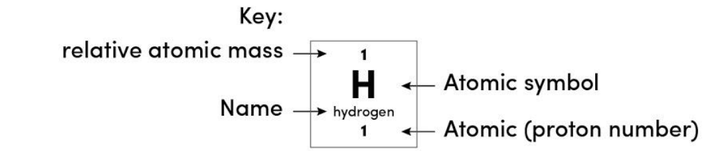
Structures and Bonding
Giant covalent structures: Graphene
Worksheet

Combined Science - Chemistry - Key Stage 4

Mr Robbins

Periodic Table of Elements



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

(i) The bonds between the atoms in graphene are .....**(1)**

(ii) Graphene is made of ..... atoms. **(1)**

(iii) In graphene each atom bonds to ..... other atoms. **(1)**

(b) This part of the question is about graphite. Graphite is used in pencils. Explain why **(2)**

2. Graphite is a non-metal. Explain why graphite conducts electricity. **(3)**

3. Lightweight handlebars for bicycles are made from materials containing carbon nanotubes. Carbon nanotubes are lightweight but very strong.

(a) Complete each sentence.

(i) Carbon nanotubes are similar to graphite because each carbon atom is joined to _____ other carbon atoms.

(ii) The carbon atoms are joined by _____ bonds

(iii) Carbon nanotubes are very strong because the _____ are hard to break

(b) An airplane contains many miles of electrical wiring made from copper. This adds to the mass of the airplane. It has been suggested that the electrical wiring made from copper could be replaced by lighter carbon nanotubes.

(i) What does the term ‘nano’ tell you about the carbon nanotubes? (1)

(ii) Like graphite, each carbon atom is joined to three other carbon atoms. Explain why the carbon nanotube can conduct electricity. (2)

Answers

1. (a)

   (i) covalent bonds

   (ii) carbon

   (iii) three

2. Graphite is made of layers. Between the layers there are delocalised electrons Which can flow.
3. (a)

   (i) three

   (ii) covalent

   (iii) covalent bonds

   (b)

   (i) they are very small

   (ii) They have delocalised electrons. Which can flow

Practice question

Carbon nanotubes are made from a single layer of graphite.
Carbon nanotubes have a high melting point, are good conductors and incredibly strong in tension
Use your knowledge of structures and bonding to explain these properties [3 marks]

Sentence starters:
Carbon nanotubes have a high melting point because.....
Carbon nanotubes are strong because...
Carbon nanotubes are good conductors of electricity becasue....

Practice question

Carbon nanotubes are made from a single layer of graphite. Carbon nanotubes have a high melting point, are good conductors and incredibly strong in tension
Use your knowledge of structures and bonding to explain these properties

[3 marks]

Answer

- Carbon nanotubes have a high melting point because they have **strong covalent bonds** which take a lot of **heat energy to break**
- Carbon nanotubes are are also very strong because of these strong **covalent bonds**
- Carbon nanotubes are good conductors of electricity because they have **delocalised electrons which are able to flow through the tube**