



# **Data Sheet for Chemistry A**

**(version 2.0)**

GCE Advanced Level and Advanced Subsidiary

**Chemistry A (H034, H434)**

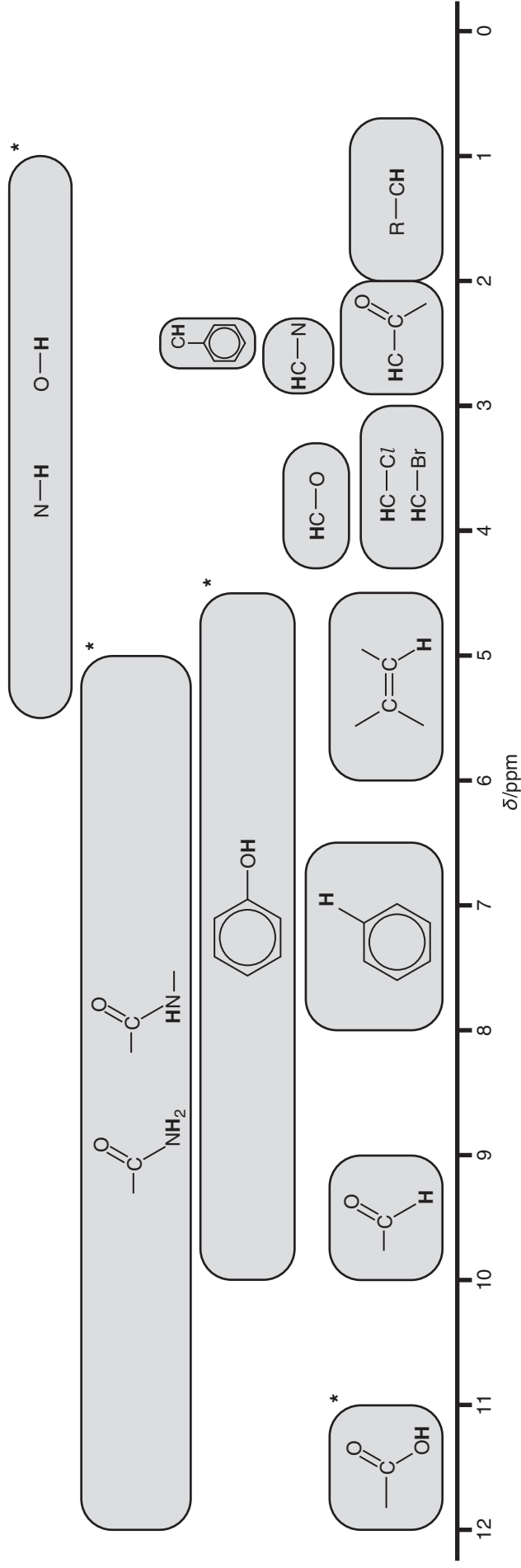
Chemistry A units F321–F326

The information in this sheet is for the use of candidates following Chemistry A (H034 and H434).

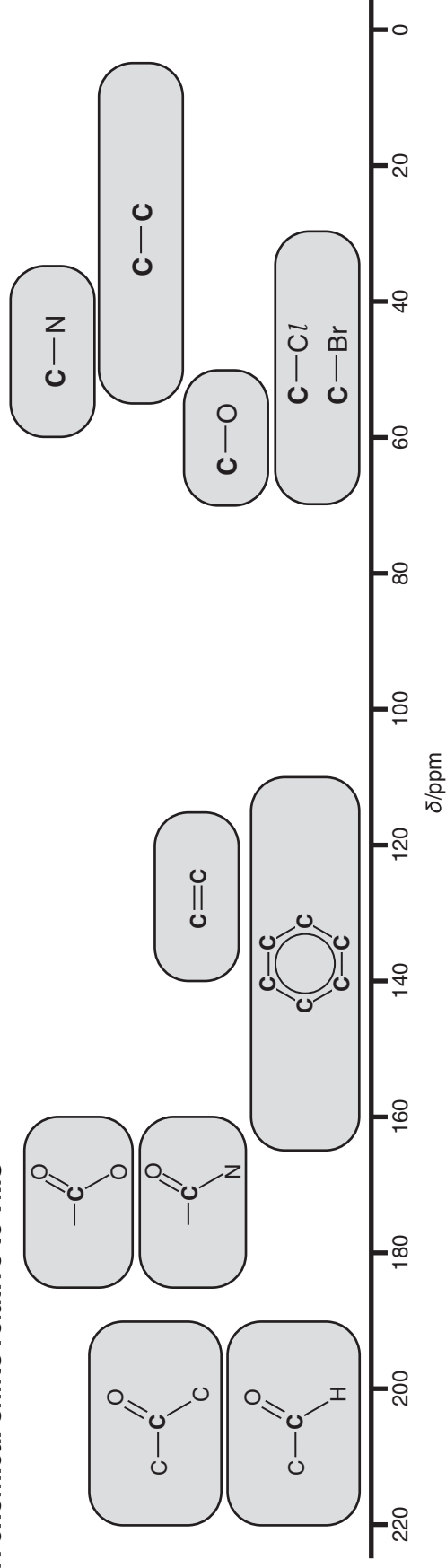
Clean copies of this sheet must be issued to candidates in the examination room, and must be given up to the invigilator at the end of the examination.

Copies of this sheet may be used for teaching.

## <sup>1</sup>H NMR chemical shifts relative to TMS



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



Chemical shifts are typical values and can vary slightly depending on the solvent, concentration and substituents.

\*OH and NH chemical shifts are very variable (sometimes outside these limits) and are often broad. Signals are not usually seen as split peaks.

# The Periodic Table of the Elements

|  | 1                                    | 2                                    | 3   | 4  | 5  | 6                                       | 7                                      | 0                                     |   |   |  |   |   |                                      |  |                                       |   |                                    |
|--|--------------------------------------|--------------------------------------|---|--|--|---|--|---------------------------------------|---|---|--|---|---|--------------------------------------|--|---------------------------------------|---|------------------------------------|
|  | 6.9<br><b>Li</b><br>lithium<br>3     | 9.0<br><b>Be</b><br>beryllium<br>4   | <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">                     1.0<br/><b>H</b><br/>hydrogen<br/>1                 </div>   |  |  |   |  | 10.8<br><b>B</b><br>boron<br>5        | 12.0<br><b>C</b><br>carbon<br>6         | 14.0<br><b>N</b><br>nitrogen<br>7         | 16.0<br><b>O</b><br>oxygen<br>8          | 19.0<br><b>F</b><br>fluorine<br>9   | 4.0<br><b>He</b><br>helium<br>2         |                                      |  |                                       |   |                                    |
|  | 23.0<br><b>Na</b><br>sodium<br>11    | 24.3<br><b>Mg</b><br>magnesium<br>12 | <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <b>Key</b><br/>                     relative atomic mass<br/>                     atomic symbol<br/>                     name<br/>                     atomic (proton) number                 </div> |  |  |   |  | 27.0<br><b>Al</b><br>aluminium<br>13  | 28.1<br><b>Si</b><br>silicon<br>14      | 31.0<br><b>P</b><br>phosphorus<br>15      | 32.1<br><b>S</b><br>sulfur<br>16         | 35.5<br><b>Cl</b><br>chlorine<br>17   | 20.2<br><b>Ne</b><br>neon<br>10         |                                      |  |                                       |   |                                    |
|  | 39.1<br><b>K</b><br>potassium<br>19  | 40.1<br><b>Ca</b><br>calcium<br>20   | 45.0<br><b>Sc</b><br>scandium<br>21   | 47.9<br><b>Ti</b><br>titanium<br>22        | 50.9<br><b>V</b><br>vanadium<br>23       | 52.0<br><b>Cr</b><br>chromium<br>24     | 54.9<br><b>Mn</b><br>manganese<br>25   | 55.8<br><b>Fe</b><br>iron<br>26       | 58.9<br><b>Co</b><br>cobalt<br>27       | 58.7<br><b>Ni</b><br>nickel<br>28         | 63.5<br><b>Cu</b><br>copper<br>29        | 65.4<br><b>Zn</b><br>zinc<br>30   | 69.7<br><b>Ga</b><br>gallium<br>31      | 72.6<br><b>Ge</b><br>germanium<br>32 | 74.9<br><b>As</b><br>arsenic<br>33       | 79.0<br><b>Se</b><br>selenium<br>34   | 79.9<br><b>Br</b><br>bromine<br>35      | 83.8<br><b>Kr</b><br>krypton<br>36 |
|  | 85.5<br><b>Rb</b><br>rubidium<br>37  | 87.6<br><b>Sr</b><br>strontium<br>38 | 88.9<br><b>Y</b><br>yttrium<br>39   | 91.2<br><b>Zr</b><br>zirconium<br>40       | 92.9<br><b>Nb</b><br>niobium<br>41       | 95.9<br><b>Mo</b><br>molybdenum<br>42   | [98]<br><b>Tc</b><br>technetium<br>43  | 101.1<br><b>Ru</b><br>ruthenium<br>44 | 102.9<br><b>Rh</b><br>rhodium<br>45     | 106.4<br><b>Pd</b><br>palladium<br>46     | 107.9<br><b>Ag</b><br>silver<br>47       | 112.4<br><b>Cd</b><br>cadmium<br>48   | 114.8<br><b>In</b><br>indium<br>49      | 118.7<br><b>Sn</b><br>tin<br>50      | 121.8<br><b>Sb</b><br>antimony<br>51     | 127.6<br><b>Te</b><br>tellurium<br>52 | 126.9<br><b>I</b><br>iodine<br>53       | 131.3<br><b>Xe</b><br>xenon<br>54  |
|  | 132.9<br><b>Cs</b><br>caesium<br>55  | 137.3<br><b>Ba</b><br>barium<br>56   | 138.9<br><b>La*</b><br>lanthanum<br>57  | 178.5<br><b>Hf</b><br>hafnium<br>72        | 180.9<br><b>Ta</b><br>tantalum<br>73     | 183.8<br><b>W</b><br>tungsten<br>74     | 186.2<br><b>Re</b><br>rhenium<br>75    | 190.2<br><b>Os</b><br>osmium<br>76    | 192.2<br><b>Ir</b><br>iridium<br>77     | 195.1<br><b>Pt</b><br>platinum<br>78      | 197.0<br><b>Au</b><br>gold<br>79         | 200.6<br><b>Hg</b><br>mercury<br>80   | 204.4<br><b>Tl</b><br>thallium<br>81    | 207.2<br><b>Pb</b><br>lead<br>82     | 209.0<br><b>Bi</b><br>bismuth<br>83      | [209]<br><b>Po</b><br>polonium<br>84  | [210]<br><b>At</b><br>astatine<br>85    | [222]<br><b>Rn</b><br>radon<br>86  |
|  | [223]<br><b>Fr</b><br>francium<br>87 | [226]<br><b>Ra</b><br>radium<br>88   | [227]<br><b>Ac*</b><br>actinium<br>89   | [261]<br><b>Rf</b><br>rutherfordium<br>104 | [262]<br><b>Db</b><br>dubnium<br>105     | [266]<br><b>Sg</b><br>seaborgium<br>106 | [264]<br><b>Bh</b><br>bohrium<br>107   | [277]<br><b>Hs</b><br>hassium<br>108  | [268]<br><b>Mt</b><br>meitnerium<br>109 | [271]<br><b>Ds</b><br>darmstadtium<br>110 | [272]<br><b>Rg</b><br>roentgenium<br>111 | Elements with atomic numbers 112–116 have been reported but not fully authenticated |   |                                      |  |                                       |   |                                    |
|  |                                      |                                      |   | 140.1<br><b>Ce</b><br>cerium<br>58         | 140.9<br><b>Pr</b><br>praseodymium<br>59 | 144.2<br><b>Nd</b><br>neodymium<br>60   | 144.9<br><b>Pm</b><br>promethium<br>61 | 150.4<br><b>Sm</b><br>samarium<br>62  | 152.0<br><b>Eu</b><br>europium<br>63    | 157.2<br><b>Gd</b><br>gadolinium<br>64    | 158.9<br><b>Tb</b><br>terbium<br>65      | 162.5<br><b>Dy</b><br>dysprosium<br>66  | 164.9<br><b>Ho</b><br>holmium<br>67     | 167.3<br><b>Er</b><br>erbium<br>68   | 168.9<br><b>Tm</b><br>thulium<br>69      | 173.0<br><b>Yb</b><br>ytterbium<br>70 | 175.0<br><b>Lu</b><br>lutetium<br>71    |                                    |
|  |                                      |                                      |   | 232.0<br><b>Th</b><br>thorium<br>90        | [231]<br><b>Pa</b><br>protactinium<br>91 | 238.1<br><b>U</b><br>uranium<br>92      | [237]<br><b>Np</b><br>neptunium<br>93  | [242]<br><b>Pu</b><br>plutonium<br>94 | [243]<br><b>Am</b><br>americium<br>95   | [247]<br><b>Cm</b><br>curium<br>96        | [245]<br><b>Bk</b><br>berkelium<br>97    | [251]<br><b>Cf</b><br>californium<br>98   | [254]<br><b>Es</b><br>einsteinium<br>99 | [253]<br><b>Fm</b><br>fermium<br>100 | [256]<br><b>Md</b><br>mendelevium<br>101 | [254]<br><b>No</b><br>nobelium<br>102 | [257]<br><b>Lr</b><br>lawrencium<br>103 |                                    |

## General Information

- 1 mol of gas molecules occupies  $24.0 \text{ dm}^3$  at room temperature and pressure, RTP.
- Avogadro constant,  $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ .
- Ionic product of water,  $K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ .

## Characteristic infrared absorptions in organic molecules

| bond | location   | wavenumber/ $\text{cm}^{-1}$ |
|------|--|------------------------------|
| C—O  | alcohols, esters, carboxylic acids                   | 1000–1300                    |
| C=O  | aldehydes, ketones, carboxylic acids, esters, amides | 1640–1750                    |
| C—H  | organic compound with a C—H bond                     | 2850–3100                    |
| O—H  | carboxylic acids                                     | 2500–3300 (very broad)       |
| N—H  | amines, amides                                       | 3200–3500                    |
| O—H  | alcohols, phenols                                    | 3200–3550 (broad)            |



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