



A-Level Chemistry
Bonding and Physical
Properties
Question Paper

Time available: 59 minutes
Marks available: 55 marks

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1.

This question is about magnesium and its compounds.

- (a) State **one** observation when magnesium reacts with steam.

Give an equation, including state symbols, for this reaction.

Observation _____

Equation

(2)

- (b) Describe the bonding in magnesium.

(2)

- (c) Explain, in terms of structure and bonding, why magnesium chloride has a high melting point.

(3)

- (d) Give **one** medical use for magnesium hydroxide.

(1)

(Total 8 marks)

The table shows some data about the elements bromine and magnesium.

In terms of structure and bonding explain why the boiling point of bromine is different from that of magnesium. Suggest why magnesium is a liquid over a much greater temperature range compared to bromine.

(Total 5 marks)

This question is about the element iodine and its compounds.

(a) Iodine is in Group 7 of the Periodic Table.

Complete the electron configuration of an iodine atom.

(1)

- (b) Part of the structure of an iodine crystal is shown in the diagram.



Use your knowledge of structure and bonding to explain why the melting point of iodine is low (113.5 °C) and why that of hydrogen iodide is very low (−50.8 °C).

(6)

- (c) State why iodine does **not** conduct electricity.

(1)

- (d) Deduce an equation for the formation of hydrogen iodide from its elements.

(1)

- (e) The triiodide ion is formed when an iodine molecule is bonded to an iodide ion.

What is the formula of ammonium triiodide?

Tick (✓) **one** box.

NH_3I_3 ☐

NH_3I_4 ☐

NH_4I ☐

NH_4I_3 ☐

(1)

- (f) Draw the shape of the IF_3 molecule and the shape of the IF_4^- ion. Include any lone pairs of electrons that influence each shape.

(2)

- (g) Deduce the oxidation state of iodine in the following species.

$\text{Ba}(\text{IO}_3)_2$ _____

$[\text{H}_4\text{IO}_6]^-$ _____

(2)

(Total 14 marks)

4.

Silicon dioxide (SiO_2) has a crystal structure similar to diamond.

- (a) Give the name of the type of crystal structure shown by silicon dioxide.

(1)

- (b) Suggest why silicon dioxide does **not** conduct electricity when molten.

(1)

- (c) Silicon dioxide reacts with hydrofluoric acid (HF) to produce hexafluorosilicic acid (H_2SiF_6) and one other substance.

Write an equation for this reaction.

(1)

(Total 3 marks)

5.

Thallium is in Group 3 of the Periodic Table.

Thallium reacts with halogens to form many compounds and ions.

- (a) Draw the shape of the TlBr_3^{2-} ion and the shape of the TlCl_4^{3-} ion.
Include any lone pairs of electrons that influence the shapes.

Name the shape made by the atoms in TlBr_3^{2-} and suggest a value for the bond angle.

(4)

- (b) Thallium(I) bromide (TlBr) is a crystalline solid with a melting point of 480°C .

Suggest the type of bonding present in thallium(I) bromide and state why the melting point is high.

(3)

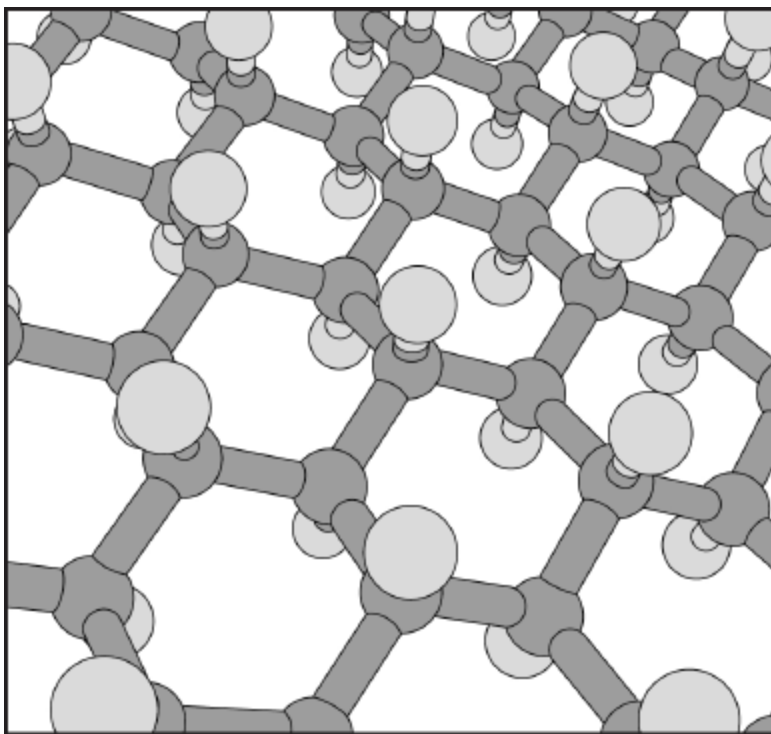
- (c) Write an equation to show the formation of thallium(I) bromide from its elements.

(1)

(Total 8 marks)

6.

In 2009 a new material called graphane was discovered. The diagram shows part of a model of the structure of graphane. Each carbon atom is bonded to three other carbon atoms and to one hydrogen atom.



- (a) Deduce the type of crystal structure shown by graphane.

(1)

- (b) State how two carbon atoms form a carbon–carbon bond in graphane.

(1)

- (c) Suggest why graphane does **not** conduct electricity.

(1)

- (d) Deduce the empirical formula of graphane.

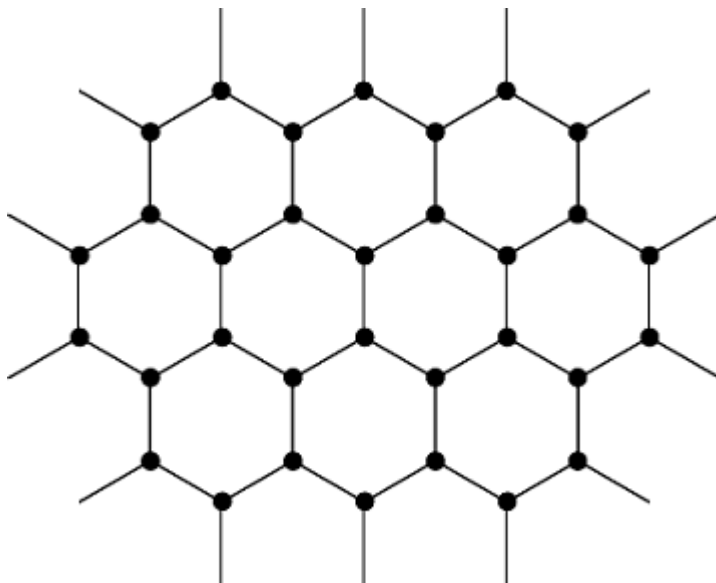
(1)

(Total 4 marks)

7.

- (a) Graphene is a new material made from carbon atoms. It is the thinnest and strongest material known. Graphene has a very high melting point and is an excellent conductor of electricity.

Part of the structure of graphene is illustrated in the diagram.



- (i) Deduce the type of crystal structure shown by graphene.

(1)

- (ii) Suggest why graphene is an excellent conductor of electricity.

(2)

- (iii) Explain, in terms of its structure and bonding, why graphene has a high melting point.

(2)

- (b) Titanium is also a strong material that has a high melting point. It has a structure similar to that of magnesium.

- (i) State the type of crystal structure shown by titanium.

(1)

- (ii) Explain, in terms of its structure and bonding, why titanium has a high melting point.

(2)

- (c) Titanium can be hammered into objects with different shapes that have similar strengths.

- (i) Suggest why titanium can be hammered into different shapes.

(1)

- (ii) Suggest why these objects with different shapes have similar strengths.

(1)

- (d) Magnesium oxide (MgO) has a melting point of 3125 K.
Predict the type of crystal structure in magnesium oxide and suggest why its melting point is high.

Type of crystal structure _____

Explanation _____

(3)

(Total 13 marks)