Chemistry

# Cambridge University Examinations

General Certificate of Education Ordinary Level
O – LEVEL 5070. Notes, P1, P2 and P4

Teacher: - Mubashir Sulehri

*Chapter*

# *Chemical Bonding*

## Work Sheet
## Paper *1*

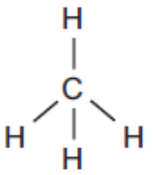

**Mubashir Sulehri**
03224307040

Lahore Grammar School
Roots International School
Lahore Learning Campus
Bloomfield Hall School

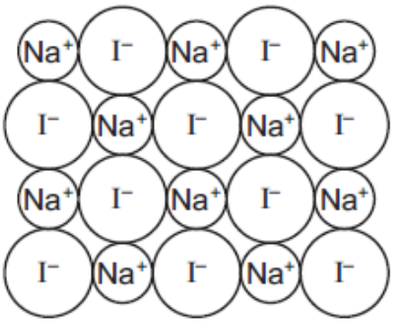
**WORKSHEET PAPER 2**

Chemical Bonding (Questions)

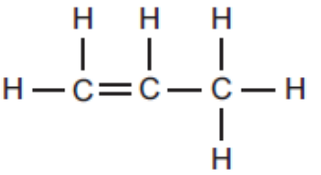
1 The structures of some substances are shown below.



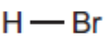

A



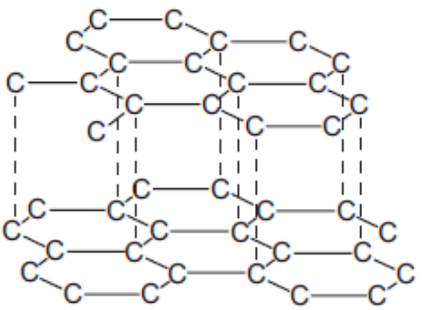

B




C




D



E

**(a)** Answer these questions using the letters **A**, **B**, **C**, **D** or **E**.

**(i)** Which structure is methane? ..... [1]

**(ii)** Which two structures are giant structures? ..... and ..... [1]

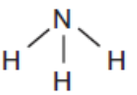
**(iii)** Which two structures are hydrocarbons? ..... and ..... [1]

**(iv)** Which structure contains ions? ..... [1]

**(v)** Which two structures have very high melting points?

..... and ..... [1]

2 The structure of the ammonia molecule is shown below.



**(i)** Write the simplest formula for ammonia.

**(ii)** Describe the type of bonding in a molecule of ammonia.

.....

**(iii)** Ammonia is a gas at room temperature.
Suggest why ammonia has a low boiling point.

.....

3 Draw a 'dot and cross' diagram to show the bonding in methane.
You only need to draw the outer (valence) electrons of carbon. [2]

4 Explain, in terms of metallic bonding, why iron is a good electrical conductor.

.....

.....

.....[2]

5 One of the reasons why copper is used in mobile phones is because it is a good conductor of electricity.

**(i)** Draw a labelled diagram to show the metallic bonding in copper.

[2]

**(ii)** Explain how copper conducts electricity.

.....

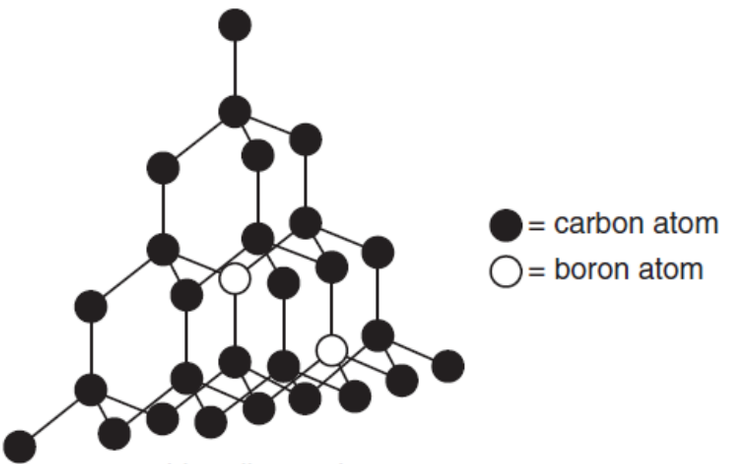
..... [1]

6 Explain why both carbon dioxide and methane are gases at room temperature.
Use ideas about structure and bonding.

.....

..... [1]

7 Blue diamonds are an impure form of carbon. Part of the structure of a blue diamond is shown below.




blue diamond

Blue diamonds have a high melting point and can conduct electricity.

**(a)** Explain, in terms of structure and bonding, why blue diamonds have a high melting point.

.....

.....

.....

.....[2]

**(b)** Normal diamonds are a pure form of carbon. They do not conduct electricity.

**(i)** Explain, in terms of structure and bonding, why normal diamonds do **not** conduct electricity.

.....

.....[1]

**(ii)** Suggest why blue diamonds can conduct electricity.

.....

.....[1]

**(c)** Graphite is another pure form of carbon. Suggest **two** reasons why graphite is often used as an electrode in electrolysis.

1 .....

2 .....[2]

8 Potassium fluoride is an ionic solid with a high melting point.

**(i)** Draw a 'dot and cross' diagram to show the bonding in potassium fluoride.
You only need to show the outer (valence) electrons.

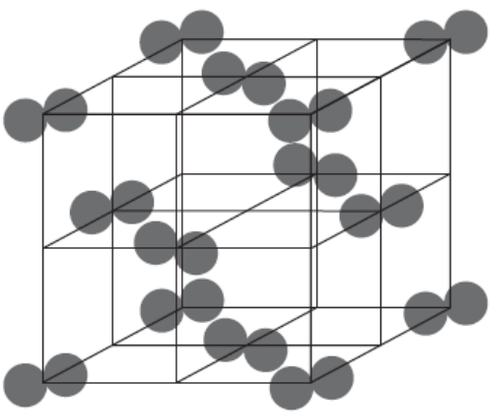
**(ii)** Explain why the melting point of potassium fluoride is very high.

.....

.....

[3]

9 Iodine forms a diatomic molecule, $I_2$.
It has a simple molecular structure.
The diagram shows the structure of the simple molecular lattice of iodine.



Each iodine molecule is held in place by weak intermolecular forces.
Within each iodine molecule the atoms are covalently bonded.

**(a)** Explain why solid iodine does not conduct electricity.

.....

..... [1]

**(b)** When heated, **solid** iodine turns directly into iodine **gas**.
Use the kinetic particle theory to explain this change of state.

.....

.....

.....

..... [2]

**(c)** Draw a 'dot-and-cross' diagram to show the bonding in an iodine molecule.
Show only the outer shell electrons.

[1]

10 Draw a 'dot-and-cross' diagram to show the bonding in a molecule of carbon dioxide.
Show only the outer shell electrons.

[1]

11 **(a)** **(i)** Draw a 'dot-and-cross' diagram for $Cl_2O$.

You only need to draw the outer shell electrons.

[1]

**(ii)** Explain, using ideas about structure and bonding, why $Cl_2O$ has a low melting point.

.....

.....

.....

..... [2]

**(b)** Draw diagrams to show the electronic structures and charges of both ions present in potassium oxide.

[2]

12 Solid sodium chloride and magnesium oxide have the same structure and bonding.

This is the structure of sodium chloride.


The table shows the melting point of these two compounds.

| compound | melting point / °C |
|---|---|
| magnesium oxide | 2852 |
| sodium chloride | 801 |

**(a) (i)** What are the formulae for a magnesium ion and an oxide ion?

..... [1]

**(ii)** Suggest why magnesium oxide has a much higher melting point than sodium chloride.

.....

..... [1]

13 **(c)** Sulfur forms simple molecules which have a relative molecular mass of 256.

Suggest the formula of a sulfur molecule.

.....

.....[1]

**(d)** Sulfur has a low melting point and does not conduct electricity.

**(i)** Explain why sulfur has a low melting point.

.....

.....[1]

**(ii)** Explain why sulfur does not conduct electricity.

.....

.....[1]

**(e)** Sulfur reacts with potassium to form potassium sulfide.

Write the formula and the electronic configuration of the positive ion and of the negative ion in potassium sulfide.

positive ion

formula ..... electronic configuration .....

negative ion

formula ..... electronic configuration .....

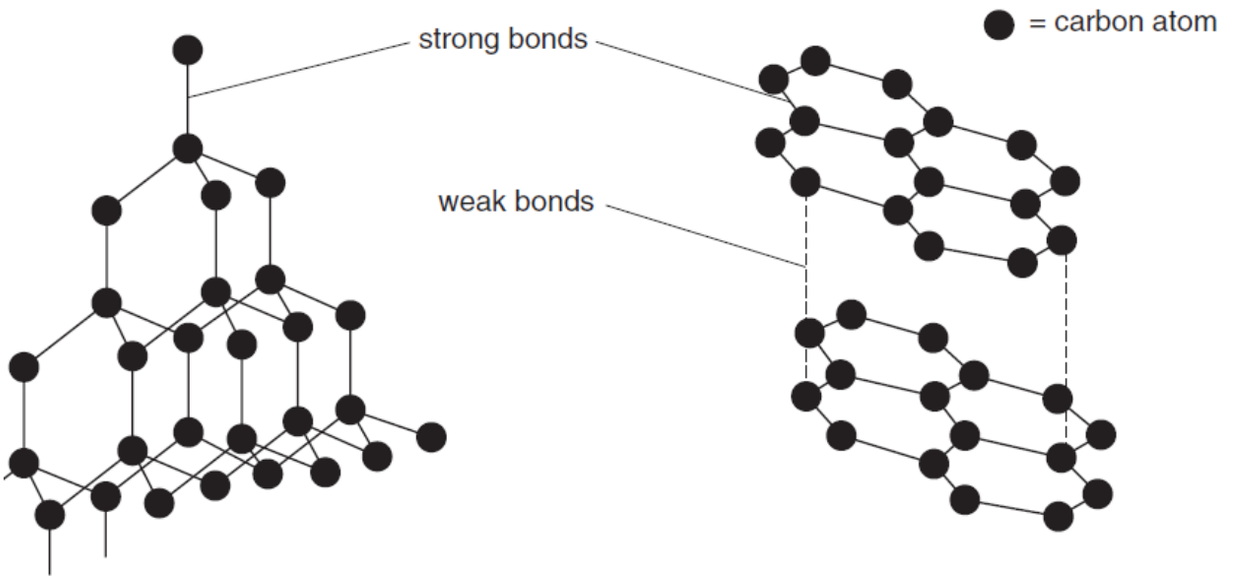
[2]

**(f)** Sulfur reacts with hydrogen to form hydrogen sulfide, $H_2S$.

Draw the 'dot-and-cross' diagram to show the bonding in a molecule of hydrogen sulfide.

Only draw the outer shell electrons.

14 The structures of diamond and graphite are drawn below.




diamond graphite

**(a)** Name the type of strong bond shown on the diagram.

.....[1]

**(b)** Diamond has a melting point of about 3700 °C and graphite has a melting point of about 3300 °C.

**(i)** Explain why both diamond and graphite have very high melting points.

.....

.....

.....

**(ii)** Suggest why the melting point of graphite is lower than that of diamond.

.....

.....

[3]

**(c)** Compare the electrical conductivity of diamond and graphite.
Explain your answer.

.....

.....

.....[2]

The table shows the melting points and relative electrical conductivities of three elements from Period 3 of the Periodic Table.

| property | element | | |
|---|---|---|---|
| | magnesium | silicon | sulfur |
| melting point /°C | 649 | 1410 | 113 |
| relative electrical conductivity | good conductor | poor conductor | does not conduct |

**(a)** Use ideas of structure and bonding to explain

**(i)** the difference in the melting points of magnesium and sulfur,

.....

.....

.....

.....[2]

**(ii)** the difference in the electrical conductivity of magnesium and sulfur.

.....

.....

.....[2]

**(b)** Silicon has a structure similar to diamond.

Explain why silicon has a high melting point.

.....

.....[2]

Copper(II) sulfate is an ionic compound.

**(a)** Describe the arrangement of the ions and the type of attractive forces between the ions in solid copper(II) sulfate.

arrangement .....

type of attractive forces .....

[2]

**(b)** Explain why solid copper(II) sulfate does not conduct electricity but aqueous copper(II) sulfate does conduct.

.....

.....

.....[2]

Draw a 'dot-and-cross' diagram of an oxygen molecule.

Show only the outer shell electrons.

[2]

Some properties of the Group IV elements are shown in the table.

| element | melting point /°C | relative electrical conductivity |
|---|---|---|
| carbon (diamond) | 3550 | non-conductor |
| silicon | 1410 | poor conductor |
| germanium | 937 | poor conductor |
| tin | 232 | conductor |
| lead | 328 | conductor |

**(a)** **(i)** Explain in terms of structure and bonding why diamond has such a high melting point.

.....

.....

.....[2]

**(ii)** Use the information in the table to suggest how the type of structure and bonding in carbon (diamond) differs from the type of structure and bonding in tin. Explain your answer.

.....

.....

.....

.....[2]

**(iii)** Lead oxide is an amphoteric oxide.

What is the meaning of the term *amphoteric oxide*?

.....[1]

Sodium oxide, $Na_2O$, is an ionic compound.

**(a)** State the electronic configuration for each of the ions in sodium oxide.

sodium ion .....

oxide ion .....

[2]

Explain how molten sodium oxide conducts electricity.

.....

.....[1]

5070/22/M/J/19

## The Periodic Table of Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group VIII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 3 Li lithium 7 | 4 Be beryllium 9 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium – | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57–71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium – | 85 At astatine – | 86 Rn radon – |
| 87 Fr francium – | 88 Ra radium – | 89–103 actinoids | 104 Rf rutherfordium – | 105 Db dubnium – | 106 Sg seaborgium – | 107 Bh bohrium – | 108 Hs hassium – | 109 Mt meitnerium – | 110 Ds darmstadtium – | 111 Rg roentgenium – | 112 Cn copernicium – | | 114 Fl flerovium – | | 116 Lv livermorium – | | |

**Key**

atomic number
atomic symbol
name
relative atomic mass

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoids | 57 La lanthanum 139 | 58 Ce cerium 140 | 59 Pr praseodymium 141 | 60 Nd neodymium 144 | 61 Pm promethium – | 62 Sm samarium 150 | 63 Eu europium 152 | 64 Gd gadolinium 157 | 65 Tb terbium 159 | 66 Dy dysprosium 163 | 67 Ho holmium 165 | 68 Er erbium 167 | 69 Tm thulium 169 | 70 Yb ytterbium 173 | 71 Lu lutetium 175 |
| actinoids | 89 Ac actinium – | 90 Th thorium 232 | 91 Pa protactinium 231 | 92 U uranium 238 | 93 Np neptunium – | 94 Pu plutonium – | 95 Am americium – | 96 Cm curium – | 97 Bk berkelium – | 98 Cf californium – | 99 Es einsteinium – | 100 Fm fermium – | 101 Md mendelevium – | 102 No nobelium – | 103 Lr lawrencium – |

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).