

# Structures and Bonding

## Giant Covalent Structures

### Worksheet

Combined Science - Chemistry - Key Stage 4

Mr Robbins



# Periodic Table of Elements

Key:

relative atomic mass → **1**

Atomic symbol ← **H**

Name → hydrogen

Atomic (proton number) ← **1**

<b>1</b> <b>H</b> hydrogen 1																	<b>4</b> <b>He</b> helium 2
<b>7</b> <b>Li</b> lithium 3	<b>9</b> <b>Be</b> beryllium 4											<b>11</b> <b>B</b> boron 5	<b>12</b> <b>C</b> carbon 6	<b>14</b> <b>N</b> nitrogen 7	<b>16</b> <b>O</b> oxygen 8	<b>19</b> <b>F</b> fluorine 9	<b>20</b> <b>Ne</b> neon 10
<b>23</b> <b>Na</b> sodium 11	<b>24</b> <b>Mg</b> magnesium 12											<b>27</b> <b>Al</b> aluminium 13	<b>28</b> <b>Si</b> silicon 14	<b>31</b> <b>P</b> phosphorus 15	<b>32</b> <b>S</b> sulfur 16	<b>35.5</b> <b>Cl</b> chlorine 17	<b>40</b> <b>Ar</b> argon 18
<b>39</b> <b>K</b> potassium 19	<b>40</b> <b>Ca</b> calcium 20	<b>45</b> <b>Sc</b> scandium 21	<b>48</b> <b>Ti</b> titanium 22	<b>51</b> <b>V</b> vanadium 23	<b>52</b> <b>Cr</b> chromium 24	<b>55</b> <b>Mn</b> manganese 25	<b>56</b> <b>Fe</b> iron 26	<b>59</b> <b>Co</b> cobalt 27	<b>59</b> <b>Ni</b> nickel 28	<b>63.5</b> <b>Cu</b> copper 29	<b>65</b> <b>Zn</b> zinc 30	<b>70</b> <b>Ga</b> gallium 31	<b>73</b> <b>Ge</b> germanium 32	<b>75</b> <b>As</b> arsenic 33	<b>79</b> <b>Se</b> selenium 34	<b>80</b> <b>Br</b> bromine 35	<b>84</b> <b>Kr</b> krypton 36
<b>85</b> <b>Rb</b> rubidium 37	<b>88</b> <b>Sr</b> strontium 38	<b>89</b> <b>Y</b> yttrium 39	<b>91</b> <b>Zr</b> zirconium 40	<b>93</b> <b>Nb</b> niobium 41	<b>96</b> <b>Mo</b> molybdenum 42	<b>[97]</b> <b>Tc</b> technetium 43	<b>101</b> <b>Ru</b> ruthenium 44	<b>103</b> <b>Rh</b> rhodium 45	<b>106</b> <b>Pd</b> palladium 46	<b>108</b> <b>Ag</b> silver 47	<b>112</b> <b>Cd</b> cadmium 48	<b>115</b> <b>In</b> indium 49	<b>119</b> <b>Sn</b> tin 50	<b>122</b> <b>Sb</b> antimony 51	<b>128</b> <b>Te</b> tellurium 52	<b>127</b> <b>I</b> iodine 53	<b>131</b> <b>Xe</b> xenon 54
<b>133</b> <b>Cs</b> caesium 55	<b>137</b> <b>Ba</b> barium 56	<b>139</b> <b>La*</b> lanthanum 57	<b>178</b> <b>Hf</b> hafnium 72	<b>181</b> <b>Ta</b> tantalum 73	<b>184</b> <b>W</b> tungsten 74	<b>186</b> <b>Re</b> rhenium 75	<b>190</b> <b>Os</b> osmium 76	<b>192</b> <b>Ir</b> iridium 77	<b>195</b> <b>Pt</b> platinum 78	<b>197</b> <b>Au</b> gold 79	<b>201</b> <b>Hg</b> mercury 80	<b>204</b> <b>Tl</b> thallium 81	<b>207</b> <b>Pb</b> lead 82	<b>209</b> <b>Bi</b> bismuth 83	<b>[209]</b> <b>Po</b> polonium 84	<b>[210]</b> <b>At</b> astatine 85	<b>[222]</b> <b>Rn</b> radon 86
<b>[223]</b> <b>Fr</b> francium 87	<b>[226]</b> <b>Ra</b> radium 88	<b>[227]</b> <b>Ac*</b> actinium 89	<b>[267]</b> <b>Rf</b> rutherfordium 104	<b>[270]</b> <b>Db</b> dubnium 105	<b>[269]</b> <b>Sg</b> seaborgium 106	<b>[270]</b> <b>Bh</b> bohrium 107	<b>[270]</b> <b>Hs</b> hassium 108	<b>[278]</b> <b>Mt</b> meitnerium 109	<b>[281]</b> <b>Ds</b> darmstadtium 110	<b>[281]</b> <b>Rg</b> roentgenium 111	<b>[285]</b> <b>Cn</b> copernicium 112	<b>[286]</b> <b>Nh</b> nihonium 113	<b>[289]</b> <b>Fl</b> flerovium 114	<b>[289]</b> <b>Mc</b> moscovium 115	<b>[293]</b> <b>Lv</b> livermorium 116	<b>[293]</b> <b>Ts</b> tennessine 117	<b>[294]</b> <b>Og</b> oganesson 118

\* The lanthanides (atomic numbers 58 - 71) and the Actinides (atomic numbers 90 - 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.



1. Silicon dioxide has a giant covalent structure. What would you expect its properties to be?
2. Silicon dioxide is used to make moulds for pouring liquid metal into. Explain why silicon dioxide is used for this.
3. Silicon carbide is a giant covalent substance. Explain why it has a high melting and boiling point.
4. Aluminium iodide has a giant structure. Will it have a giant **ionic** or **covalent** structure?
5. Explain your answer to 4.
6. A student has a sample of two substances. One has a giant ionic lattice and the other is giant covalent.
  - a. Why can the student not use their melting points to work out which is which?
  - b. How could the student work out which one is which?
  - c. What other differences are there between giant ionic and covalent structures.



7. In what ways are graphite and diamond similar?
8. State two differences between diamond and graphite
9. Explain why graphite can conduct electricity
10. What is the difference between an element and a compound?
11. A student has a sample of two substances. One is graphite and the other is sodium chloride:
  - A. Other than appearance, how could the student identify which is which?
  - B. In terms of charged particles, what is the difference in electrical conductivity between graphite and an ionic substance?
  - C. How can you tell from the elements sodium chloride is made of that it will be ionic?
  - D. Draw a dot and cross bonding diagram for sodium chloride
  - E. Explain why sodium chloride has a high melting and boiling point



# Answers

1. Hard, high melting and boiling point, not conduct electricity
2. High melting point
3. Strong covalent bonds between the atoms require lots of energy to break
4. Ionic
5. Aluminium loses electrons, iodine gains/ metal bonding to a non-metal
6.
  - a. They would both be high
  - b. Melt them/dissolve and see which conducts electricity
  - c. One is made of ions, the other of atoms
7. Made of carbon atoms, giant covalent structures
8. Graphite is in layers, is soft and conducts electricity
9. Delocalised electrons are free to move through the graphite
10. Element is only one type of atoms chemically bonded, compound is two or more
11.
  - a. See which conducts electricity when solid
  - b. Ionic substance conducts by the movement of ions, graphite by the movement of electrons
  - c. Sodium is a metal and chlorine is a non-metal
  - d. Sodium is 2,8 with a 1+ charge, chlorine is 2,8,8 with a 1- charge
  - e. Giant ionic lattice; strong ionic bonds formed from electrostatic force of attraction between oppositely charged ions, requires lots of energy to break



# Quick check

Giant covalent structures have high \_\_\_\_\_ and boiling points because the atoms are held together by \_\_\_\_\_ bonds in a \_\_\_\_\_ covalent lattice.

These need a lot of \_\_\_\_\_ to break so we need to \_\_\_\_\_ them to a high temperature.



# Independent task

1. Why do diamond and graphite have a high melting and boiling point?
2. Why is diamond hard?
3. Why is graphite soft?
4. Why can graphite conduct electricity?
5. Why does diamond not conduct electricity?



# Independent practice

Graphite is used in Lubricants. **Explain** why graphite is used this way. Include information about the structure and bonding of graphite in your answer.

- State the property of graphite
- State the structure of graphite
- Describe the number and type of bonds in graphite
- Explain why these bonds give graphite the right property

Keywords: soft, carbon, covalent bond, three, strong, layers, weak forces of attraction



# Independent practice

Graphite is used in Electrodes. **Explain** why graphite is used this way. Include information about the structure and bonding of graphite in your answer.

- State the property of graphite
- State the structure of graphite
- Describe the number and type of bonds in graphite
- Explain why these bonds give graphite the right property

Keywords: delocalised electrons, carbon, covalent bond, three, strong, layers, current, flow, conducts

