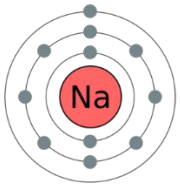
Unit 2 Chemistry - Chemical Bonding Triple and HT booklet answers

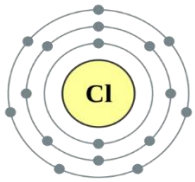
- P= +1, n= 0, e= -1
- Atom, protons, electrons, charge
- 2 on first shell, 7 on second
- 9
- 0
- The number of protons and electrons are equal so the charges balance out
- 9
- Atoms have equal numbers of protons and electrons
- It no longer has equal numbers of protons as electrons. It has now become charged.
- +1
- +2
- -1

Full outer shells

11: Sodium 2,8,1



17: Chlorine 2,8,7



Element name and symbol	Group	Number of electrons in outer shell	Will it lose or gain electrons? How many?	Charge on ion
Lithium, Li	1	1	Will lose one	Li^{+}
Beryllium, Be	2	2	Lose two	Be^{2+}
Oxygen, O	6	6	Gain two	O^{2-}
Nitrogen, N	5	5	Gain three	N^{3-}
Boron, B	3	3	Lose three	B^{3+}
Fluorine, F	7	7	Gain one	F^{-}
Phosphorous, P	5	5	Gain three	P^{3-}
Rubidium, Rb	1	1	Lose one	Rb^{+}

- We will show the diagrams in class but for now;
    a. 2; 1+ charge
    b. 2, 8, 8 1- charge
    c. 2; 2+ charge
    d. 2,8,8; 2- charge
    e. 2,8; 3+ charge
    f. 2,8; 3- charge
    g. 2,8; 2+ charge
    h. 2,8,8; 1+ charge
- A Potassium ion has a 1+ charge because it will lose one electron from its outer shell So; protons = 19 and electrons = 18. There is an extra +1 charge from the proton
- Potassium atoms have no charge because the number of protons and electrons are the same and the equal number of positive and negative charges cancel each other out

Ionic Bonding

- We will show these diagram in class but for now;
    a. Lithium loses one electron and Fluorine gains the one electron (Li^+, F^-) = LiF
    b. Magnesium loses two electrons and Oxygen gains the two electrons(Mg^{2+}, O^{2-}) = MgO
- One electron from sodium is lost from the outer shell and transferred to a chlorine atom. This forms a positive charged sodium ion (Na^+). The Chlorine atom gains the electron from sodium and forms a negative charged chloride ion (Cl^-). The oppositely charged ions are now attracted electrostatically to form Sodium Chloride.

Giant Ionic Lattices

- The structure of Sodium fluoride has a giant ionic lattice as Sodium and Fluorine bond ionically. Sodium fluoride is made of positive sodium ions (Na^+) and negative fluoride ions (F^-). These ions are oppositely charged and they are held together by the strong electrostatic force of attraction between the ions. This force acts in all directions, which forms a giant lattice of alternating positive and negative ions**.**
- Aluminium loses three electrons, one each to three different chlorine atoms forming one Al^{3+} aluminium ion and three Cl^- chloride ions that can be attracted electrostatically.
- The structure of Aluminium Chloride is a giant ionic lattice made of alternating Al^{3+} and Cl^- ions held together by the strong electrostatic force of attraction in all directions.

GCSE Past paper Questions

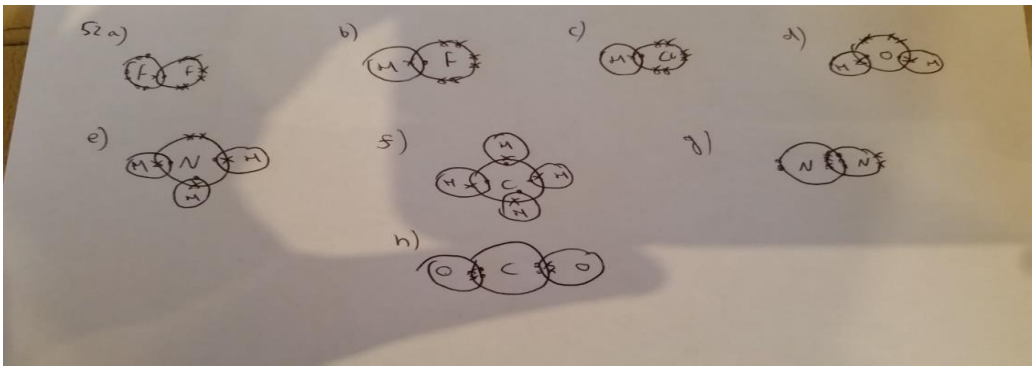
a. One Magnesium atom loses two electrons, one to each of the two different chlorine atoms forming the ions Mg^{2+} and two Cl^-. These ions are attracted to each other electrostatically, forming strong bonds in a giant ionic lattice structure.

- We will do this in class with the diagram
- NaCl(s) is a solid where the ions are held in a giant ionic lattice. NaCl(aq) is dissolved in water where the ions from the lattice have separated and are free to move
- Giant ionic lattice made of strong electrostatic force between alternating ions of positive and negative charge which requires a large amount of energy to overcome or break apart
- One electron from a sodium atom has been lost and transferred to a chlorine atom which gains the electron
- Potassium fluoride is an ionic compound formed by a giant ionic lattice structure. Since the electrostatic forces of attraction between oppositely charged ions are very strong, their melting and boiling points are high. The reason for this is, the ionic lattice contains such a large number of ions that, a lot of energy is needed to overcome this ionic bonding so ionic compounds have high melting and boiling points.

Summary questions:

- 19
- 8
- 8 protons, 10 electrons
- Two potassium atoms each transfer one electron to an oxygen, forms $2K^+$ and O^{2-}
- Oxygen atoms gain two electrons when they form ions so they have two extra negative charges.
- They have opposite charges
- Giant ionic lattice
- High melting and boiling point, does not conduct electricity as solid, does conduct as (aq) or (l)
- Giant ionic lattice; in the solid state, its ions are not free to move, so it is unable to carry the charge
- Giant ionic lattice; strong ionic bonds formed from electrostatic force of attraction between oppositely charged ions, requires lots of energy to break so have high melting points.

Covalent bonding – a bit untidy but, you should get the idea, h is g for your questions

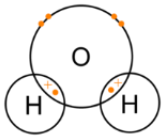


- Silicon dioxide properties would be; hard, high melting and boiling point, does not conduct electricity
- High melting point so therefore can withstand very high temperatures of the liquid metal. Strong covalent bonds between the atoms require lots of energy to break
- Aluminium Iodide would have a giant ionic lattice structure
- Aluminium loses electrons, iodine gains electrons. They form ions which are electrostatically attracted to each other
- Ionic compounds will conduct electricity when aqueous (in solution)or molten (melted)
- A student has a sample of two substances. One has a giant ionic lattice and the other is giant covalent - answers
    a. They would both be hard, Melt them/dissolve and see which conducts electricity (only ionic will), one is made of ions, the other of atoms

- Both graphite and diamond are made of carbon atoms with giant covalent structures
- Graphite is in layers, is soft/slippery and conducts electricity, diamond does not
- Graphite has delocalised electrons which are free to move through the graphite structure

Simple Molecular Substances

Water covalent structure is



- It is difficult to separate the hydrogen atoms from the oxygen atoms because they have a covalent bond between them which is strong
- Low melting and boiling point, will not to conduct electricity
- **Elements** – made of one type of atom; **Compounds** – made of two or more type of atom chemically joined; **Atoms**- smallest part of any substance (made of protons, neutrons and electrons); **Molecules** – joining of atoms (can be elements or compounds); **Coxygen covalent bonds**- a very strong bond formed by a sharing pair of electrons between non-metal atoms

Summary Questions (all from GCSE papers)

a. i. Covalent, ii Carbon, iii 3

b. It is soft as the layers can slide over each other and off the material onto the paper
c. It has delocalised electrons that are free to move through the graphite and carry charge

a. Complete each sentence – i. 3, ii. Covalent, iii. Bonds, iv. It is very, very small, nano particles 1nm – 100nm in size and have a high volume to surface ratio. They are 100 times larger than atoms in simple molecules, v. It has delocalised electrons that are free to move through the nanotube

Properties of Metals

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

- Layers of positive metal ions with a sea of delocalised electrons held together by strong electrostatic force of attraction between positive ions and negative electrons. The electrostatic force between the delocalised electrons and metal ions is strong and requires large amounts of energy to overcome.
- It is malleable and conducts electricity
- Graphite has delocalised electrons are free to move through the graphite structure
- Covalent substances do not have free ions or delocalised electrons to carry charge
- Molten as a liquid (l) or dissolved in solution (aq)

Alloys

- Metals have layers of positive metal ions with a sea of delocalised electrons throughout the structure. The ions and electrons are held together by electrostatic interaction between positive ions and negative electrons. Delocalised electrons can move throughout the metal structure and carry charge.
- It has different sized atoms which disturb the layers and distort the structure.
- They would be too soft/would corrode too easily

- Complete the table
  b. Metal
  c. Simple molecular
  d. Giant covalent
  e. Giant ionic lattice
  f. Simple molecular

d. Identify the substances
   i. C
   ii. A
   iii. D
   iv. B

Challenge – Metals are good conductors of electricity because they contain delocalised electrons can move throughout the metal structure which will carry charge. The electrical conductivity increases across the Periodic table from Mg to Al because there are more electrons in aluminium to be donated to the sea of delocalised electrons which can carry more charge/current.

Chemical Bonding Summary

a) A student has a substance which conducts electricity when solid and it is very hard. What type of structure does it have? **Using the Table : The only types of structure in the table which conduct electricity when solid are metals and graphite. Graphite and pure metals are soft, so it must be an alloy.**

b) Given an example of a substance which has a high melting and boiling point and never conducts electricity. **Using the Table: Giant covalent, giant ionic and metallic substances all have high melting and boiling points. Out of those, ionic conducts electricity under certain conditions and metallic can always conduct electricity, therefore it must be giant covalent so it could be graphite, diamond or silicon dioxide. Out of those, graphite conducts electricity so either diamond or silicon dioxide.**

Now try these. You do not need to write a whole paragraph in your answers, just the final answer.

c) Metallic or Giant Ionic
d) Using the table - giant ionic and metallic substances all have high melting and boiling points. Out of those, ionic conducts electricity under certain conditions and metallic can always conduct electricity. Doesn't specify physical state of the substance, so could be both.
e) Try to dissolve both white substances. The giant ionic should be soluble and the giant covalent will be insoluble
f) Simple molecular
g) No as simple molecular substances do not have delocalised electrons of free ions to carry charge.
h) See table.
i) They are made of layers which can slide over each other and pure metals have no other atoms in the structure to disturb or distort the layers.
j) Giant ionic
k) They have weak intermolecular forces which do not require lots of energy to overcome and separate the molecules
l) Alloys contain different sized atoms which disturb the layered structure. Metals have layers which can easily slide over each other.
m) Silicon dioxide has a Giant covalent structure and is used to make coatings for fire fighters because it has a very high melting and boiling point.
n) Graphite conducts electricity because each carbon atom is bonded to three other carbon atoms which leaves delocalised electrons throughout the structure which can carry charge. Diamond does not have delocalised electrons because each carbon atom in the structure is bonded to four other carbon atoms
o) Graphite and metals both conduct electricity because they contain delocalised electrons throughout the structure which can carry charge. Metals and graphite also have their atoms arranged in layers which can move and slide over each other surrounded by electrons.