OCR
Oxford Cambridge and RSA

Advanced Subsidiary GCE (H033)
Advanced GCE (H433)

Data Sheet for Chemistry B

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.

Clean copies of this sheet must be available in the examination room, and must be given up to the invigilator at the end of the examination.

Copies of this sheet may be used for teaching.

This document consists of **4** pages.

General Information

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

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

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

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

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

Ionic product of water, $K_w = 1.00 \times 10^{-14} mol^2 dm^{-6}$ 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, $R = 8.314 J mol^{-1} K^{-1}$

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

Instructions to Exams Officer/Invigilator

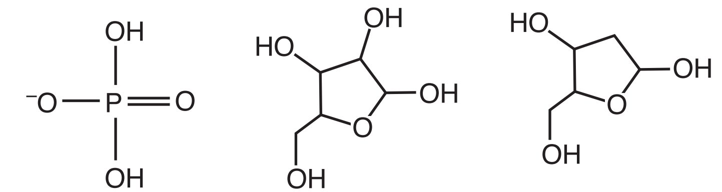
- **Do not send this Data Sheet for marking; it should be retained in the centre or destroyed.**

Chemistry B

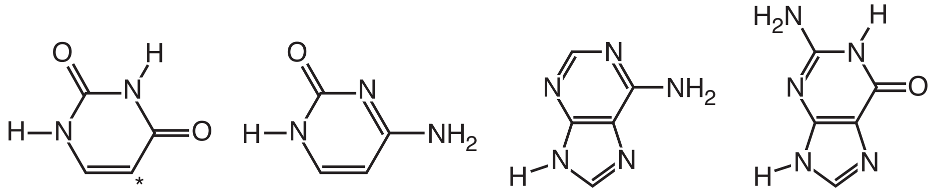
Characteristic infrared absorptions in organic molecules

Bond	Location	Wavenumber/cm^{-1}
C–H	Alkanes	2850–2950
	Alkenes, arenes	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	1720–1740
	Ketones	1705–1725
	Carboxylic acids	1700–1725
	Esters	1735–1750
	Amides	1630–1700
	Acyl chlorides and acid anhydrides	1750–1820
C–O	Alcohols, ethers, esters and carboxylic acids	1000–1300
C≡N	Nitriles	2220–2260
C–X	Fluoroalkanes	1000–1350
	Chloroalkanes	600–800
	Bromoalkanes	500–600
O–H	Alcohols, phenols	3200–3600 (broad)
	Carboxylic acids	2500–3300 (broad)
N–H	Primary amines	3300–3500
	Amides	*ca*. 3500

Monomers of DNA and RNA



phosphate **ribose** **deoxyribose**



uracil **cytosine** **adenine** **guanine**

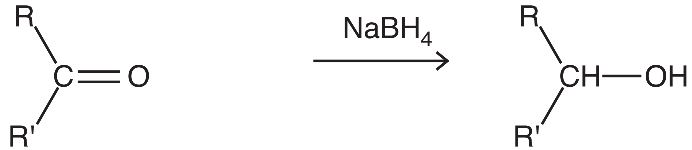
(thymine has a CH_3 at position *)

Some useful organic reactions

1 R–Br + CN^- ⟶ R–CN + Br^-

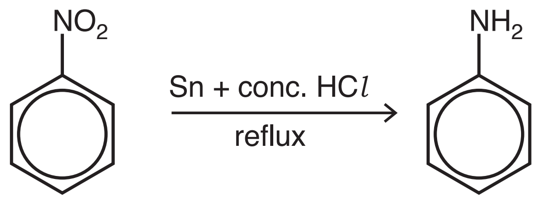
2 R–CN $\xrightarrow[\text{reflux}]{H^+\text{(aq)}}$ R–COOH

3

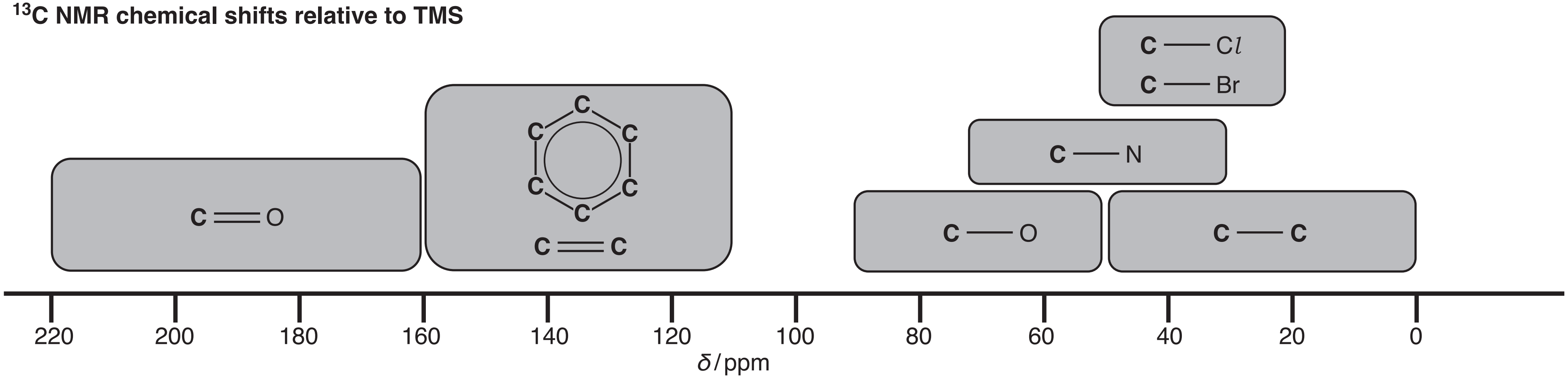


4 R–COOH + $SOCl_2$ ⟶ R–COC*l* + SO_2 + HC*l*

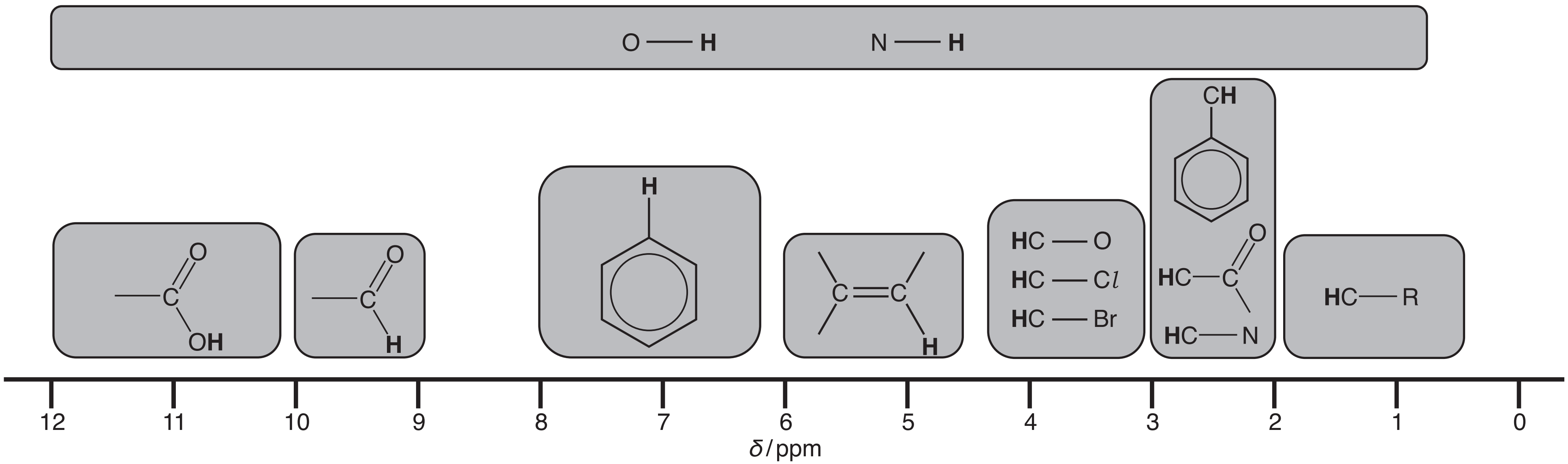
5



^{13}C NMR chemical shifts relative to TMS



^{1}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.
O**H** and N**H** chemical shifts are very variable and are often broad. Signals are not usually seen as split peaks.
Note that C**H** bonded to 'shifting groups' on either side, e.g. O–C**H**$_2$–C=O, may be shifted more than indicated above.

The Periodic Table of the Elements

Key
atomic number
Symbol
name
relative atomic mass

(1) 1	(2) 2	3	4	5	6	7	8	9	10	11	12	(3) 13	(4) 14	(5) 15	(6) 16	(7) 17	(0) 18
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	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
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	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
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	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
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	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

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