



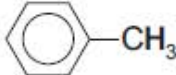
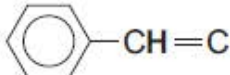
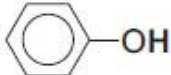
## WJEC Eduqas A LEVEL in CHEMISTRY

### Data Booklet

#### Infrared absorption values


| Bond                  | Wavenumber (cm <sup>-1</sup> ) |
|-----------------------|--------------------------------|
| C—Br                  | 500 to 600                     |
| C—Cl                  | 650 to 800                     |
| C—O                   | 1000 to 1300                   |
| C=C                   | 1620 to 1670                   |
| C=O                   | 1650 to 1750                   |
| C≡N                   | 2100 to 2250                   |
| C—H                   | 2800 to 3100                   |
| O—H (carboxylic acid) | 2500 to 3200 (very broad)      |
| O—H (alcohol/ phenol) | 3200 to 3550 (broad)           |
| N—H                   | 3300 to 3500                   |

<sup>1</sup>H NMR chemical shifts relative to TMS = 0

| Type of proton  | Chemical shift, $\delta$ (ppm) |
|---|--------------------------------|
| $-\text{CH}_3$  | 0.1 to 2.0                     |
| $\text{R}-\text{CH}_3$  | 0.9                            |
| $\text{R}-\text{CH}_2-\text{R}$   | 1.3                            |
| $\text{CH}_3-\text{C}\equiv\text{N}$  | 2.0                            |
| $\text{CH}_3-\text{C}(=\text{O})$   | 2.0 to 2.5                     |
| $-\text{CH}_2-\text{C}(=\text{O})$  | 2.0 to 3.0                     |
|   | 2.2 to 2.3                     |
| $\text{R}-\text{CH}_2\text{Cl}$   | 3.3 to 4.3                     |
| $\text{R}-\text{OH}$  | 4.5 *                          |
| $-\text{C}=\text{CH}-\text{CO}$   | 5.8 to 6.5                     |
|  | 6.5 to 7.5                     |
|  | 7.0 *                          |
| $\text{R}-\text{C}(=\text{O})\text{H}$  | 9.8 *                          |
| $\text{R}-\text{C}(=\text{O})\text{OH}$   | 11.0 *                         |

\*variable figure dependent on concentration and solvent

<sup>13</sup>C NMR chemical shifts relative to TMS = 0

| Type of carbon   | Chemical shift, $\delta$ (ppm) |
|--|--------------------------------|
| $\begin{array}{c}   \quad   \\ -\text{C} - \text{C}- \\   \quad   \end{array}$                           | 5 to 40                        |
| $\begin{array}{c}   \\ \text{R}-\text{C}-\text{Cl} \\   \end{array}$                                     | 10 to 70                       |
| $\begin{array}{c}   \\ \text{R}-\text{C}-\text{C}- \\    \quad   \\ \text{O} \end{array}$                | 20 to 50                       |
| $\begin{array}{c}   \\ \text{R}-\text{C}-\text{N} \diagup \diagdown \\   \end{array}$                    | 25 to 60                       |
| $\begin{array}{c}   \\ -\text{C}-\text{O}- \\   \end{array}$   | 50 to 90                       |
| $\begin{array}{c} \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \end{array}$ | 90 to 150                      |
| $\text{R}-\text{C} \equiv \text{N}$  | 110 to 125                     |
|                       | 110 to 160                     |
| $\begin{array}{c} \text{R}-\text{C}- \text{(carboxylic acid / ester)} \\    \\ \text{O} \end{array}$     | 160 to 185                     |
| $\begin{array}{c} \text{R}-\text{C}- \text{(aldehyde / ketone)} \\    \\ \text{O} \end{array}$           | 190 to 220                     |

# THE PERIODIC TABLE

Period  
 1 2 3 4 5 6 7 0

s Block

|   |                               |                               |                               |                               |                             |                                |                                |                              |                            |                              |                            |                            |                               |                               |                               |                               |                            |
|---|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------------------|--------------------------------|--------------------------------|------------------------------|----------------------------|------------------------------|----------------------------|----------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|----------------------------|
| 1 | 1.01<br>H<br>Hydrogen<br>1    |                               |                               |                               |                             |                                |                                |                              |                            |                              |                            | 4.00<br>He<br>Helium<br>2  |                               |                               |                               |                               |                            |
| 2 | 6.94<br>Li<br>Lithium<br>3    | 9.01<br>Be<br>Beryllium<br>4  |                               |                               |                             |                                |                                |                              |                            |                              |                            |                            | 20.2<br>Ne<br>Neon<br>10      |                               |                               |                               |                            |
| 3 | 23.0<br>Na<br>Sodium<br>11    | 24.3<br>Mg<br>Magnesium<br>12 |                               |                               |                             |                                |                                |                              |                            |                              |                            |                            | 35.5<br>Cl<br>Chlorine<br>17  |                               |                               |                               |                            |
| 4 | 39.1<br>K<br>Potassium<br>19  | 40.1<br>Ca<br>Calcium<br>20   | 45.0<br>Sc<br>Scandium<br>21  | 47.9<br>Ti<br>Titanium<br>22  | 50.9<br>V<br>Vanadium<br>23 | 52.0<br>Cr<br>Chromium<br>24   | 54.9<br>Mn<br>Manganese<br>25  | 55.8<br>Fe<br>Iron<br>26     | 58.9<br>Co<br>Cobalt<br>27 | 58.7<br>Ni<br>Nickel<br>28   | 63.5<br>Cu<br>Copper<br>29 | 65.4<br>Zn<br>Zinc<br>30   | 72.6<br>Ge<br>Germanium<br>32 | 74.9<br>As<br>Arsenic<br>33   | 79.0<br>Se<br>Selenium<br>34  | 83.8<br>Kr<br>Krypton<br>36   |                            |
| 5 | 85.5<br>Rb<br>Rubidium<br>37  | 87.6<br>Sr<br>Strontium<br>38 | 88.9<br>Y<br>Yttrium<br>39    | 91.2<br>Zr<br>Zirconium<br>40 | 92.9<br>Nb<br>Niobium<br>41 | 95.9<br>Mo<br>Molybdenum<br>42 | 98.9<br>Tc<br>Technetium<br>43 | 101<br>Ru<br>Ruthenium<br>44 | 103<br>Rh<br>Rhodium<br>45 | 106<br>Pd<br>Palladium<br>46 | 108<br>Ag<br>Silver<br>47  | 112<br>Cd<br>Cadmium<br>48 | 119<br>Sn<br>Tin<br>50        | 122<br>Sb<br>Antimony<br>51   | 128<br>Te<br>Tellurium<br>52  | 131<br>Xe<br>Xenon<br>54      |                            |
| 6 | 133<br>Cs<br>Caesium<br>55    | 137<br>Ba<br>Barium<br>56     | 139<br>La<br>Lanthanum<br>57  | 179<br>Hf<br>Hafnium<br>72    | 181<br>Ta<br>Tantalum<br>73 | 184<br>W<br>Tungsten<br>74     | 186<br>Re<br>Rhenium<br>75     | 190<br>Os<br>Osmium<br>76    | 192<br>Ir<br>Iridium<br>77 | 195<br>Pt<br>Platinum<br>78  | 197<br>Au<br>Gold<br>79    | 201<br>Hg<br>Mercury<br>80 | 204<br>Tl<br>Thallium<br>81   | 207<br>Pb<br>Lead<br>82       | (210)<br>Po<br>Polonium<br>84 | (210)<br>At<br>Astatine<br>85 | (222)<br>Rn<br>Radon<br>86 |
| 7 | (223)<br>Fr<br>Francium<br>87 | (226)<br>Ra<br>Radium<br>88   | (227)<br>Ac<br>Actinium<br>89 |                               |                             |                                |                                |                              |                            |                              |                            |                            |                               | (227)<br>Fr<br>Francium<br>87 |                               |                               |                            |

**Key**

|                |                      |
|----------------|----------------------|
| A <sub>r</sub> | relative atomic mass |
| Symbol         | atomic number        |
| Name           |                      |
| Z              |                      |

p Block

d Block

f Block

▶ Lanthanoid elements

▶▶ Actinoid elements

|                            |                                   |                              |                                |                                |                                |                               |                                |                                  |                                  |                               |                                   |                                |                                  |
|----------------------------|-----------------------------------|------------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|--------------------------------|----------------------------------|----------------------------------|-------------------------------|-----------------------------------|--------------------------------|----------------------------------|
| 140<br>Ce<br>Cerium<br>58  | 141<br>Pr<br>Praseodymium<br>59   | 144<br>Nd<br>Neodymium<br>60 | 147<br>Pm<br>Promethium<br>61  | 150<br>Sm<br>Samarium<br>62    | (153)<br>Eu<br>Europium<br>63  | 157<br>Gd<br>Gadolinium<br>64 | 159<br>Tb<br>Terbium<br>65     | 163<br>Dy<br>Dysprosium<br>66    | 165<br>Ho<br>Holmium<br>67       | 167<br>Er<br>Erbium<br>68     | 169<br>Tm<br>Thulium<br>69        | 173<br>Yb<br>Ytterbium<br>70   | 175<br>Lu<br>Lutetium<br>71      |
| 232<br>Th<br>Thorium<br>90 | (231)<br>Pa<br>Protactinium<br>91 | 238<br>U<br>Uranium<br>92    | (237)<br>Np<br>Neptunium<br>93 | (242)<br>Pu<br>Plutonium<br>94 | (243)<br>Am<br>Americium<br>95 | (247)<br>Cm<br>Curium<br>96   | (245)<br>Bk<br>Berkelium<br>97 | (251)<br>Cf<br>Californium<br>98 | (254)<br>Es<br>Einsteinium<br>99 | (253)<br>Fm<br>Fermium<br>100 | (256)<br>Md<br>Mendelevium<br>101 | (254)<br>No<br>Nobelium<br>102 | (257)<br>Lr<br>Lawrencium<br>103 |