

4.1 Ionic & Covalent Bonding

Question Paper

Course	DPIB Chemistry
Section	4. Chemical Bonding & Structure
Topic	4.1 Ionic & Covalent Bonding
Difficulty	Hard

Time allowed: 50
Score: /40
Percentage: /100

Question 1a

a)

Magnesium fluoride is a white crystalline salt that has a giant ionic lattice structure.

State whether the following substances conduct electricity when solid or molten, and explain your answers in terms of the particles involved:

- magnesium
- magnesium fluoride
- boron tribromide

[5]

[5 marks]

Question 1b

b)

Sodium chloride and iodine are both solids. Sodium chloride does not melt until it reaches a temperature of 1074 K yet iodine sublimates when heated gently, giving off purple vapours. Sodium chloride will conduct electricity when molten and iodine is a very poor conductor of electricity.

State the type of crystal structure for each of iodine and sodium chloride.

[2]

[2 marks]

Question 1c

c)

Explain why iodine vaporises easily.

[2]

[2 marks]

Question 1d

d)

Explain the differences in the electrical conductivity of sodium chloride and iodine.

[3]

[3 marks]

Question 2a

a)

The nitrate(V) ion, NO_3^- , is a polyatomic ion, bonded by covalent bonds.

The three oxygen atoms are bonded by one single covalent bond, one double covalent bond and one dative covalent bond.

Draw the Lewis structure for NO_3^- .

[2]

[2 marks]

Question 2b

b)

An ionic compound has the empirical formula $\text{H}_4\text{N}_2\text{O}_3$.

Suggest the formulae of the ions present in this compound.

[2]

[2 marks]

Question 2c

c)

The compounds SO_2 and MgO are both oxides but with different melting points as shown below.

Compound	Melting point / °C
SO_2	-72
MgO	2852

Describe the bonding in, and the structure of, SO_2 and MgO and explain the difference in their melting points.

[4]

[4 marks]

Question 2d

d)

Ammonia, NH_3 , has the same crystalline structure as SO_2 and yet its melting point is 2°C . Explain the difference in melting point between SO_2 and NH_3 .

[2]

[2 marks]

Question 3a

a)

Silver chloride, AgCl, is a chloride compound that has uses in photography films as well as having antiseptic properties. Silver chloride has a high melting point and a structure similar to sodium fluoride.

Explain why, with reference to structure and bonding, why silver chloride has such a high melting point.

[3]

[3 marks]

Question 3b

b)

Cyanide is a fast-acting chemical, which can be found in various forms and can have toxic effects on the body. Draw the Lewis structure for a CN^- ion.

Show the outer electrons only.

[1]

[1 mark]

Question 3c

c)

Ammonia, NH_3 , and boron trifluoride, BF_3 , react together to form NH_3BF_3 . Each of the molecules NH_3 and BF_3 have different features of its electronic structure which allows them to bond together. Explain how the two molecules bond together and what type of bond is formed between NH_3 and BF_3 .

You may use a labelled diagram to help you.

[3]

[3 marks]

Question 3d

d)

Aluminium chloride, Al_2Cl_6 , does not conduct electricity when molten but aluminium oxide, Al_2O_3 , does. Explain this in terms of the structure and bonding of the two compounds.

[4]

[4 marks]

Question 4a

a)

State why magnesium and oxygen form an ionic compound while carbon and oxygen form a covalent compound.

[1]

[1 mark]

Question 4b

b)

Explain why the melting point of phosphorus(V) oxide is lower than that of sodium oxide in terms of their bonding and structure.

[2]

[2 marks]

Question 4c

c)

N, N-dinitronitramide $\text{N}(\text{NO}_2)_3$, also known as trinitramide, has been identified as a potentially more environmentally friendly rocket fuel oxidant.

Using section 10 of the data booklet, outline how the length of the bond between nitrogen atoms in trinitramide compares with the bond between nitrogen atoms in nitrogen gas, N_2 .

[2]

[2 marks]

Question 4d

d)

Describe the bonding within the carbon monoxide molecule.

[2]

[2 marks]