

# CHEMISTRY

## Written examination 1

### DATA SHEET

#### Directions to students

This data sheet is provided for your reference.

Make sure that you remove this data sheet from the centrefold during reading time.

Any writing, jottings, notes or drawings you make on this data sheet will **not** be considered in the marking.

At the end of the examination, make sure that you do **not** leave the data sheet in the centrefold of the question and answer book.

You may keep this data sheet.

**Physical constants**

$$F = 96\,500 \text{ C mol}^{-1}$$

$$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$1 \text{ atm} = 101\,325 \text{ Pa} = 760 \text{ mmHg}$$

$$0^\circ\text{C} = 273 \text{ K}$$

$$\text{Molar volume at STP} = 22.4 \text{ L mol}^{-1}$$

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

**Ideal gas equation**

$$pV = nRT$$

**The electrochemical series**

	$E^\circ$ in volt
$\text{F}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{F}^-(\text{aq})$	+2.87
$\text{H}_2\text{O}_2(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+1.77
$\text{Au}^+(\text{aq}) + \text{e}^- \rightarrow \text{Au}(\text{s})$	+1.68
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^-(\text{aq})$	+1.36
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+1.23
$\text{Br}_2(\text{l}) + 2\text{e}^- \rightarrow 2\text{Br}^-(\text{aq})$	+1.09
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.80
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+0.77
$\text{I}_2(\text{s}) + 2\text{e}^- \rightarrow 2\text{I}^-(\text{aq})$	+0.54
$\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \rightarrow 4\text{OH}^-(\text{aq})$	+0.40
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$	+0.34
$\text{S}(\text{s}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2\text{S}(\text{g})$	+0.14
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	0.00
$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Pb}(\text{s})$	-0.13
$\text{Sn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}(\text{s})$	-0.14
$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Ni}(\text{s})$	-0.23
$\text{Co}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Co}(\text{s})$	-0.28
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.44
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$	-0.76
$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$	-0.83
$\text{Mn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mn}(\text{s})$	-1.03
$\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Al}(\text{s})$	-1.67
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$	-2.34
$\text{Na}^+(\text{aq}) + \text{e}^- \rightarrow \text{Na}(\text{s})$	-2.71
$\text{Ca}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Ca}(\text{s})$	-2.87
$\text{K}^+(\text{aq}) + \text{e}^- \rightarrow \text{K}(\text{s})$	-2.93
$\text{Li}^+(\text{aq}) + \text{e}^- \rightarrow \text{Li}(\text{s})$	-3.02

## Periodic table of the elements

<b>1</b> <b>H</b> 1.0																	<b>2</b> <b>He</b> 4.0
<b>3</b> <b>Li</b> 6.9	<b>4</b> <b>Be</b> 9.0											<b>5</b> <b>B</b> 10.8	<b>6</b> <b>C</b> 12.0	<b>7</b> <b>N</b> 14.0	<b>8</b> <b>O</b> 16.0	<b>9</b> <b>F</b> 19.0	<b>10</b> <b>Ne</b> 20.1
<b>11</b> <b>Na</b> 23.0	<b>12</b> <b>Mg</b> 24.3											<b>13</b> <b>Al</b> 27.0	<b>14</b> <b>Si</b> 28.1	<b>15</b> <b>P</b> 31.0	<b>16</b> <b>S</b> 32.1	<b>17</b> <b>Cl</b> 35.5	<b>18</b> <b>Ar</b> 39.9
<b>19</b> <b>K</b> 39.1	<b>20</b> <b>Ca</b> 40.1	<b>21</b> <b>Sc</b> 44.9	<b>22</b> <b>Ti</b> 47.9	<b>23</b> <b>V</b> 50.9	<b>24</b> <b>Cr</b> 52.0	<b>25</b> <b>Mn</b> 54.9	<b>26</b> <b>Fe</b> 55.9	<b>27</b> <b>Co</b> 58.9	<b>28</b> <b>Ni</b> 58.7	<b>29</b> <b>Cu</b> 63.6	<b>30</b> <b>Zn</b> 65.4	<b>31</b> <b>Ga</b> 69.7	<b>32</b> <b>Ge</b> 72.6	<b>33</b> <b>As</b> 74.9	<b>34</b> <b>Se</b> 79.0	<b>35</b> <b>Br</b> 79.9	<b>36</b> <b>Kr</b> 83.8
<b>37</b> <b>Rb</b> 85.5	<b>38</b> <b>Sr</b> 87.6	<b>39</b> <b>Y</b> 88.9	<b>40</b> <b>Zr</b> 91.2	<b>41</b> <b>Nb</b> 92.9	<b>42</b> <b>Mo</b> 95.9	<b>43</b> <b>Tc</b> 98.1	<b>44</b> <b>Ru</b> 101.1	<b>45</b> <b>Rh</b> 102.9	<b>46</b> <b>Pd</b> 106.4	<b>47</b> <b>Ag</b> 107.9	<b>48</b> <b>Cd</b> 112.4	<b>49</b> <b>In</b> 114.8	<b>50</b> <b>Sn</b> 118.7	<b>51</b> <b>Sb</b> 121.8	<b>52</b> <b>Te</b> 127.6	<b>53</b> <b>I</b> 126.9	<b>54</b> <b>Xe</b> 131.3
<b>55</b> <b>Cs</b> 132.9	<b>56</b> <b>Ba</b> 137.3	<b>57</b> <b>La</b> 138.9	<b>72</b> <b>Hf</b> 178.5	<b>73</b> <b>Ta</b> 180.9	<b>74</b> <b>W</b> 183.8	<b>75</b> <b>Re</b> 186.2	<b>76</b> <b>Os</b> 190.2	<b>77</b> <b>Ir</b> 192.2	<b>78</b> <b>Pt</b> 197.0	<b>79</b> <b>Au</b> 197.0	<b>80</b> <b>Hg</b> 200.6	<b>81</b> <b>Tl</b> 204.4	<b>82</b> <b>Pb</b> 207.2	<b>83</b> <b>Bi</b> 209.0	<b>84</b> <b>Po</b> (209)	<b>85</b> <b>At</b> (210)	<b>86</b> <b>Rn</b> (222)
<b>87</b> <b>Fr</b> (223)	<b>88</b> <b>Ra</b> (226)	<b>89</b> <b>Ac</b> (227)	<b>104</b> <b>Rf</b> (261)	<b>105</b> <b>Db</b> (262)	<b>106</b> <b>Sg</b> (263)	<b>107</b> <b>Bh</b> (264)	<b>108</b> <b>Hs</b> (265)	<b>109</b> <b>Mt</b> (268)	<b>110</b> <b>Uun</b>	<b>111</b> <b>Uuu</b>	<b>112</b> <b>Uub</b>		<b>114</b> <b>Uuq</b>		<b>116</b> <b>Uuh</b>		<b>118</b> <b>Uuo</b>

<b>58</b> <b>Ce</b> 140.1	<b>59</b> <b>Pr</b> 140.9	<b>60</b> <b>Nd</b> 144.2	<b>61</b> <b>Pm</b> (145)	<b>62</b> <b>Sm</b> 150.3	<b>63</b> <b>Eu</b> 152.0	<b>64</b> <b>Gd</b> 157.2	<b>65</b> <b>Tb</b> 158.9	<b>66</b> <b>Dy</b> 162.5	<b>67</b> <b>Ho</b> 164.9	<b>68</b> <b>Er</b> 167.3	<b>69</b> <b>Tm</b> 168.9	<b>70</b> <b>Yb</b> 173.0	<b>71</b> <b>Lu</b> 175.0
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<b>90</b> <b>Th</b> 232.0	<b>91</b> <b>Pa</b> 231.0	<b>92</b> <b>U</b> 238.0	<b>93</b> <b>Np</b> 237.1	<b>94</b> <b>Pu</b> (244)	<b>95</b> <b>Am</b> (243)	<b>96</b> <b>Cm</b> (247)	<b>97</b> <b>Bk</b> (247)	<b>98</b> <b>Cf</b> (251)	<b>99</b> <b>Es</b> (254)	<b>100</b> <b>Fm</b> (257)	<b>101</b> <b>Md</b> (258)	<b>102</b> <b>No</b> (259)	<b>103</b> <b>Lr</b> (260)
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