

*Rewarding Learning*General Certificate of Secondary Education  
2017–2018

Centre Number

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Candidate Number

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# Double Award Science: Chemistry

Unit C1

Higher Tier

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| <b>MV18</b> |
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**[GSD22]****THURSDAY 17 MAY 2018, MORNING**

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**Time**

1 hour, plus your additional time allowance.

**Instructions to Candidates**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.****Do not write on blank pages.**

Complete in black ink only.

Answer **all seven** questions.**Information for Candidates**

The total mark for this paper is 70.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in

Question **2(b)**.A Data Leaflet, which includes a Periodic Table of the elements is provided.

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- 1** Read the passage about lithium and some of its uses. Then use this information along with your own knowledge and understanding to answer the questions that follow.

Lithium is a very light, soft Group 1 metal and is an excellent conductor of electricity. It can be extracted by electrolysis of molten lithium chloride. Lithium is used in making batteries for mobile phones and golf trolleys. Lithium–aluminium alloys are used in the manufacture of aircraft, bicycle frames and high speed trains.

- (a) (i)** What name is given to the Group 1 elements?  
[1 mark]

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- (ii)** How are lithium and the other Group 1 elements stored in the laboratory? [1 mark]

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- (b) (i)** What is meant by the term electrolysis? [2 marks]

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- (ii)** Write a half equation to show what happens at the cathode during the electrolysis of molten lithium chloride. [2 marks]

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(iii) Apart from lithium, what else is produced during the electrolysis of molten lithium chloride? [1 mark]

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(c) Why is lithium used in batteries for mobile phones and golf trolleys? [1 mark]

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(d) Give two main advantages of using lithium–aluminium alloys. [2 marks]

1. \_\_\_\_\_

2. \_\_\_\_\_

(e) Some people are concerned that we may run out of lithium. Suggest why this might be the case and how might the problem be reduced. [2 marks]

Reason why we might run out of lithium:

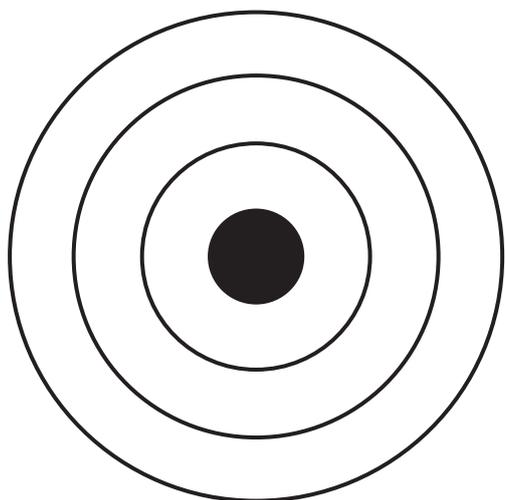
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How the problem might be reduced:

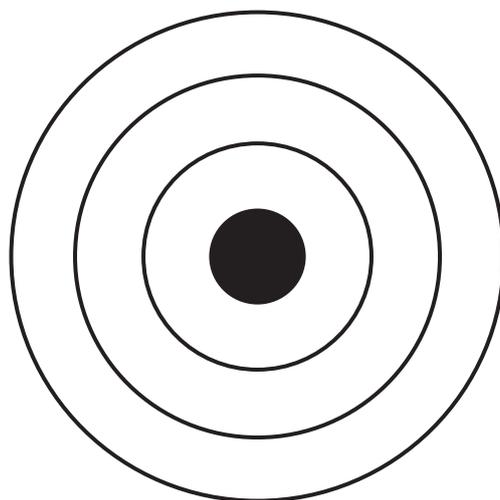
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2 Sodium reacts with sulfur to form a compound called sodium sulfide.

(a) Complete the diagrams below to show the electronic structures of: [2 marks]



a sodium **atom**



a sulfur **atom**

**(b) In this question you will be assessed on your written communication skills including the use of specialist scientific terms.**

Describe in words: [6 marks]

1. how the electronic structures of both the sodium atom and the sulfur atom change in order to form sodium sulfide. Your answer should include the charges on the ions formed, and the formula of the compound produced.

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2. at least two physical properties you would expect sodium sulfide to have.

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3 (a) What is a covalent bond? [1 mark]

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(b) In the space below draw a dot and cross diagram to show how covalent bonding occurs in a chlorine molecule,  $\text{Cl}_2$ . Show all the electrons. [3 marks]

(c) Complete the three sentences below by adding the missing words: [6 marks]

Covalent bonding is typical of \_\_\_\_\_ elements and compounds.

The term diatomic means that

there are \_\_\_\_\_ atoms

covalently bonded in a \_\_\_\_\_ .

Covalent bonds are \_\_\_\_\_ and

\_\_\_\_\_ amounts of

\_\_\_\_\_ are needed to break them.

(d) In the space below draw a dot and cross diagram to show the bonding in a nitrogen molecule,  $N_2$ . Show all the electrons.  
Label your diagram to identify a lone pair of electrons.  
[3 marks]

4 This question is about solubility.

(a) Complete the sentence below to define **solubility**.

[4 marks]

Solubility is the mass of \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

The table below gives information on whether or not some salts are soluble (S) or insoluble (I) in water.

| <b>cation</b> \ <b>anion</b> | <b>carbonate</b> | <b>chloride</b> | <b>nitrate</b> | <b>sulfate</b> |
|------------------------------|------------------|-----------------|----------------|----------------|
| sodium                       | S                | S               | S              | S              |
| lead                         | I                | I               | S              | I              |
| magnesium                    | I                | S               | S              | S              |
| ammonium                     | S                | S               | S              | S              |
| calcium                      | I                | S               | S              | S              |

(b) Use the information in the table to complete the sentences which follow:

(i) For the **cations**: [2 marks]

All \_\_\_\_\_

and \_\_\_\_\_ salts are soluble.

**(ii)** For the **anions**: [1 mark]

All chlorides are \_\_\_\_\_

except for \_\_\_\_\_ .

**(c)** Predict whether sodium bromide and zinc nitrate are soluble (S) or insoluble (I) in water. [2 marks]

sodium bromide \_\_\_\_\_

zinc nitrate \_\_\_\_\_

**(d)** A student mixed a colourless sodium chloride solution with a colourless lead nitrate solution. Why did the mixture turn white? [2 marks]

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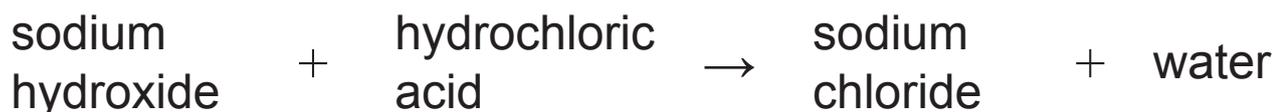
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- 5 (a) The table below gives information about the salts formed when four bases react with acids. Complete the table by filling in all the gaps. [4 marks]

| Base              | Acid              | Formula of cation in salt | Formula of anion in salt | Formula of salt produced |
|-------------------|-------------------|---------------------------|--------------------------|--------------------------|
| calcium hydroxide | hydrochloric acid |                           | $\text{Cl}^-$            | $\text{CaCl}_2$          |
|                   | sulfuric acid     | $\text{Cu}^{2+}$          |                          | $\text{CuSO}_4$          |
| magnesium oxide   |                   | $\text{Mg}^{2+}$          | $\text{Cl}^-$            |                          |
| sodium hydroxide  | nitric acid       |                           | $\text{NO}_3^-$          |                          |

- (b) A word equation is given below:



- (i) Use this equation to help write an **ionic** equation to show the formation of sodium chloride. [2 marks]
-

- (ii) The reaction between sodium hydroxide and hydrochloric acid can be described as a neutralisation. Write an ionic equation including state symbols for a neutralisation reaction. [3 marks]
-

- 6 The table below gives information about the physical properties of four substances A, B, C and D. Use the information to help you answer the questions which follow.

| Substance | Melting point/°C | Boiling point/°C | Electrical conductivity when solid | Electrical conductivity when molten |
|-----------|------------------|------------------|------------------------------------|-------------------------------------|
| A         | 808              | 1465             | poor                               | good                                |
| B         | 3650             | 4200             | good                               | good                                |
| C         | 660              | 2500             | good                               | good                                |
| D         | -182             | -161             | poor                               | poor                                |

- (a) Which substance A, B, C or D has a molecular covalent structure? Explain your choice. [2 marks]

Substance with a molecular covalent structure:

\_\_\_\_\_

Explanation:

\_\_\_\_\_  
\_\_\_\_\_

**(b)** Which substance A, B, C or D is made up of oppositely charged ions in a giant lattice structure? Explain your choice. [2 marks]

Substance made up of oppositely charged ions in a giant lattice structure:

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Explanation:

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**(c)** Which substance A, B, C or D could be graphite? Explain your choice. [2 marks]

Substance which could be graphite:

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Explanation:

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**(d)** Which substance A, B, C or D is a metal with a relatively low melting point? Explain your choice. [2 marks]

Substance which is a metal:

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Explanation:

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7 (a) When chlorine gas is bubbled into sodium iodide solution, it causes a chemical reaction which results in a colour change in the solution.

(i) Write a balanced symbol equation for this reaction.  
[3 marks]

\_\_\_\_\_

(ii) Describe the colour change in the solution.  
[2 marks]

The colour changes from \_\_\_\_\_  
to \_\_\_\_\_ .

(iii) The reaction is described as a displacement reaction.

Complete the sentence: [2 marks]

The reaction between chlorine and sodium iodide is described as a displacement reaction because

\_\_\_\_\_ is  
displacing \_\_\_\_\_ .

(b) When bromine is added to sodium iodide solution a similar reaction occurs to that of chlorine with sodium iodide solution.

Explain why **chlorine** and **bromine** react in similar ways. [2 marks]

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**THIS IS THE END OF THE QUESTION PAPER**

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**DO NOT WRITE ON THIS PAGE**

| For Examiner's use only |       |
|-------------------------|-------|
| Question Number         | Marks |
| 1                       |       |
| 2                       |       |
| 3                       |       |
| 4                       |       |
| 5                       |       |
| 6                       |       |
| 7                       |       |
| <b>Total Marks</b>      |       |

Examiner Number

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## SYMBOLS OF SELECTED IONS

### Positive ions

| Name          | Symbol           |
|---------------|------------------|
| Ammonium      | $\text{NH}_4^+$  |
| Chromium(III) | $\text{Cr}^{3+}$ |
| Copper(II)    | $\text{Cu}^{2+}$ |
| Iron(II)      | $\text{Fe}^{2+}$ |
| Iron(III)     | $\text{Fe}^{3+}$ |
| Lead(II)      | $\text{Pb}^{2+}$ |
| Silver        | $\text{Ag}^+$    |
| Zinc          | $\text{Zn}^{2+}$ |

### Negative ions

| Name               | Symbol                       |
|--------------------|------------------------------|
| Carbonate          | $\text{CO}_3^{2-}$           |
| Dichromate         | $\text{Cr}_2\text{O}_7^{2-}$ |
| Ethanoate          | $\text{CH}_3\text{COO}^-$    |
| Hydrogen carbonate | $\text{HCO}_3^-$             |
| Hydroxide          | $\text{OH}^-$                |
| Methanoate         | $\text{HCOO}^-$              |
| Nitrate            | $\text{NO}_3^-$              |
| Sulfate            | $\text{SO}_4^{2-}$           |
| Sulfite            | $\text{SO}_3^{2-}$           |

## DATA LEAFLET

For the use of candidates taking  
 Science: Chemistry,  
 Science: Double Award  
 or Science: Single Award

**Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.**

### SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

| Soluble   |
|---|
| All sodium, potassium and ammonium salts  |
| All nitrates  |
| Most chlorides, bromides and iodides<br>EXCEPT<br>silver and lead chlorides, bromides and iodides |
| Most sulfates<br>EXCEPT<br>lead and barium sulfates<br>Calcium sulfate is slightly soluble        |
| Insoluble   |
| Most carbonates<br>EXCEPT<br>sodium, potassium and ammonium carbonates                            |
| Most hydroxides<br>EXCEPT<br>sodium, potassium and ammonium hydroxides                            |
| Most oxides<br>EXCEPT<br>sodium, potassium and calcium oxides which react with water              |

| Contents                       | Page |
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| Periodic Table of the Elements | 2–3  |
| Symbols of Selected Ions       | 4    |
| Solubility of Common Salts     | 4    |

# gcse . science

chemistry  
 double award  
 single award



# THE PERIODIC TABLE OF ELEMENTS

## Group

|   |   |  |   |   |  |  |  |  |  |   |   |   |   |   |  |  |   |  |  |  |  |   |
|---|---|--|---|---|--|--|--|--|--|---|---|---|---|---|--|--|---|--|--|--|--|---|
|   |   |  |   |   |  |  |  |  |  |   |   |   |   |   |  |  | <b>0</b>                                |  |  |  |  |   |
| <b>1</b>                                  | <b>2</b>                                  |  |   |   |  |  |  |  |  |   |   | <b>3</b>                                  | <b>4</b>                                  | <b>5</b>                                  | <b>6</b>                                   | <b>7</b>                                   |   |  |  |  |  |   |
|   |   | <div style="display: flex; justify-content: center; align-items: center; height: 40px;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> <b>1</b><br/><b>H</b><br/>Hydrogen<br/>1         </div> </div> |   |   |  |  |  |  |  |   |   |   |   |   |  |  |   |  |  |  |  | <div style="display: flex; justify-content: center; align-items: center; height: 40px;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> <b>4</b><br/><b>He</b><br/>Helium<br/>2         </div> </div> |
| <b>7</b><br><b>Li</b><br>Lithium<br>3     | <b>9</b><br><b>Be</b><br>Beryllium<br>4   |  |   |   |  |  |  |  |  |   |   | <b>11</b><br><b>B</b><br>Boron<br>5       | <b>12</b><br><b>C</b><br>Carbon<br>6      | <b>14</b><br><b>N</b><br>Nitrogen<br>7    | <b>16</b><br><b>O</b><br>Oxygen<br>8       | <b>19</b><br><b>F</b><br>Fluorine<br>9     | <b>20</b><br><b>Ne</b><br>Neon<br>10    |  |  |  |  |   |
| <b>23</b><br><b>Na</b><br>Sodium<br>11    | <b>24</b><br><b>Mg</b><br>Magnesium<br>12 |  |   |   |  |  |  |  |  |   |   | <b>27</b><br><b>Al</b><br>Aluminium<br>13 | <b>28</b><br><b>Si</b><br>Silicon<br>14   | <b>31</b><br><b>P</b><br>Phosphorus<br>15 | <b>32</b><br><b>S</b><br>Sulfur<br>16      | <b>35.5</b><br><b>Cl</b><br>Chlorine<br>17 | <b>40</b><br><b>Ar</b><br>Argon<br>18   |  |  |  |  |   |
| <b>39</b><br><b>K</b><br>Potassium<br>19  | <b>40</b><br><b>Ca</b><br>Calcium<br>20   | <b>45</b><br><b>Sc</b><br>Scandium<br>21   | <b>48</b><br><b>Ti</b><br>Titanium<br>22        | <b>51</b><br><b>V</b><br>Vanadium<br>23   | <b>52</b><br><b>Cr</b><br>Chromium<br>24     | <b>55</b><br><b>Mn</b><br>Manganese<br>25  | <b>56</b><br><b>Fe</b><br>Iron<br>26       | <b>59</b><br><b>Co</b><br>Cobalt<br>27       | <b>59</b><br><b>Ni</b><br>Nickel<br>28         | <b>64</b><br><b>Cu</b><br>Copper<br>29        | <b>65</b><br><b>Zn</b><br>Zinc<br>30          | <b>70</b><br><b>Ga</b><br>Gallium<br>31   | <b>73</b><br><b>Ge</b><br>Germanium<br>32 | <b>75</b><br><b>As</b><br>Arsenic<br>33   | <b>79</b><br><b>Se</b><br>Selenium<br>34   | <b>80</b><br><b>Br</b><br>Bromine<br>35    | <b>84</b><br><b>Kr</b><br>Krypton<br>36 |  |  |  |  |   |
| <b>85</b><br><b>Rb</b><br>Rubidium<br>37  | <b>88</b><br><b>Sr</b><br>Strontium<br>38 | <b>89</b><br><b>Y</b><br>Yttrium<br>39   | <b>91</b><br><b>Zr</b><br>Zirconium<br>40       | <b>93</b><br><b>Nb</b><br>Niobium<br>41   | <b>96</b><br><b>Mo</b><br>Molybdenum<br>42   | <b>99</b><br><b>Tc</b><br>Technetium<br>43 | <b>101</b><br><b>Ru</b><br>Ruthenium<br>44 | <b>103</b><br><b>Rh</b><br>Rhodium<br>45     | <b>106</b><br><b>Pd</b><br>Palladium<br>46     | <b>108</b><br><b>Ag</b><br>Silver<br>47       | <b>112</b><br><b>Cd</b><br>Cadmium<br>48      | <b>115</b><br><b>In</b><br>Indium<br>49   | <b>119</b><br><b>Sn</b><br>Tin<br>50      | <b>122</b><br><b>Sb</b><br>Antimony<br>51 | <b>128</b><br><b>Te</b><br>Tellurium<br>52 | <b>127</b><br><b>I</b><br>Iodine<br>53     | <b>131</b><br><b>Xe</b><br>Xenon<br>54  |  |  |  |  |   |
| <b>133</b><br><b>Cs</b><br>Caesium<br>55  | <b>137</b><br><b>Ba</b><br>Barium<br>56   | <b>139</b><br><b>La</b> <sup>*</sup><br>Lanthanum<br>57  | <b>178</b><br><b>Hf</b><br>Hafnium<br>72        | <b>181</b><br><b>Ta</b><br>Tantalum<br>73 | <b>184</b><br><b>W</b><br>Tungsten<br>74     | <b>186</b><br><b>Re</b><br>Rhenium<br>75   | <b>190</b><br><b>Os</b><br>Osmium<br>76    | <b>192</b><br><b>Ir</b><br>Iridium<br>77     | <b>195</b><br><b>Pt</b><br>Platinum<br>78      | <b>197</b><br><b>Au</b><br>Gold<br>79         | <b>201</b><br><b>Hg</b><br>Mercury<br>80      | <b>204</b><br><b>Tl</b><br>Thallium<br>81 | <b>207</b><br><b>Pb</b><br>Lead<br>82     | <b>209</b><br><b>Bi</b><br>Bismuth<br>83  | <b>210</b><br><b>Po</b><br>Polonium<br>84  | <b>210</b><br><b>At</b><br>Astatine<br>85  | <b>222</b><br><b>Rn</b><br>Radon<br>86  |  |  |  |  |   |
| <b>223</b><br><b>Fr</b><br>Francium<br>87 | <b>226</b><br><b>Ra</b><br>Radium<br>88   | <b>227</b><br><b>Ac</b> <sup>†</sup><br>Actinium<br>89   | <b>261</b><br><b>Rf</b><br>Rutherfordium<br>104 | <b>262</b><br><b>Db</b><br>Dubnium<br>105 | <b>263</b><br><b>Sg</b><br>Seaborgium<br>106 | <b>262</b><br><b>Bh</b><br>Bohrium<br>107  | <b>265</b><br><b>Hs</b><br>Hassium<br>108  | <b>266</b><br><b>Mt</b><br>Meitnerium<br>109 | <b>269</b><br><b>Ds</b><br>Darmstadtium<br>110 | <b>272</b><br><b>Rg</b><br>Roentgenium<br>111 | <b>285</b><br><b>Cn</b><br>Copernicium<br>112 |   |   |   |  |  |   |  |  |  |  |   |

\* 58 – 71 Lanthanum series  
 † 90 – 103 Actinium series

a x  
b = relative atomic mass (approx)  
 x = atomic symbol  
 b = atomic number

|  |   |  |   |  |  |   |  |  |  |   |   |  |  |
|--|---|--|---|--|--|---|--|--|--|---|---|--|--|
| <b>140</b><br><b>Ce</b><br>Cerium<br>58  | <b>141</b><br><b>Pr</b><br>Praseodymium<br>59 | <b>144</b><br><b>Nd</b><br>Neodymium<br>60 | <b>147</b><br><b>Pm</b><br>Promethium<br>61 | <b>150</b><br><b>Sm</b><br>Samarium<br>62  | <b>152</b><br><b>Eu</b><br>Europium<br>63  | <b>157</b><br><b>Gd</b><br>Gadolinium<br>64 | <b>159</b><br><b>Tb</b><br>Terbium<br>65   | <b>162</b><br><b>Dy</b><br>Dysprosium<br>66  | <b>165</b><br><b>Ho</b><br>Holmium<br>67     | <b>167</b><br><b>Er</b><br>Erbium<br>68   | <b>169</b><br><b>Tm</b><br>Thulium<br>69      | <b>173</b><br><b>Yb</b><br>Ytterbium<br>70 | <b>175</b><br><b>Lu</b><br>Lutetium<br>71    |
| <b>232</b><br><b>Th</b><br>Thorium<br>90 | <b>231</b><br><b>Pa</b><br>Protactinium<br>91 | <b>238</b><br><b>U</b><br>Uranium<br>92    | <b>237</b><br><b>Np</b><br>Neptunium<br>93  | <b>242</b><br><b>Pu</b><br>Plutonium<br>94 | <b>243</b><br><b>Am</b><br>Americium<br>95 | <b>247</b><br><b>Cm</b><br>Curium<br>96     | <b>245</b><br><b>Bk</b><br>Berkelium<br>97 | <b>251</b><br><b>Cf</b><br>Californium<br>98 | <b>254</b><br><b>Es</b><br>Einsteinium<br>99 | <b>253</b><br><b>Fm</b><br>Fermium<br>100 | <b>256</b><br><b>Md</b><br>Mendelevium<br>101 | <b>254</b><br><b>No</b><br>Nobelium<br>102 | <b>257</b><br><b>Lr</b><br>Lawrencium<br>103 |