



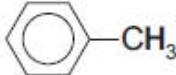
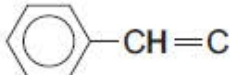
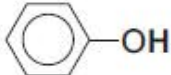
## WJEC Eduqas A LEVEL in CHEMISTRY

### 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

$^1\text{H}$  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

