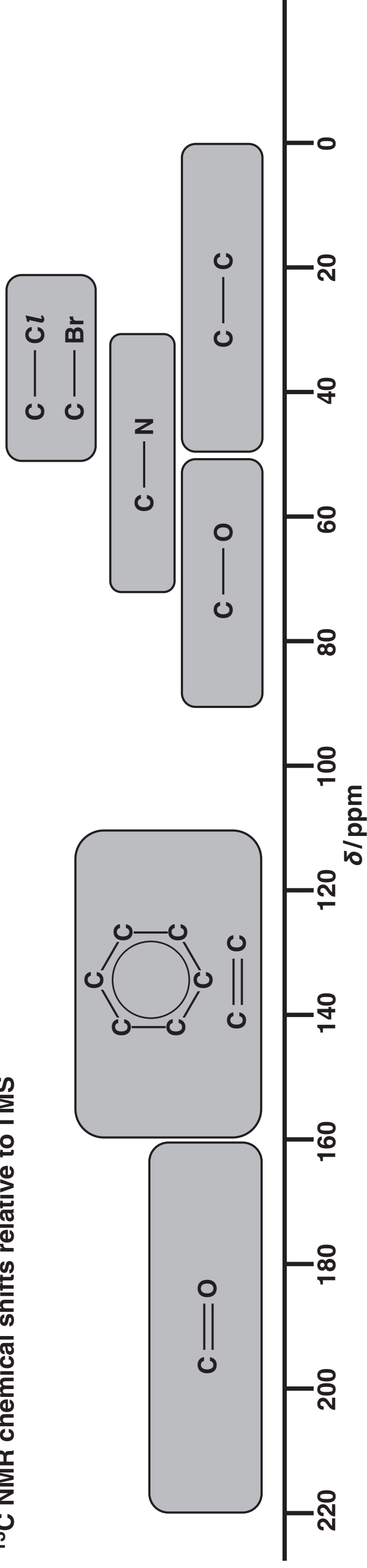
Arrhenius equation:  $k = Ae^{-E_a/RT}$  or  $\ln k = -E_a/RT + \ln A$

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

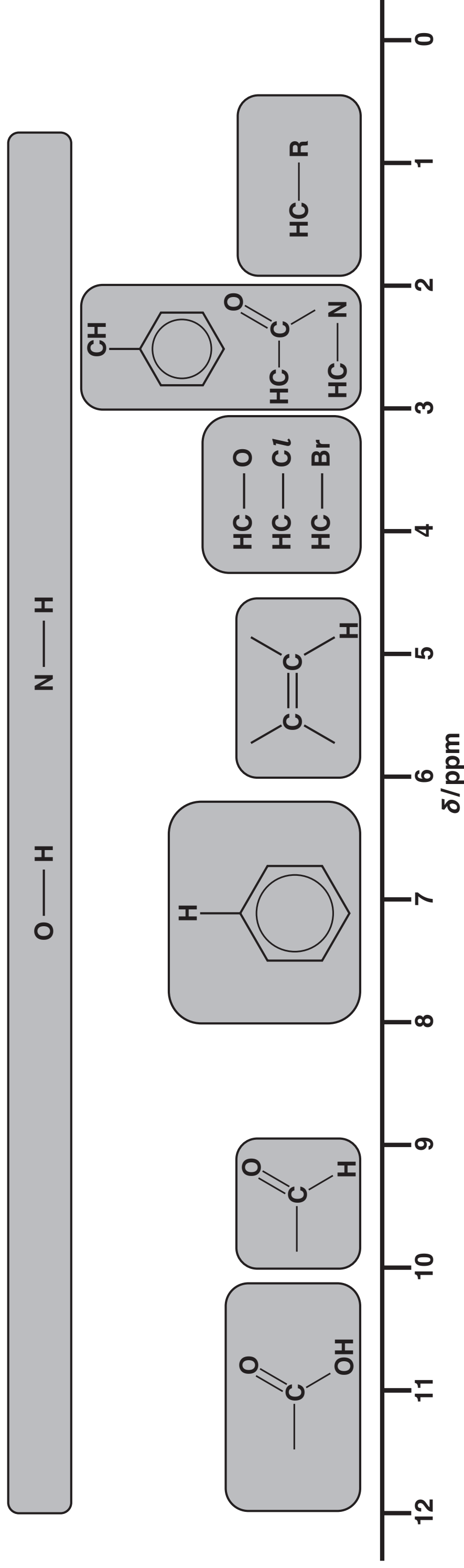
## CHARACTERISTIC INFRARED ABSORPTIONS IN ORGANIC MOLECULES

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

### <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)

Key atomic number Symbol name relative atomic mass																																										
1		2																18																								
1	H hydrogen 1.0																	2	He helium 4.0																							
3	Li lithium 6.9	4	Be beryllium 9.0															9	F fluorine 19.0	17																						
11	Na sodium 23.0	12	Mg magnesium 24.3															7	N nitrogen 14.0	15	16	17																				
																		5	B boron 10.8	6	C carbon 12.0	13	14	15	16	17																
																		13	Al aluminium 27.0	14	Si silicon 28.1	15	P phosphorus 31.0	16	S sulfur 32.1	17	18															
																		31	Ga gallium 69.7	32	Ge germanium 72.6	33	As arsenic 74.9	34	Se selenium 79.0	35	36															
																		49	In indium 114.8	50	Sn tin 118.7	51	Sb antimony 121.8	52	Te tellurium 127.6	53	54															
																		81	Tl thallium 204.4	82	Pb lead 207.2	83	Bi bismuth 209.0	84	Po polonium	85	86															
																		112	Cn copernicium	111	Rg roentgenium	110	Ds darmstadtium	109	Mt meitnerium	108	Hs hassium	107	Bh bohrium	106	Sg seaborgium	105	Db dubnium	104	Rf rutherfordium	103	actinoids	89–103	88	Ra radium	87	Fr francium

57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium 144.9	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.2	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.0	71 Lu lutetium 175.0
89 Ac actinium	90 Th thorium 232.0	91 Pa protactinium	92 U uranium 238.1	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium