



## **Data Sheet for Chemistry (Salters)**

**GCE Advanced level and Advanced Subsidiary**

**Chemistry (Salters) 3887, 7887**

**Chemistry units 2848–2855**

The information in this Sheet is for the use of candidates following Chemistry (Salters) 3887 or 7887.

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.

## The Periodic Table

Period	1	2	3	4	5	6	7	0
Group	1	2	3	4	5	6	7	0
1	6.9 <b>Li</b> <sub>3</sub> lithium	9.0 <b>Be</b> <sub>4</sub> beryllium	10.8 <b>B</b> <sub>5</sub> boron	12.0 <b>C</b> <sub>6</sub> carbon	14.0 <b>N</b> <sub>7</sub> nitrogen	16.0 <b>O</b> <sub>8</sub> oxygen	19.0 <b>F</b> <sub>9</sub> fluorine	20.2 <b>Ne</b> <sub>10</sub> neon
2	23.0 <b>Na</b> <sub>11</sub> sodium	24.3 <b>Mg</b> <sub>12</sub> magnesium	27.0 <b>Al</b> <sub>13</sub> aluminium	28.1 <b>Si</b> <sub>14</sub> silicon	31.0 <b>P</b> <sub>15</sub> phosphorus	32.1 <b>S</b> <sub>16</sub> sulphur	35.5 <b>Cl</b> <sub>17</sub> chlorine	39.9 <b>Ar</b> <sub>18</sub> argon
3	39.1 <b>K</b> <sub>19</sub> potassium	40.1 <b>Ca</b> <sub>20</sub> calcium	45.0 <b>Sc</b> <sub>21</sub> scandium	50.9 <b>V</b> <sub>23</sub> vanadium	54.9 <b>Mn</b> <sub>25</sub> manganese	55.9 <b>Fe</b> <sub>26</sub> iron	58.7 <b>Ni</b> <sub>28</sub> nickel	63.5 <b>Cu</b> <sub>29</sub> copper
4	85.5 <b>Rb</b> <sub>37</sub> rubidium	87.6 <b>Sr</b> <sub>38</sub> strontium	88.9 <b>Y</b> <sub>39</sub> yttrium	91.2 <b>Zr</b> <sub>40</sub> zirconium	95.9 <b>Mo</b> <sub>42</sub> molybdenum	101.1 <b>Ru</b> <sub>44</sub> ruthenium	106.4 <b>Pd</b> <sub>46</sub> palladium	107.9 <b>Ag</b> <sub>47</sub> silver
5	132.9 <b>Cs</b> <sub>55</sub> caesium	137.3 <b>Ba</b> <sub>56</sub> barium	138.9 <b>La</b> <sub>57</sub> lanthanum	178.5 <b>Hf</b> <sub>72</sub> hafnium	183.9 <b>W</b> <sub>74</sub> tungsten	190.2 <b>Os</b> <sub>76</sub> osmium	195.1 <b>Pt</b> <sub>78</sub> platinum	200.6 <b>Hg</b> <sub>80</sub> mercury
6	(223) <b>Fr</b> <sub>87</sub> francium	(226) <b>Ra</b> <sub>88</sub> radium	(227) <b>Ac</b> <sub>89</sub> actinium	(261) <b>Rf</b> <sub>104</sub> rutherfordium	(262) <b>Ta</b> <sub>73</sub> tantalum	(269) <b>Hs</b> <sub>108</sub> hassium	(269) <b>Ir</b> <sub>77</sub> iridium	197.0 <b>Au</b> <sub>79</sub> gold
7								

140.1 <b>Ce</b> <sub>58</sub> cerium	140.9 <b>Pr</b> <sub>59</sub> praseodymium	144.2 <b>Nd</b> <sub>60</sub> neodymium	(147) <b>Pm</b> <sub>61</sub> promethium	150.4 <b>Sm</b> <sub>62</sub> samarium	152.0 <b>Eu</b> <sub>63</sub> europium	157.3 <b>Gd</b> <sub>64</sub> gadolinium	158.9 <b>Tb</b> <sub>65</sub> terbium	162.5 <b>Dy</b> <sub>66</sub> dysprosium	164.9 <b>Ho</b> <sub>67</sub> holmium	167.3 <b>Er</b> <sub>68</sub> erbium	168.9 <b>Tm</b> <sub>69</sub> thulium	173.0 <b>Yb</b> <sub>70</sub> ytterbium	175.0 <b>Lu</b> <sub>71</sub> lutetium
232.0 <b>Th</b> <sub>90</sub> thorium	(231) <b>Pa</b> <sub>91</sub> protactinium	238.1 <b>U</b> <sub>92</sub> uranium	(237) <b>Np</b> <sub>93</sub> neptunium	(242) <b>Pu</b> <sub>94</sub> plutonium	(243) <b>Am</b> <sub>95</sub> americium	(247) <b>Cm</b> <sub>96</sub> curium	(245) <b>Bk</b> <sub>97</sub> berkelium	(251) <b>Cf</b> <sub>98</sub> californium	(254) <b>Es</b> <sub>99</sub> einsteinium	(253) <b>Fm</b> <sub>100</sub> fermium	(256) <b>Md</b> <sub>101</sub> mendelevium	(254) <b>No</b> <sub>102</sub> nobelium	(257) <b>Lr</b> <sub>103</sub> lawrencium

118 <b>Xe</b> <sub>54</sub> xenon	131.3 <b>Rn</b> <sub>86</sub> radon	(222) <b>Uuo</b> <sub>118</sub> ununoctium	(289) <b>Uuh</b> <sub>116</sub> ununhexium	(285) <b>Uuq</b> <sub>114</sub> ununquadium	(277) <b>Uub</b> <sub>112</sub> ununbium	(272) <b>Uuu</b> <sub>111</sub> unununium	(269) <b>Uun</b> <sub>110</sub> ununnilium	(268) <b>Mt</b> <sub>109</sub> meitnerium	(266) <b>Sg</b> <sub>106</sub> seaborgium	(264) <b>Bh</b> <sub>107</sub> bohrium	(262) <b>Db</b> <sub>105</sub> dubnium	(261) <b>Rf</b> <sub>104</sub> rutherfordium	(259) <b>Hs</b> <sub>108</sub> hassium	(258) <b>Mt</b> <sub>109</sub> meitnerium	(257) <b>Uub</b> <sub>112</sub> ununbium	(256) <b>Uuu</b> <sub>111</sub> unununium	(255) <b>Uuq</b> <sub>114</sub> ununquadium	(254) <b>Uuh</b> <sub>116</sub> ununhexium	(253) <b>Uuo</b> <sub>118</sub> ununoctium
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10.8 <b>B</b> <sub>5</sub> boron	12.0 <b>C</b> <sub>6</sub> carbon	14.0 <b>N</b> <sub>7</sub> nitrogen	16.0 <b>O</b> <sub>8</sub> oxygen	19.0 <b>F</b> <sub>9</sub> fluorine	20.2 <b>Ne</b> <sub>10</sub> neon
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27.0 <b>Al</b> <sub>13</sub> aluminium	28.1 <b>Si</b> <sub>14</sub> silicon	31.0 <b>P</b> <sub>15</sub> phosphorus	32.1 <b>S</b> <sub>16</sub> sulphur	35.5 <b>Cl</b> <sub>17</sub> chlorine	39.9 <b>Ar</b> <sub>18</sub> argon
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69.7 <b>Ga</b> <sub>31</sub> gallium	72.6 <b>Ge</b> <sub>32</sub> germanium	74.9 <b>As</b> <sub>33</sub> arsenic	79.0 <b>Se</b> <sub>34</sub> selenium	79.9 <b>Br</b> <sub>35</sub> bromine	83.8 <b>Kr</b> <sub>36</sub> krypton
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114.8 <b>In</b> <sub>49</sub> indium	118.7 <b>Sn</b> <sub>50</sub> tin	121.8 <b>Sb</b> <sub>51</sub> antimony	127.6 <b>Te</b> <sub>52</sub> tellurium	126.9 <b>I</b> <sub>53</sub> iodine	131.3 <b>Xe</b> <sub>54</sub> xenon
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204.4 <b>Tl</b> <sub>81</sub> thallium	207.2 <b>Pb</b> <sub>82</sub> lead	209.0 <b>Bi</b> <sub>83</sub> bismuth	(210) <b>Po</b> <sub>84</sub> polonium	(210) <b>At</b> <sub>85</sub> astatine	(222) <b>Rn</b> <sub>86</sub> radon
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118 <b>Xe</b> <sub>54</sub> xenon	131.3 <b>Rn</b> <sub>86</sub> radon	(222) <b></b>
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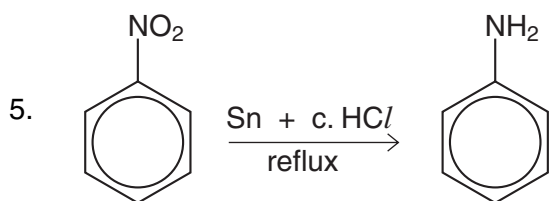
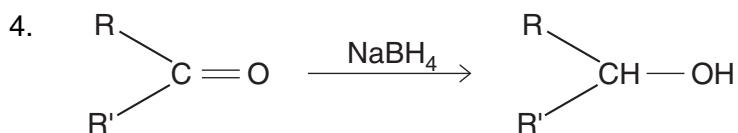
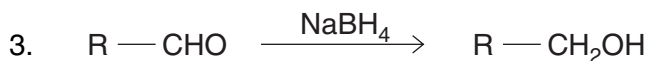
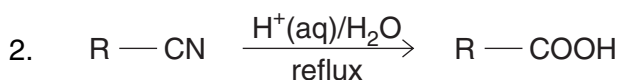
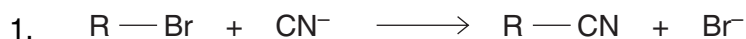
An entry in brackets indicates the mass number of the longest-lived isotope of an element with no stable isotopes.

## Characteristic i.r. absorptions in organic molecules

Bond	Location	Wavenumber/cm <sup>-1</sup>	Intensity
C—H	alkanes	2850–2950	M–S
	alkenes, arenes	3000–3100	M–S
	alkynes	ca 3300	S
C=C	alkenes	1620–1680	M
	arenes	several peaks in range 1450–1650	variable
C≡C	alkynes	2100–2260	M
C=O	aldehydes	1720–1740	S
	ketones	1705–1725	S
	carboxylic acids	1700–1725	S
	esters	1735–1750	S
	amides	1630–1700	M
C—O	alcohols, ethers, esters	1050–1300	S
C≡N	nitriles	2200–2260	M
C—F	fluoroalkanes	1000–1400	S
C—Cl	chloroalkanes	600–800	S
C—Br	bromoalkanes	500–600	S
O—H	alcohols, phenols	3600–3640	S
	* alcohols, phenols	3200–3600	S (broad)
	* carboxylic acids	2500–3200	M (broad)
N—H	primary amines	3300–3500	M–S
	amides	ca 3500	M

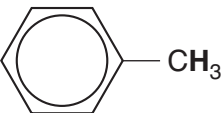
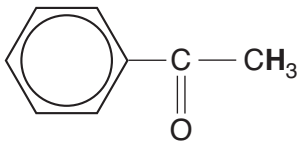
M Medium  
S Strong  
\* hydrogen-bonded

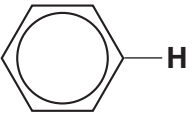
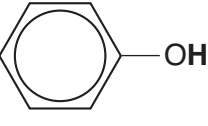
### Some useful organic reactions



## Chemical shifts for some type of protons ( $^1\text{H}$ ) in n.m.r. spectra

Chemical shifts are for hydrogen ( $^1\text{H}$ ) relative to TMS (tetramethylsilane).  
R represents an alkyl group.

Type of proton	Chemical shift ( $\delta$ ) in approximate region of
$\text{R}-\text{CH}_3$	0.8–1.2
$\text{R}-\text{CH}_2-\text{R}$	1.4
$\begin{array}{c} \text{R} \\   \\ \text{R}-\text{CH}-\text{R} \end{array}$	1.5
$\begin{array}{c}   \\ >\text{C}=\text{C}-\text{CH}_3 \end{array}$	1.6
$\begin{array}{c}   \\ >\text{C}=\text{C}-\text{CH}_2-\text{R} \end{array}$	2.3
	2.3
$\begin{array}{c} \text{R}-\text{C}-\text{CH}_3 \\    \\ \text{O} \end{array}$	2.2
$\begin{array}{c} \text{R}-\text{C}-\text{CH}_2-\text{R} \\    \\ \text{O} \end{array}$	2.4
	2.6
$\begin{array}{c} >\text{N}-\text{CH}_3 \\ \text{(amine)} \end{array}$	2.3
$\begin{array}{c} >\text{N}-\text{CH}_2-\text{R} \\ \text{(amine)} \end{array}$	2.5
$\begin{array}{c}   \\ \text{R}-\text{C}-\text{N}-\text{CH}_3 \\    \\ \text{O} \end{array} \text{ (amide)}$	2.9

Type of proton	Chemical shift ( $\delta$ ) in approximate region of
$-\text{O}-\text{CH}_3$ (alcohol)	3.3
$-\text{O}-\text{CH}_2-\text{R}$ (alcohol)	3.6
$\begin{array}{c} \text{R}-\text{C}-\text{O}-\text{CH}_3 \\    \\ \text{O} \end{array}$ (ester)	3.7
$\text{R}-\text{CH}_2-\text{Cl}$	3.6
$\text{R}-\text{CH}_2-\text{Br}$	3.5
$\text{R}-\text{CH}=\text{CH}-\text{R}$	4.5–6.0
$\begin{array}{c} \text{R}-\text{CH}=\text{CH}-\text{C}- \\    \\ \text{O} \end{array}$	6.0–8.0
	6.0–9.0
$\begin{array}{c} \text{R}-\text{C}=\text{O} \\   \\ \text{H} \end{array}$ (aldehyde)	10.0
$\text{R}-\text{OH}$	0.5–4.5*
	4.5–10.0*
$\text{R}-\text{NH}_2$ (amine)	0.5–6.0*
$\begin{array}{c} \text{R}-\text{C}-\text{NH}_2 \\    \\ \text{O} \end{array}$ (amide)	5–12*
$\begin{array}{c} \text{R}-\text{C}-\text{OH} \\    \\ \text{O} \end{array}$ (acid)	9–15*

\* Signals from hydrogens in  $-\text{OH}$  and  $-\text{NH}-$  groups in alcohols, phenols, carboxylic acids, amines and amides are very variable and often broad. The chemical shift is sensitive to temperature, nature of the solvent and the concentration. The stronger the hydrogen bonding the larger the chemical shift.

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