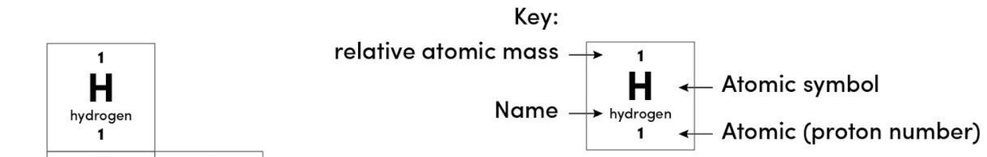
Structures and Bonding
Metallic Bonding
Worksheet

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. For each of the elements below, state which type of bond would be formed. The first two have been done for you.

Element 1	**Element 2**	**Type of bond**
Sodium	Sodium	Metallic
Carbon	Silicon	Covalent
Carbon	Carbon	
Oxygen	Lithium	
Silver	Fluorine	
Magnesium	Chlorine	
Magnesium	Calcium	
Beryllium	Nitrogen	
Phosphorous	Oxygen	

2. Explain how the particles are held together in a metal

3. Explain why metals have high melting and boiling points
4. Copper is used to make wires for household circuits. Give two reasons why.
5. Explain why graphite can conduct electricity
6. Explain why most covalent substances do not conduct electricity
7. State the conditions under which an ionic substance will conduct electricity
8. Define malleable
9. Explain why sodium atoms and potassium atoms cannot form ionic bonds
10. *Challenge: which of sodium or magnesium do you think has the highest melting point? Explain your answer.*
11. Explain how electricity is conducted in a metal. To gain full marks you must include a description of the structure and bonding of a metal. (4)
12. Describe how the structure of an alloy is different from the structure of a pure metal. (2)
13. Suggest one reason why coins are not made of pure copper. Do not give cost as a reason. (1)
14. Iron is used (as steel) to make the body panels for cars. Explain how the structure and bonding of iron:
    a. allows the body panels to conduct electricity;
    b. allows the body panels to be bent into shape;
    c. gives the body panels strength.

Answers

1. See right
2. Layers of positive metal ions with a sea of delocalised electrons held together by electrostatic interaction between positive ions and negative electrons
3. the electrostatic force between the delocalised electrons and metal ions is strong
4. It is malleable and conducts electricity
5. Delocalised electrons are free to move through the graphite
6. They do not have free ions or delocalised electrons to carry charge
7. (l) or (aq)
8. Easy to bend into shape
9. They both need to lose electrons
10. Magnesium, more electrons in the sea of delocalised and greater positive charge on the ion means greater strength of electrostatic attraction and more energy required to break
11. Layers of positive metal ions with a sea of delocalised electrons held together by electrostatic interaction between positive ions and negative electrons. Delocalised electrons can move through the metal and carry charge
12. It has different sized atoms which disturb the layers
13. They would be too soft/would corrode too easily
14. –
    a. Delocalised electrons free to move through the metal
    b. Malleable as layers can slide over each other
    c. Strong force of electrostatic attraction between metal ions and delocalised electrons

Sodium	Sodium	Metallic
Carbon	Silicon	Covalent
Carbon	Carbon	Covalent
Oxygen	Lithium	Ionic
Silver	Fluorine	Ionic
Magnesium	Chlorine	ionic
Magnesium	Calcium	Metallic
Beryllium	Nitrogen	Ionic
Phosphorous	Oxygen	Covalent

Independent practice

1. Metals are used to make a saxophone because they are….
2. Metals are used bridges because they are….
3. Metals are used in frying pans because they are…..
4. Metals are used in jewellery because they are…
5. Metals are used in electrical cables because they are….

Independent task

Metals bond by _____ bonding. Each atom donates the _____ in its outside shell forming an _____. The electrons are _____ which means they are able to move freely around. The metal ions and the delocalised electrons are attracted together by _____ attraction because they have _____ charges. The structure formed is a giant _____ lattice.

Independent task

1. Why are pure metals soft?
2. What happens when we make an alloy?
3. Why is an alloy harder than the pure metal?